PROPOSED

GEOTHERMAL LEASING / SODIUM PROSPECTING PERMITS FOR PISGAH CRATER

FINAL ENVIRONMENTAL ASSESSMENT

United States
Department of the Interior
Bureau of Land Management

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
California Desert District
1695 Spruce Street
Riverside, California 92507

IN REPLY REFER TO
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(C-069.24)

Memorandum

DEC 24 1980

To: Interested Parties

From: District Manager, California Desert

Subject: Final Environmental Assessment Record for Proposed Geothermal Leasing and Sodium Prospecting in the Pisgah Crater Area, California

Enclosed is a copy of the Final Environmental Assessment Record for Proposed Geothermal Leasing/Sodium Prospecting in the Pisgah Crater Area of California. This EAR analyzes the general impacts which would result from geothermal and sodium exploration and development in this area. It has been determined that the proposed leasing and permitting in the Pisgah Crater Area do not represent major Federal actions significantly affecting the quality of the human environment within the meaning of Section 102 (c) of NEPA. Therefore, no Environmental Statement will be prepared on these proposed actions.

Prior to the surface disturbing activities, the lessee and permittee must submit plans of operation to the U.S. Geological Survey (USGS) which describe the proposed action. Site specific Environmental Analyses are then prepared by the USGS in cooperation with the BLM.

If you have any questions concerning this document, please call Jim Williams, at (714) 326-3896 in Needles, California.

Conrad E. Wilson

Enclosure

P I S G A H C R A T E R

Proposed Geothermal Leasing/Sodium Prospecting Permits

Environmental Assessment Record

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The last two sentences of Paragraph 1 of Chapter I(A) on page 1 of the Final Pisgah EAR should be deleted. Information from the Draft EAR and the thirty-day public comment period which followed was used to determine whether an EIS was necessary. As noted in the cover memo of the Final EAR, an EIS will not be prepared.

I. INTRODUCTION AND DESCRIPTION OF THE PROPOSED ACTION

A. Introduction

This Environmental Assessment Record (EAR) analyzes the environmental impacts which could occur as a result of the exploration, development, and production of geothermal and sodium resources on Federal lands. This EAR will focus mainly on the effects of geothermal development for two reasons: (1) By far, the greatest potential impacts would occur from geothermal activities, and (2) The applicant for sodium is primarily interested in locatable minerals, for which exploration is now being conducted. The EAR is subject to a thirty-day public comment period and is utilized by management to determine if surface occupancy should be allowed. If an EIS is determined to be necessary, then surface occupancy will be deferred.

If the geothermal leases are issued with surface occupancy, then the U.S. Geological Survey (GS) becomes the lead responsible agency. At this time, any activities proposed by the lessee are detailed in a Plan of Operations (PO) submitted to the GS. The Bureau of Land Management (BLM) and the Fish and Wildlife Service (FWS) provide input. The GS then prepares an EA which is site specific and addresses problems that should be avoided. Any additional or nearby activities are also detailed in separate POs and supplementary EAs are written. Plans of development are also reviewed by Federal, State, and local agencies.

The Federal geothermal leasing program is governed by the Geothermal Steam Act of 1970 (Public Law 91-581) and is implemented according to geothermal leasing and operating regulations contained in 43 CFR Part 3200 and 30 CFR Parts 270 and 271. Geothermal Resources Operational (GRO) Orders 1-7 (USDI-USGS, 1976), which were issued under the Geothermal Steam Act, set up technical responsibilities of lease applicants associated with their proposed actions. These orders specify mitigating measures which must be followed to protect the environment from adverse effects caused by geothermal exploration, development, and production. The GRO Orders are considered to be part of the proposed action and are not reproduced here. These orders were considered when analyzing the impacts of the proposed actions in Chapter 3.

The Federal sodium permitting and leasing program is governed by the Mineral Leasing Act of 1920 and is implemented according to leasing and surface management regulations contained in 43 CFR Part 3500 and 43 CFR Part 23, respectively.

The Multiple Mineral Development Act of 1954 (Public Law 585) was enacted to provide for the operation of the mineral leasing and mining laws on the same tracts of public land. This act is implemented according to regulations contained in 43 CFR 3740.

Mitigating measures are addressed in Chapter 4.

B. Background

An area of approximately 28,300 acres (11,453 hectares) has been designated as the study area for this EAR (Fig. 1-1). Of this total, 9,580 acres (3,877 hectares) of public land are under geothermal lease applications, 5,060 (2,048 hectares) acres are included within sodium prospecting permit applications, and about 10,500 acres (4,249 hectares) are private lands. The study area is located about 30 miles (48 kilometers) east of Barstow adjacent to I-40 in the Pisgah Crater area of San Bernardino County, California.

In 1974, four non-competitive geothermal lease applications were filed on public lands by Anadarko Production Company and, in 1978, two sodium prospecting permit applications were filed by Duval Corporation. As can be seen in Fig. 1-1, the sodium applications overlap two of the geothermal lease application areas. The filing of these applications initiated the EAR process in which the impacts of the proposed activities on the various resources in the area were evaluated.

C. The Geothermal Resource

Geothermal Resources are defined by White and Williams (1975) as "...stored heat, both identified and undiscovered, that is recoverable using current or near-current technology...." These resources occur in four systems: vapor dominated, hot water, geopressured reservoir, and hot dry rock. Hot water systems are the most common and, thus, are presumed to exist in the EAR area.

According to White and Williams (1975), this system is characterized by circulating liquid which transmits heat and controls subsurface pressure. Thermal energy is stored in hot rock and is transferred to the fluids which fill the pore spaces in the rock. When this circulating fluid is tapped by drill holes, the fluid may flash to steam due to the pressure decrease brought about by the open drill bore. This steam can be used to do work and thus, produce electrical power.

The Pisgah Crater area has been classified as "prospectively valuable" for geothermal resources (USGS, 1979). This determination identifies an area as having similar geologic conditions to other areas in which similar minerals or resources have been extracted; the resource is known or believed to exist, but the extent and quality are unknown.

The study area includes the crater itself and basaltic rocks of Quaternary age. Volcanic features of this age, in addition to the recent faulting, form the basis for designation of this region as prospectively valuable.

Heat flow data is not currently available. However, the Office of Earthquake Studies, USGS, Menlo Park, California, may drill in the near future to gain such information (P. Galanis, Personal Communication, 1979).

1. Proposed Action

The applicant proposes to conduct exploration and possible development activities for geothermal resources for the purpose of generating electrical energy for local use and export, if feasible.

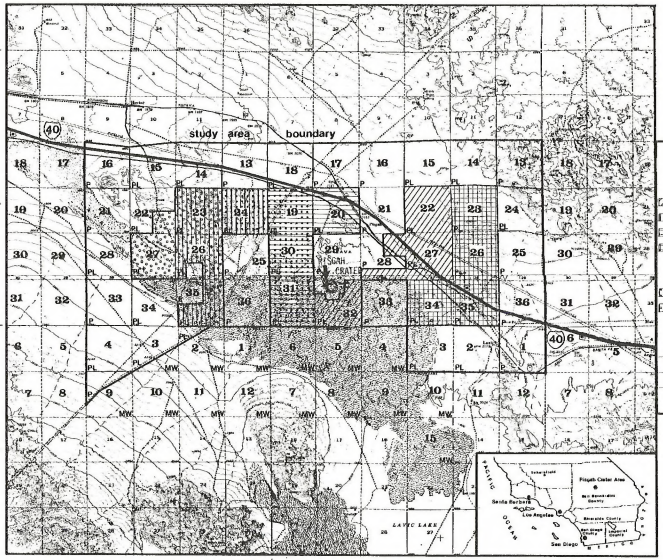
To quantify the extent and potential of the geothermal resources of the study area, down-hole investigations and resource testing are needed. Presently, there is no information available that would indicate that the geothermal resources of the study area are sufficient for electrical generation.

To assess the environmental impacts resulting from geothermal exploration, development, and production, it is necessary to make certain assumptions as to the possible development intensity.

As the nature of the resource is unknown, a dual model for development, electrical and non-electrical, is presented. However, as the applicant has indicated an interest in developing the resource for only electrical generation, emphasis was placed on this model. The applicant plans to conduct geophysical surveys and drill 10-15 temperature gradient holes (500 feet in depth). This process may take 1½ years. Two slim holes, each 2-3,000 feet (610-914 meters) in depth, will subsequently be drilled into any target areas.

Five stages of geothermal resource development are assumed for both models: The Preliminary Exploration Stage, Field Development Stage, Production and Operation Stage, and the Closedown Stage. These stages are discussed in Appendix A.

LAND STATUS Fig. 1-1



(a) Electrical Model

Until test well data of the study area have been obtained and analyzed, the extent and potential of the resource will remain unknown. As a result, the size of the power plant and associated facilities that may be constructed is difficult to estimate. Therefore, the baseline for the electrical model assumes the development of one 50 MW generating facility on one 2,560 acre (1,036 hectares) lease. Tables 1-1 and 1-2 (modified from USDI-BLM, 1975) list the amount of surface disturbance likely to result from exploration drilling and power plant development. However, perhaps as much as 20% of the lease area may be directly affected by the proposed action.

A 30-year economic life of a geothermal generation facility (based on amortization of the plant) will be used as the base for planning purposes.

(b) Non-Electrical Model

The great majority of geothermal systems known to exist do not meet the criteria for the development of a power plant (Raschen and Cook, USDI-USGS, 1976). This is due primarily to insufficient reservoir temperatures. Nevertheless, these systems have many possibilities if used for non-energy applications. A few such examples, now in effect in California, include space heating, heating water for domestic use, greenhouses, spas, and lumber mill drying kilns.

Three potential uses - for hydroponic greenhouses, dehydration plants, and spas - are discussed in the North Salton Sea EAR (BLM, 1979). For a 2,560 acre (1,036 hectares) lease, it has been estimated that the greenhouses, dehydration plants, and spas will disturb, respectively, 40 acres (16 hectares), 4 acres (1.6 hectares), and 60 acres (24 hectares).

D. The Sodium Resource

The potential of the area for commercial quantities of sodium is presently unknown. The Pisgah Crater area was not investigated for its potential for prospectively valuable or known valuable deposits of sodium (USGS, 1979); the area was not viewed as possessing geologically favorable conditions for the occurrence of sodium. The known locatable minerals include hectorite, zeolite, and colemanite. Duval Corporation holds unpatented mining claims in all of the nine sections covered by the sodium application areas. The company is presently conducting exploration activities on these claims for calcium borates and zeolites. These activities consist of drilling test holes and coring selected intervals to a depth of 1500-2000 feet (457-610 meters).

This exploration program has been in operation for nearly one year and, thus far, 12 holes have been drilled. Sodium deposits have not been located by Duval in this area. However, colemanite deposits commonly contain sodium borate minerals, and, therefore, Duval believes that it is prudent to apply for sodium prospecting permits, in the event that valuable sodium deposits are discovered.

TABLE I-I

APPROXIMATE SURFACE DISTURBANCE EXPECTED TO RESULT FROM EXPLORATION DRILLING ON ONE 2,560-ACRE LEASE

Unit	No. of Acres Disturbed Per Unit	No. of Units	Acres Disturbed
Well	3	6	18
Disposal Pond	1	2	2
Access Roads	1.5	5	8
	5.5	13	28

or 1.1% of total lease area (2,560 acres).

TABLE 1-2

APPROXIMATE SURFACE DISTURBANCE EXPECTED TO RESULT FROM DEVELOPMENT OF A 50 MW POWER PLANT ON ONE 2,560-ACRE LEASE

Unit	No. of Acres Disturbed Per Unit	No. of Units	Acres Disturbed
Power Plant Complex	5	1	5
Well	3	30	90
Disposal Pond	1	2	2
Pipeline	1	25	25
Access Roads	2.4	30	72
Mainline Road	7.3	1	7.3
Transmission Line	4.8	1	4.8
			206.1 or about 8.0% of total lease area

Adapted from U.S. Department of Interior, Bureau of Land Management, 1975.

1. Proposed Action

The discrete operations involved in the proposed action are the drilling of a series of test holes (several thousand feet in depth) and the construction of drill pads and temporary access roads for the drill equipment. This activity may directly disturb 1-2% of the application areas. Prior to any surface disturbing operations, the operator must file an exploration plan with the USGS Area Mining Supervisor. The Mining Supervisor then consults with the BLM before approving the plan. As indicated in a previous section, this activity is already occurring on Duval's mining claims in connection with their search for borates. Activities related primarily to sodium exploration are not anticipated. Also, an extensive road network currently exists in the area, associated with past and present mineral-related activities, and should be able to accommodate further drilling operations.

Sodium prospecting permits do not allow development of the sodium resource. However, to assess all of the impacts at the outset, it was assumed that the EAR area would undergo full development. For this reason, a discussion of sodium preference right leases follows.

Based on favorable analyses of test hole data obtained from the permit areas, the applicant may then apply for a preference right lease. The initial lease application must include information as to the quantity and quality of the mineral indicating that a valuable deposit has been discovered. Topographic maps of the area showing physical features, roads and trails, and the location of the proposed development or mining operations must also be submitted. In addition, a narrative statement discussing the scope, method, and schedule of the mining operations needs to be included with the lease application.

An EAR is prepared which assesses the impacts related to activities allowable under a preference right lease, after which the applicant must demonstrate a "final showing" in the form of a statement indicating the proposed costs of development and operation of the mine as compared to anticipated revenues. Information showing that the land is chiefly valuable for sodium must also be included.

A preference right lease allows the production of the sodium resource. This involves the construction of solar evaporation ponds, piping of brine from the wells to the ponds, concentrating of brines, piping or hauling of brine concentrate to a plant for processing, and extracting the various minerals. Access roads to the wells and ponds will need to be upgraded and maintained for intermittent travel by haul trucks and/or service vehicles.

For planning purposes, the actual disturbed land, as a result of operations under a preference right lease, will be assumed to be, at most, 5% of the total application area.

II. DESCRIPTION OF THE EXISTING ENVIRONMENT

A. Introduction

Chapter 2 describes those elements of the environment which are likely to be impacted by the proposed action.

B. Geology

The surface geology of the study area consists of late Pleistocene or Holocene basaltic lava and scoriaceous pumice surrounded primarily by Quaternary alluvial sediments and some Tertiary-Quaternary volcanic and sedimentary rocks which are concentrated in the northeastern corner of the study area (Dibblee & Bassett, 1966; Fig. 2-1). Basement rocks are pre-Tertiary plutonic and metamorphic rocks which are exposed in the nearby mountains (Bassett & Kupfer, 1969).

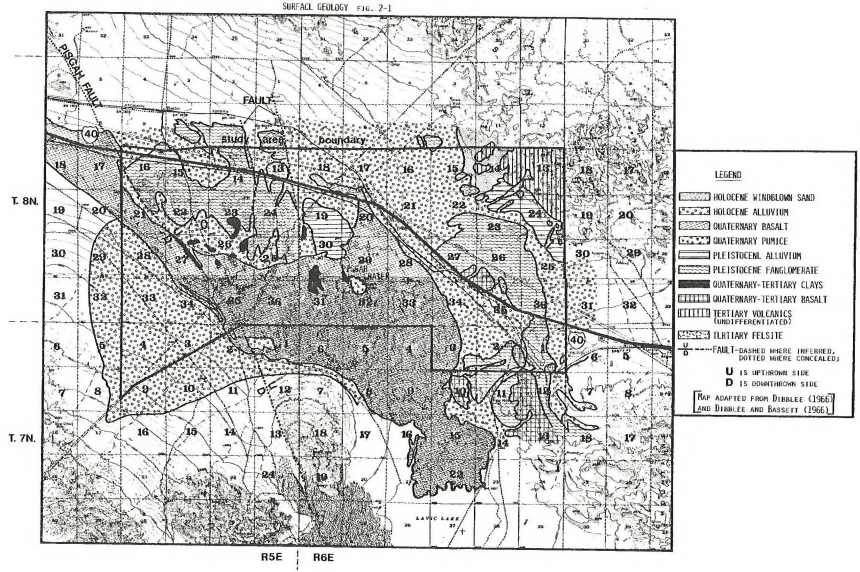
1. Lava Field

The Pisgah basalt flows comprise the central portion of the study area and extend 11 miles (18 kilometers) northwest of Pisgah Crater into Troy Basin and 6.2 miles (10 kilometers) south into Lavic Basin.

According to Wise (1969), field evidence indicates that five distinct lava flows erupted from a series of closely spaced vents centered around the Pisgah cinder cone. Pisgah Crater itself was produced during a pyroclastic event which occurred near the end of the volcanic activity in this area.

Basanites and alkali-olivine basalts are the major rock types of the Pisgah basalt flows. Petrographic and chemical analyses of the flow units reveal that each successive lava phase contains more silica and less potash than the preceding unit. These basaltic magmas probably originated by partial melting in the upper mantle which, according to Wise (1969), lies at depths greater than 13.5 miles (22 kilometers) in the study area.

The age of the flows has not yet been determined. Stratigraphic position and the fresh appearance of the flows suggest an age no older than late Pleistocene. Most workers in the area believe that the age is younger than 20,000 B.P. Hydration dating of basaltic glasses and carbon-14 work on organic material lying immediately beneath the flow offer possiblities for age determinations of the basalt.


SURFACE GEOLOGY FIG. 2-1
FAULT
Study Area Boundary
T. 8N.
T. 7N.
R5E
R6E
LEGEND
HOLOCENE WINDBLOWN SAND
HOLOCENE ALLUVIUM
QUATERNARY BASALT
QUATERNARY PUMICE
PLEISTOCENE ALLUVIUM
PLEISTOCENE FANGLOMERATE
QUATERNARY-TERTIARY CLAYS
QUATERNARY-TERTIARY BASALT
TERTIARY VOLCANICS (UNDIFFERENTIATED)
TERTIARY FELSITE
FAULT-DASHED WHERE INFERRED, DOTTED WHERE CONCEALED
U IS UPTHROWN SIDE
D IS DOWNTHROWN SIDE
MAP ADAPTED FROM DIBBLEE (1966) AND DIBBLEE AND BASSETT (1966)

The basalt flows are predominantly of pahoehoe variety, although clinkery aa lava may also be found. An interesting aspect of these flows is the presence of numerous lava tubes or caves, most of which are located east of Pisgah Crater. These features formed by solidification of the upper crust of a lava stream followed by withdrawal of lava from the tube structure.

2. Structure

The EAR area contains several northwest-trending faults of normal basin-and-range type, particularly in the western and northern portions of the area (Dibblee & Bassett, 1966). Of all of the faults in the study area, the Pisgah Fault (located in the western part of the area) shows the greatest displacement and according to Dibblee & Bassett (1966), is the most continuous at the surface. Gardner (1940) stated that the Pisgah lava flows did not show movement along these faults. However, Dibblee's 1966 geologic map shows that there exist at least two areas along the Pisgah Fault suggesting displacement which affected the flow.

3. Stratigraphy

In 1964, two mineral test wells were drilled in the area. Dibblee and Bassett (1966) provide a summary of the drill logs of these wells. One is outside of the study area, in the SE¼ Sec. 8, T. 8 N., R. 5 E. The other lies in the NW¼SW¼ Sec. 25, T. 8 N., R. 5 E. The log of the latter well is summarized as follows:

735 Feet (0-224 meters):	Claystone, light reddish-brown to gray, massive to faintly bedded, contains some thin layers of cream-white tuff. Dip, 0-5°.
735-1289 Feet (224-393 meters):	Claystone, gray, massive to bedded; occasional laminae of evaporite (anhydrite).
1289-1572 Feet (393-479 meters)	Claystone, greenish-gray and numerous layers of crystalline white evaporite (mostly anhydrite, some calcite, colemanite, strontianite); evaporite as much as 75% of rock. Dip 0-5°.
1572-1660 Feet (479-506 meters):	Claystone, gray to reddish-brown, massive to poorly bedded. Dip, 0-5°.

Drill log information provided by an unknown party searching for hectorite in the SW¼ Sec. 35, T. 8 N., R. 5 E., revealed the following (stratigraphically, from top to bottom): 80 feet (24 meters) of basalt, 2 feet (.6 meters) of weathered basalt soil, , 158 feet (48 meters) of red-brown "bentonitic-like" clay, and 40 feet (12 meters) of a white clay zone with lenses of hectorite totaling approximately five feet

1.5 meters). The basalt may, in fact, be as much as 150 feet (46 meters) thick in the northern part of the lava units. The Pleistocene alluvium may range in thickness from an inch (2.5 centimeters) to approximately 975 feet (300 meters). These deposits are composed of poorly sorted sand and gravel, with some silt and clay. The basement may exist at depths of 2000 feet (610 meters) or more in the EAR area.

4. Geologic Hazards

The basalt flow possesses an extremely irregular, uneven, and frequently blocky surface. As a result, vehicular travel across such terrain is quite hazardous and most difficult. Travel by foot is not easy and requires special care as well.

Flash flooding is also a potential hazard, as in most desert areas. However, the basalt flow provides a natural water barrier as it rises several feet above the alluvial surface, thus creating a relatively safe interior area.

C. Hydrology

The study area lies approximately midway between the Troy and Lavic Basins and is bordered on the northeast by the Cady Mountains and on the south by the Rodman and Lava Bed Mountains. Most of the drainage is to the northwest, toward Troy Basin (Thompson, 1929, and California Department of Water Resources, 1967).

1. Surface Water

No springs, perennial streams, or permanent water bodies exist in the study area. Rainfall occurs mainly in the winter and annual totals average about four inches (10.0 cm) with maximum totals reaching six inches (15.0 cm) (California Department of Water Resources, 1967).

Storms can produce intense rainfall causing runoff to flow into Troy Valley from the Cady and Rodman Mountains. The water is generally quickly absorbed by the alluvial material on the valley floor or evaporated.

2. Ground Water

The basement rocks in the area are generally non-water bearing (California Department of Water Resources, 1967). The Tertiary sediments are relatively impermeable, also. However, conglomerate and sandstone units within these sediments may contain a small amount of water, but receive little recharge because they occur as isolated lenses.

The Tertiary sediments are relatively impermeable, also. However, conglomerate and sandstone units within these sediments may contain a small amount of water, but receive little recharge because they occur as isolated lenses.

The sand and gravel units within the Pleistocene alluvium yield water freely to wells and contain the majority of the ground water storage for the Troy Basin (California Department of Water Resources, 1963, 1967).

In some places, the Pleistocene sediments consist of ancient lake deposits. These well-bedded silts, clays, sands, and limestones yield little water to wells. The remnants of lakeshore sand and gravel bars are usually above the water table and do not yield water. The faulted Pleistocene and Holocene basalt flows are potentially a good water reservoir but these, too, lie above the water table.

The water table in Lavic Valley lies approximately 49 feet (15 meters) below Lavic Playa. This depth varies considerably within the study area and may be 262-295 feet (80-90 meters) in the western portion of the area. As the water table is far below the surface, there may be underground drainage from the valley, most probably toward the northwest beneath the lava flow. Thompson (1929) estimated the ground water gradient from this playa to Troy Playa to be 5 feet per mile (one meter per kilometer).

3. Water Quality

Water quality analyses from two wells located north of the study area (T. 8 N., R. 5 E., Sec. 1; and T. 9 N., R. 5 E., Sec. 8) indicate that the water is generally unsuitable for domestic or irrigation use. The water is highly mineralized and its principal constituents are sodium sulfate and sodium chloride.

According to the California Regional Water Quality Control Board, (1979), the Hector mine is located on a perched aquifer which has a high Total Dissolved Solids (TDS) concentration (5,000 to 10,000 mg/1). The depth to the ground water is about 180 feet (55 meters). A separate aquifer exists at a greater depth on the west side of Pisgah Fault with a better water quality (200-800 mg/1 TDS).

D. Soils

Soil associations in the study area include the Daggett-Tonopah-Bitterspring association, the Anthony-Cajon-Arizo association, and the Lava Rock Land association (Fig. 2-2).

1. Soil Descriptions

a. AC - Anthony-Cajon-Arizo association

Surface and subsoil textures range from sandy loam to gravelly sand. Soils occur on nearly level areas to moderately sloping alluvial fans. In the study area, many of these soils are on sand-covered alluvial fans.

b. DT - Daggett-Tonopah-Bitterspring association

Surface textures range from gravelly, sandy loam to sand and subsoil textures vary from gravelly, sandy loam to gravelly sand. Some of the soils are covered with desert pavement. Many of the soils are on dissected alluvial fans. Thick, medium-textured vesicular crusts and well-developed subsurface horizons with accumulations of clay typically underlie the surface stone cover. The soil profile may be less than 10 inches (25 centimeters) in thickness.

c. LR - Lava Rockland association

These are areas with volcanic material covering approximately 50% of the area. The soil is mostly shallow to non-existent.

E. Climatology

The prevailing wind direction in the study area is northwesterly to westerly. "Santa Ana" patterns also exist, in which winds tend to flow out of the Great Basin into the Central Valley, the Southeastern Desert Basin, and the South Coast (U.S. Weather Bureau, 1959). The mean year-round wind velocities are 10-15 miles (16-24 kilometers) per hour with gusts up to 70 miles (113 kilometers) per hour, according to the USGS (1970).

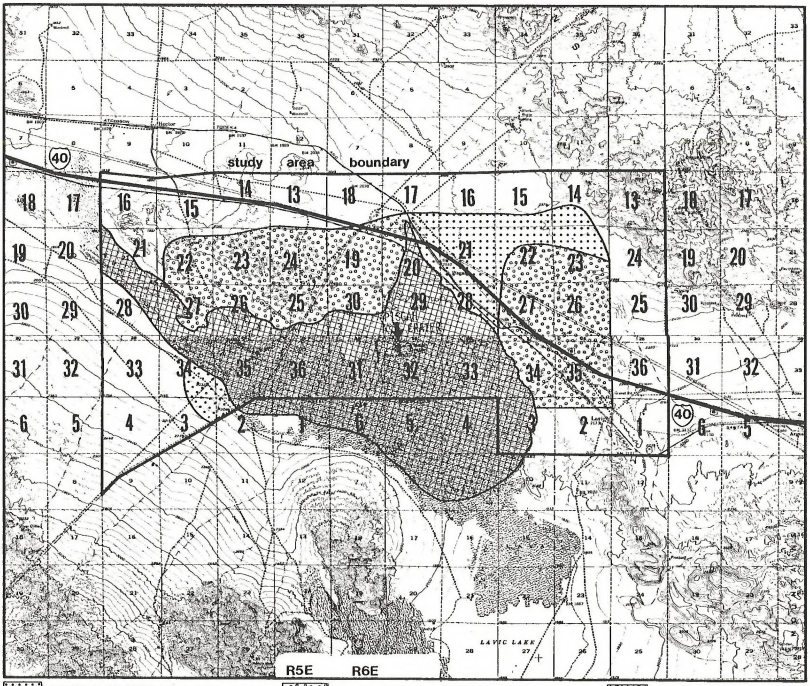
The mean maximum and minimum January temperatures are 60°F (16°C) and 28° F (-2°C), respectively. The relative humidity during this month averages approximately 40%. The mean maximum and minimum July temperatures are, respectively, 102°F (39°C) and 72°F (22°C). The average relative humidity for July is about 25%.

The normal annual precipitation total is approximately 4 inches (10 centimeters).

F. Air Quality

Air quality standards are mandated by both Federal and State governments (Table 2-1). The main purpose of these standards is to protect the public from any known or anticipated adverse effects of air pollution.

SOIL ASSOCIATIONS FIG.2.2



The study area is located in the Southeast Desert Air Basin (SEDAB). The closest air monitoring station to the Pisgah Crater area is at Barstow, which is approximately 30 miles (48 kilometers) west of the EAR area.

Barstow was able to meet the State air quality standards in 1977 in all categories except ozone (0_3), nitrogen dioxide (NO_2), and total suspended particulates (TSP). The Barstow area exceeded the ozone standard during 42 days of the year with the highest single one hour average of the year of 0.20 ppm 0_3 (the Federal standard was exceeded 54 days of the year). NO_2 exceeded the State standard only one day of the year (no other station in the SEDAB exceeded the standard for NO_2). Barstow also achieved the highest percentage of days (71%) not meeting the TSP state standard.

G. Noise

Basically, the noise sources in the study area are of three types: (1) noises associated with transportation routes, (2) noises associated with military activities, and (3) noises associated with mining activities.

The overall greatest source of noise is derived from vehicular traffic on I-40, which bisects the study area, and from the freight trains of the Santa Fe Railroad, whose line closely follows the highway.

The noise from practice bombing in the Marine Corps Training Center, just south of the area, contributes to the ambient noise level of the EAR area.

Also, noises related specifically to mining activities at NL Industries open pit mine (T. 8 N., R. 5 E., Sec. 35) and Lavic Stone Corporation's cinder mine (T. 8 N., R. 6 E., Sec. 32) add to the ambient noise levels in the region.

H. Vegetation and Wildlife

1. Vegetation

Inventory data indicates that no species of endangered, threatened, or rare plants exist within the study area. This determination was made from information accumulated by the Desert Plan Staff and botanical records within the Cima Resource Area (the Pisgah Crater area is now within the Barstow Resource Area).

Table 2-1

AMBIENT AIR QUALITY STANDARDS
APPLICABLE IN CALIFORNIA*

POLLUTANT	AVERAGING TIME	CALIFORNIA STANDARDS CONCENTRATION(7)	METHODS(1)	FEDERAL STANDARDS(4) PRIMARY(2)(7)	SECONDARY(3)(7)	METHOD(5)
Photochemical Oxidants (Corrected for NO_2)	1 hour	0.10 ppm (200 ug/m^3)	Neutral Buffered KI	160 ug/m^3(8)	Same as Primary	Chemilumi-nescent
Carbon Monoxide	12 hours	10 ppm (11 mg/m^3)	Non-dispersive Infrared Spectroscopy		Same as Primary Standards	Non-dispersive Infrared Spectroscopy
	8 hours			10 mg/m^3 (9 ppm)		
	1 hour	40 ppm (46 mg/m^3)		40 mg/m^3 (35 ppm)		
Nitrogen Dioxide	Annual Average		Saltzman Method	100 ug/m^3 (0.05 ppm)	Same as Primary Standard	Colorimetric Method Using NaOH
	1 hour	0.25 ppm (470 ug/m^3)				
Sulfur Dioxide	Annual Avg.			80 ug/m^3 (.03 ppm)		
	24 hours	0.04 ppm (105 ug/m^3)	Conductimetric Method	365 ug/m^3 (0.14 ppm)		Pararosaniline
	3 hours				1300 ug/m^3 (0.5 ppm)	
	1 hour	0.5 ppm (1310 ug/m^3)				
Suspended Particulate Matter	Annual Geometric Mean	60 ug/m^3	High Volume Sampling	75 ug/m^3	60 ug/m^3	High Volume Sampling
	24 hours	100 ug/m^3		260 ug/m^3	150 ug/m^3	
Lead (Particulate)	30-day Average	1.5 ug/m^3	High Volume Sampling Dithizone Method			
Hydrogen Sulfide	1 hour	0.03 ppm (42 ug/m^3)	Cadmium Hydroxide STRactan Method			
Hydrocarbons (Corrected for Methane)	3 hours (6-9 a.m.)			160 ug/m^3 (0.24 ppm)	Same as Primary Standard	Flame Ioniza-tion Detection Using Gas Chromatography
Sulfates	24 hours	25 ug/m^3	-	-	-	-
Visibility Reducing Particles	1 observation	In sufficient amount to reduce the prewailing visibility(6) to less than 10 miles when the relative humidity is less than 70%				

NOTES:

(1) Any equivalent procedure which can be shown to the satisfaction of the Air Resources Board to give equivalent results at or near the level of air quality standard may be used.

(2) National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than three years after that state's implementation plan is approved by the Environmental Protection Agency (EPA).

(3) National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after implementation plan is approved by EPA.

(4) Federal Standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than one per year.

(5) Reference method as described by the EPA. An "equivalent method" of measurement may be used, but must have a "consistent relationship to the reference method" approved by the EPA.

(6) Prevailing visibility is defined as the greatest visibility which is attained or surpassed around at least half of the horizon circle, but not necessarily in continuous sectors.

(7) Concentration expressed first in units in which it was promulgated. Equivalent units given in parenthesis are based upon a reference temperature of 25°C and a reference pressure of 760 mm of mercury.

(8) Corrected for SO_2 in addition to NO_2.

*Data from San Bernardino County, 1974.

Over twenty sites within the area were analyzed for vegetative composition. Creosote (Larrea tridentata)/bursage (Ambrosia dumosa) is the dominant vegetative type throughout the study area. Secondary species include desert senna (Cassia armata), brittlebush (Encelia farinosa), ratany (Krameria sp.), cheesebush (Hymenoclea salsola), saltbush (Atriplex polycarpa and Lymenelytra) and desert trumpet (Erigonum inflatum number of areas support good stands of galleta grass (Hilaria rigida) Fig. 2-3 shows an ecologically sensitive area containing galleta grass, creosote bushes, and mesquite (Prosopis sp.).

The degree of species diversity appears to be, at least in part, correlated with substrate. Within and immediately adjacent to the lava flows, creosote and bursage comprise more than 90% of the perennial species.

The more sandy and gravelly areas support greater percentages of the above-named "secondary" species, especially on the bajadas in the southwest and northeast portions of the EAR area. In these regions, species diversity is significantly greater than in the lava flows. Creosote and bursage are the dominant species but, in addition to most of the secondary species, listed above, Mojave yucca (Yucca schidigera), smoketree (Dalea spinescens), bladder-pod (Isomeris arborea), and cholla (Opuntia echinocarpa and ramosissima) also occur. Among the annuals in evidence were desert sunflower (Geraea conescens), lupine (Lupinus sp.), and filaree (Erodium cicutarium).

2. Wildlife

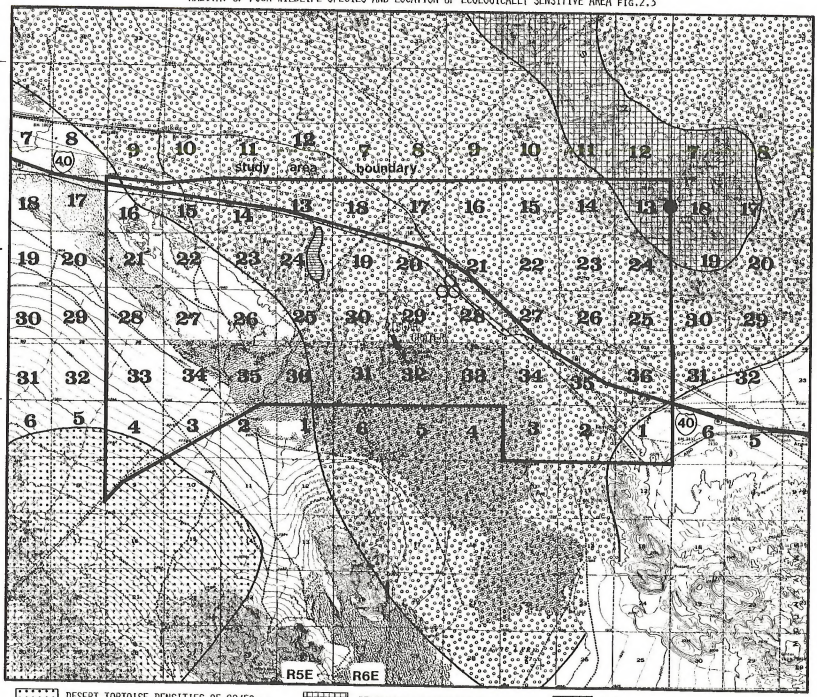
No species of wildlife currently listed (or formally proposed for listing) on the Federal List of Endangered and Threatened Wildlife (or similar state list) are known to inhabit the study area.

Within the lava flows, the primary habitat types are the rocky areas and the areas of windblown sand. The chuckwalla (Sauromalus obesus) is commonly found in lava flows (Stebbins, 1966). Barn owls are also quite common in the rocky crevices and lava tubes. The Mojave fringe-toed lizard (Uma scoparia) has been recorded from Pisgah siding area and viable habitat exists throughout much of the study area. Figure 2-3 shows the habitat regions of four wildlife species within the EAR area.

Additional species encountered in the lava flows area are typical of creosote scrub desert and include the kit fox (Vulpes macrotia), which is a fully protected furbearer under California law.

Of the raptors in the area, the Prairie Falcon (Falco mexicanus) and the American Kestrel (Falco sparverius) are

HABITAT OF FOUR WILDLIFE SPECIES AND LOCATION OF ECOLOGICALLY SENSITIVE AREA FIG.2.3



listed on the Audubon Society's Blue List of species whose numbers (or range) are diminishing either regionally or nationally (Arbib, 1979). A Golden Eagle (Aquila chrysaetos) habitat is shown on Fig. 2-3.

The sandy bajada in the southwestern corner of the study area appears to be viable habitat for the desert tortoise (Gopherus agassizi). The tortoise is fully protected (Fisk, 1972) and is under Federal review of status (Federal Register, 8/23/78); it is also a BLM sensitive species. Figure 2-3 designates known desert tortoise habitat with populations of 20 to 50 per square mile (8-19 per square kilometer).

Known permanent range of the fully protected desert bighorn sheep (Ovis canadensis nelsoni) exists in the Cady Mountains, a portion of which falls within the extreme northeastern portion of the EAR area (Fig. 2-3). Populations are believed to be declining and presently number approximately 25 individuals (Weaver, 1972).

I. Visual Resources

1. Visual Overview

The study area north of I-40 is a characteristic desert valley landscape with scattered shrubs which add color and texture to a relatively featureless area. The Sleeping Beauty Mountains dominate the view to the north by providing a striking contrast in color and form. Structures include railroad lines, 500 kv transmission lines, and pole lines. South of I-40, the view is dominated primarily by the strong blacks of the Pisgah lava field and to a lesser extent by the distant Lava Bed and Bullion Mountains. Much of the southwestern portion of the EAR area is screened from view by low hills near I-40 so that several roads cannot be seen.

The cinder mine operation, situated on the west side of Pisgah Crater, creates dust which is sometimes visible from I-40. The southeastern portion of the study area is relatively undisturbed as seen from the highway.

In spite of the numerous intrusions, the area retains a surprisingly natural character. The intrusions are screened by topography, vegetation, and distance.

2. Inventory Methods

The Visual Resource Management (VRM) System, detailed in the Bureau of Land Management Manual 6300-6310, is the basis for evaluating scenic/visual values. It involves analysis of the scenic quality of the area and identification of the visual sensitivity. The results of such a study are combined

to establish one of five management-objective classes for each area. Each Management Class indicates appropriate objectives for management of the visual resource. These include:

Class I. This class provides primarily for natural ecological changes. It is applied to primitive areas, natural areas, and other similar situations where management activities are to be restricted.

Class II. Changes in the form, line, color, or texture (basic elements) caused by an activity should not be evident in the characteristic landscape.

Class III. Changes in the basic elements of the existing landscape caused by a management activity may be evident. However, the changes should remain subordinate to the existing landscape character.

Class IV. Contrasts in the elements are allowed to attract attention and become a dominant feature of the landscape.

Class V. The landscape has been so highly degraded that it should be rehabilitated to bring it back into character with the surrounding region.

3. Inventory Results

Approximately 30% of the study area is rated as VRM Class II, 60% is Class III, and 10% is Class IV. Scenic quality for most of the area is "C" or low; the Pisgah lava field and part of the Sleeping Beauty Mountians are "B" or medium scenic quality.

J. Cultural Resources

A more detailed discussion of cultural resources and investigations is available in "A Summary of the Cultural Resources of the Proposed Pisgah Geothermal Lease Area", on file with the BLM, Riverside District Office.

1. Prehistory

Cultural resource material reminiscent of the lake playa lithic traditions of the Manix and Mojave Basins (+9,000 years B.P.) was discovered in a number of quarry and workshop sites in the study area. The similarity in artifacts may be explained by the theory that during the Pleistocene epoch, the Mojave River flowed past Newberry Springs, the study area, and Ludlow, and eventually joined the Colorado River. To exploit the resources of the lacustrine environment along this waterway, people concentrated in these areas, leaving

behind a patterned distribution of similar tools and artifacts. As most artifacts in the area are viewed as being post-Pleistocene in age, the possibility of finding similar cultural material beneath the flow would probably necessitate age adjustments.

The types of sites characteristically found in the study area are large lithic workshops consisting mainly of jasper and basalt. This site type indicates that habitation was probably not a major activity here. This may be due, in part, to the sparse vegetation which has been supported here in more recent Holocene times. Instead, village sites were located along the Lavic Lake shoreline or in the surrounding mountain ranges where food resources were more easily procured. Thus, the study area may be considered a resource area to which prehistoric peoples came to utilize the high grade raw stone for tool production.

Some of the variations in tool types are viewed as adaptations to the environment which changed from the wet/cool of the Pleistocene to the dry/warm of the Holocene. In addition, some tools are quite sandblasted and patinated, and appear to be of a relatively great age, whereas tools made of the Pisgah basalt appear "fresh" and of a more recent age. More reliable testing and analysis are needed before a dependable date can be obtained for sites located in the study area.

2. Ethnography

The study area lies between two ethnographically distinguishable Shoshonean territories - the Vanuyme (a Serrano division) and the Chemehuevi. The study area may have been frequented by both groups, with the Serrano division occupying the land eastward from Daggett (Smith, 1957; Kroeber, 1925) and the Chemehuevi concentrating in areas southwest of the Granite and Providence Mountains (Laird, 1976; Kroeber, 1925). Apparently, the area was used by the Chemehuevi for collecting "red rocks and basalt" (Robert Laidlaw, pers. comm., 1980).

3. History

Historically, the nearest center of commerce to the study area has been the railroad town of Ludlow, located approximately eight miles (13 kilometers) to the east of the area. The town became an important stop on the Atchison, Topeka, and Santa Fe Railroad line soon after 1898 when gold was discovered south of Ludlow, in the Bullion Mountains. Presently, commercial services in Ludlow consist of a motel, restuarant, and two gas stations.

During the 1940's, General George S. Patton trained his troops for the African campaign east of the study area, near Amboy. During this time, the Army Air Corps was training in what is now Twentynine Palms Marine Corps Base, located just south of the study area.

4. Native American Values

The Mojave and Chemehuevi tribes have traditions of occupancy and conflict from the Colorado River to the Pacific Ocean and from Death Valley to Twentynine Palms. The study area is considered culturally significant to these groups as both claim use and habitation of the region.

The Native American attitudes were determined by direct contact with members of the Chemehuevi and Mojave tribes and the Paiute Band of Las Vegas. Disturbance of vegetation/wildlife and archeological resources were of greatest concern. The development of the geothermal and sodium resources is viewed as beneficial to the public, as a whole, as long as proper mitigation of environmental impacts is carried out.

5. Summary of Survey Methodology

A systematic survey of the study area was performed by the Desert Research Institute of Nevada for input into the Desert Plan. Approximately 1.4% of the study area and 2.5% of the proposed lease area were sampled. In 1979, Southern California Edison surveyed portions of the powerline corridor that trends NE-SW through the study area. In January of 1980, BLM archeologists conducted a Class I inventory (record check) and verified the existing data in the field. An estimated 1.5% (4,365 acres or 1,767 hectares) of the proposed lease areas were examined. During this survey, emphasis was placed on desert pavement areas, the perimeter of the basalt flow, and other areas not covered by recent alluvial deposits.

6. Survey Results

Figure 2-4 indicates those areas which were surveyed and inspected on foot for cultural resources by the BLM archaeologists. Twenty-five (25) prehistorical and historical sites were located in the study area.

At present, none of the known cultural resources within the study area are considered to be of National Register quality. To qualify for the National Register, properties must meet the criteria of significance established by the Secretary of the Interior. Primary among these criteria is that sites must "possess integrity of location, design, setting, materials, workmanship, feeling, and association...." (36 CFR 800.10a).

Most of the sites have been disturbed by rock hounders, ORVs, construction projects, and erosion.

Some sites satisfy the qualifying criterion of "yielding.... information important in prehistory or history" (36 CFR 800.10a 4) and so have been classified as having moderate potential as a National Register site.

Pisgah Historic Site #1 (Lavic Siding) lacks the necessary integrity needed to qualify as a National Register Property. Pisgah Historic Site #2 (rock alignments) is not old enough to satisfy the National Register fifty-year age requirement (36 CFR 800.10b), nor is it considered of sufficient importance to override this requirement and qualify as a property "achieving significance within the past 50 years....(that are) of exceptional importance" (36 CFR 800.1067).

A description of all known cultural resources within the subject area has been forwarded to the State Historic Preservation Officer for comment on National Register eligibility in accordance with 36 CFR 800 and 36 CFR 63.

K. Paleontology

There are no known paleontological sites within the study area. Extinct varieties of Equus, camelus, and antelope have been located in the faunal remains at Schuiling cave to the west of the study area in the Newberry Mountains. A high potential exists for finding paleontologic remains along the fault lines and in Pleistocene lacustrine sediments in the EAR area.

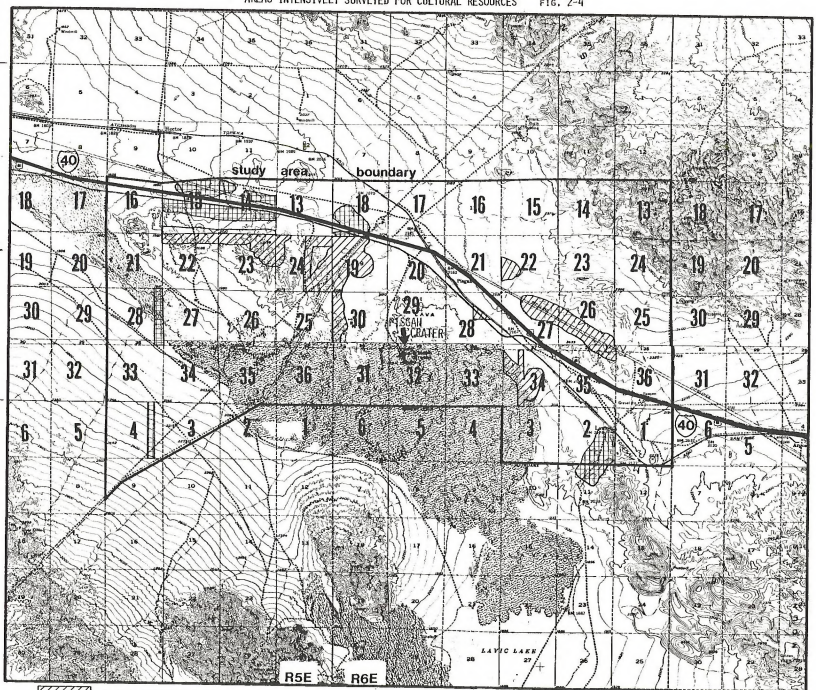
L. Land Use

The most significant land uses involve activity on upatented and patented mining claims and rights-of-way.

NL industries operates a patented hectorite mine in the southwestern portion of the study area (Sec. 35, T. 8N., R. 5E.) The area contains several pits, waste dumps, ponds, and related mine infrastructures. In the vicinity of this mine, Duval Corporation is presently conducting exploratory drilling for industrial minerals. Lavic Stone Corporation operates a patented cinder mine on the western flank of Pisgah Crater.

A rather extensive road network exists throughout the area, particularly, in the western half of the study area. Here, numerous unmaintained roads exist, most of which are a result of past and present mineral exploration activity. Interstate 40 and Old Highway 66 trend roughly northwest-southeast through the area. Well-maintained roads provide access from Highway 66 to the two mining operations.

AREAS INTENSIVELY SURVEYED FOR CULTURAL RESOURCES FIG. 2-4



Other land uses are a railroad line, four power transmission lines which traverse the area from northeast-southwest, several pipelines which closely follow I-40, telephone lines, and a gravel pit located one and a half miles (2.5 kilometers) northeast of the NL mine.

The San Bernardino County Planning Commission considers the proposed exploration and development activities compatible with their land-use guidelines and zones.

Over 35% of the study area is private land, of which approximately half is owned by the Southern Pacific Land Company. The area is bordered to the south by the Marine Corps Training Center.

According to the Interim and Proposed Plans of the Final California Desert Plan, the study area is located primarily within Multiple-Use Class M. This class provides for a wide variety of uses. Mineral exploration and development are considered to be compatible with other actions on the lands.

An area of approximately 1500 acres, located in the extreme northeastern corner of the study area, is the only exception to the above classification in the study area. Under the Interim Plan, this small area is a portion of Wilderness Study Area (WSA) 252; 50 acres of this WSA fall within proposed lease area CA-1076. Under the Proposed Plan, the 1500 acres are within Multiple-Use Class L. In this class, leases are issued subject to an EIS on the proposed leasing action; power plant sitings must undergo less intensive EA's on the plant site.

M. Socio-Economics

The nearest large population center is Barstow which is located approximately 30 miles (48 kilometers) west of the study area, adjacent to I-40.

The city is primarily a trade center. Is population, including such small neighboring communities as Daggett, Newberry Springs, and Hinkley, is nearly 38,000. The ethnic content is as follows: 68% Caucasian, 24% Mexican-American, 5% Black, and 3% other (Barstow Chamber of Commerce, 1980).

The median income per employed person of the Barstow area is approximately $16,000 per year. The largest employer is the U.S. Marine Corp Logistics Center with various civilian agencies providing the balance of governmental employment. The second largest employer is the Santa Fe Railroad. The retail sector comprises an estimated 30% of the total employment.

According to the Employment Development Department, The San Bernardino County unemployment rate was 7.1% during January, 1980. This rate in the Barstow area is approximately 2% higher (Stevenson, 1980).

Ample housing facilities are located in the Barstow area. Nearly 800 motel rooms are contained in the town of Barstow. Newberry Springs, which lies about 13 miles (21 kilometers) west of the EAR study, has one campground which can accommodate 20 trailers. Yermo, just east of Barstow, has a KOA campground with approximately 50 hookups.

The Daggett-Barstow airport is located only a few miles north of I-40

N. Wilderness

Most of the area was found to lack wilderness suitability when inventoried by the BLM in 1978-79. Factors in this determination were the lack of opportunities for solitude or primitive and unconfined recreation, intrusions, and lack of sufficient vegetation or topographic features to screen visitors from the intrusions.

The Interim Plan of the Final California Desert Plan (FCDP) indicates that in the extreme northeastern corner of the study area (T. 8 N., R. 6 E., Section 13, 14, 23, and 24), approximately 1500 acres are within Wilderness Study Area (WSA) 252. This constitutes less than 5% of the study area. Section 13 is privately owned and rest are public lands. Interim management policy of WSA's allows only those actions on public land that will not impair an area's wilderness values during the wilderness review process, with the exception of valid existing rights or grandfathered activities which may, in fact, cause impairment. Section 23 is the only one of the above-mentioned four sections which lies within a proposed lease area; this section contains an estimated 50 acres of wilderness area.

The Proposed Plan of the FCDP does not include any wilderness areas (or Class C lands) within the study area.

III. ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

A. Introduction

This chapter describes the unmitigated impacts that could result from the implementation of the proposed action. The impact assessment which follows provides that basis for the mitigation measures of Chapter 4. A summary of the environmental impacts of the proposed action on the resources in the study area is given in Appendix B.

B. Geology

Impacts to the geologic resources will be due primarily to drill pad and road construction which will increase runoff and erosion. Additional impacts related to geothermal activities could consist of induced seismic activity and subsidence.

Seimic activity in the form of micro-earthquakes may result from the injection of fluids and heat withdrawal (VTN consolidated Inc., 1978).

The production of large volumes of water from a water-dominated geothermal system may cause subsidence. This could adversely affect the local topography, existing structures in the area, and any new facilities that may be constructed. However, this problem may be lessened by maintaining fluid levels and pressures through controlled reinjection.

The degree of subsidence and/or seismic activity caused by the proposed action are considered to be insignificant.

The full development of the sodium resource will have a minimal effect on the geology. Operations similar to those performed under a sodium prospecting permit are now being undertaken in the area by Duval on their mining claims.

Impacts to certain areas of the lava flow are potentially significant. Because no roads presently exist within the lava flow in T. 8 N., R 6 E., S½ Section 30, Section 31, the public land within Section 32, and the S½S½ Section 28, road building, exploratory drilling, and development activities will permanently destroy the natual condition of the basalt flow. The lava field provides abundant opportunities for recreation and scientific investigations. The flows in the vicinity of Pisgah Crater are frequented by numerous university and private groups interested in the formation of basaltic flows, the Pisgah volcanic system itself, and the lava tubes or caves. Road building into these areas of lava

flow for exploration and development will not only cause irreparable damage to those flows directly affected by such activities, but will greatly increase the accessibility of the area for visitor and ORV use. This may well result in additional, and equally serious, damage to lava features by individuals who do not appreciate the delicate environment. If not for roads, many of these persons would not venture into such areas.

C. Hydrology

The major impacts to hydrologic resources will result from the use of water during drilling activities. Sources of water for such activity in the Pisgah area are ground water or trucking in water from an outside source. As noted in a previous section, the surface water regime is negligible within the study area.

The drilling of wells may create adverse effects on water resources. Such potential impacts include: the seepage of fluids through the sump, which may contaminate shallow ground water; interzonal mixing of ground water leading to contamination of fresh-water zones (could occur in production and injection wells); spillage or escape, as in a blowout, of toxic materials which may reach ground water regimes; and leaking of geothermal or brine fluids from associated pipes and equipment with subsequent ground water contamination.

If a power plant is constructed, cooling water is necessary to condense the flashed steam after it passes through the turbine. This could have an impact on local water supplies if such water must be obtained from outside sources. However, cooling water may be obtained by recycling the condensed water or cooled fluids, which would eliminate the demand for water from outside sources. This measure could be included in Plans of Operation. Still, if corrosive fluids are produced or a binary-heat exchanger (isobutane) plant is employed, cooling water may have to be obtained from elsewhere. According to the USGS Geothermal Office in Menlo Park (1980, personal communication), water demand based on a 55-MW generator a nd a well-head temperature of 405° F is 3100 acre-ft/yr. for an Isobutane Power Plant and 200 acre-ft/yr.for a Flashed Steam Power Plant.

D. Soils

1. Impacts

Exploratory drilling for geothermal resources can be expected to disrupt approximately 1% of the application area. The development stage may disturb 10 to 15% of the lease area, however.

Sodium prospecting activities will cause soil disruption in approximately 1% of the application area. If valuable sodium deposits are found and exploited, perhaps 5% of the application area would be disturbed.

2. Daggett-Tonopah-Bitterspring Association

The soils with the greatest susceptibility to impacts are those with desert pavement. The disturbance of the protective surface rock layer results in a much greater potential for wind and water erosion. The silty soil found under the pavement can produce large amounts of dust from traffic, construction activities, and wind erosion. Compaction may also occur, especially if vehicles are driven across wet soils.

Considerable disturbance already exists on some of the desert pavement in the study area. However, as disturbance of the pavement will occur mainly during the exploration and development stages of the proposed action, the greatest increases in dust will be of limited duration.

3. Anthony-Cajon-Arizo Association

Smaller increases in dust emission will occur as this association is present on sand-covered fans. Also, water erosion will not be greatly increased by surface disturbance because the association is on relatively level terrain. Significant compaction of soils may occur, especially when wet.

4. Lava Rockland Association

This association contains large amounts of rock and limited soil areas. Thus, this area will generally be the least susceptible to soil impacts.

E. Climatology

Operations related to geothermal or sodium activities are not expected to impact the regional climate. A possible exception is carbon dioxide gas (CO_2), which is the major gas emitted from geothermal wells. "Some people suggest that the production of CO_2 gas (from all energy sources) will result in adverse impacts on the global climate, by creating a heating effect.

A local increase in the relative humidity may develop from water vapor from the cooling towers.

F. Air Quality

Impacts are expected to be minimal during the exploratory phase.

During the field development stage of both the geothermal and sodium operations, impacts will occur in the following areas: an increase in hydrocarbons, NO_x, and CO due to the exhaust emissions of diesel and gasoline equipment; well emissions; and suspended particulates due to ground-breaking activities.

During the production and operation stage of the geothermal activity, there may be increased levels of non-condensible gases such as CO_2, NH_3, H_2, CH_4, and N_2. CO_2 concentrations of the emissions at the San Diego Gas and Electric Geothermal Loop Experimental Facility near Niland have been found to be 98% (Lawrence Livermore Laboratory, 1977). Emission of H_2S may also develop from solar evaporation ponds.

It is impossible to predict, at this time, whether or not air emission standards will be exceeded as no information exists on the content of non-condensible gases in the suspected geothermal resource.

The closedown stage of both proposed actions will produce impacts slightly less than the field development stage.

G. Vegetation and Wildlife

1. Vegetation

Geothermal and sodium exploration activities primarily involve the construction of access roads, drill pads, and sumps. Quantitatively, 0.25 to 1 acre (0.1-0.4 hectare) of vegetation per drill pad (including mud pits) for shallow temperature gradient holes and approximately 1.5 acres (0.6 hectare) of vegetation per mile ((1.6 kilometers) of road will be totally destroyed (USDI, BLM, 1976) for the duration of the project. Also, soils are compacted which impairs growth, destroys seedbeds, decreases soil permeability to water, and increases runoff and erosion. This results in the loss of topsoil which is essential for revegetation. The disturbance created by the road and drill pad construction provides an opportunity for the invasion of "weedy" species thereby causing changes in the health and vigor (due to increased competition) of resident, native species (Johnson et al., 1975). During the exploration stages, total productivity, species composition, and density of the immediate area are affected either directly or indirectly.

If a sodium preference right lease is granted, vegetation may be totally eliminated in approximately 5% of the lease area.

During the field development stage of geothermal operations, a certain amount of disturbance and destruction of vegetation will occur as a direct result of each activity. A total loss of vegetation within the area of the power plant itself may be anticipated. Spillage of liquid wastes from wells and sumps can accelerate soil erosion and impair soil productivity and nutrient cycles thereby adversely affecting vegetative growth, species composition, and densities (USDI, BLM, 1979). Also, gaseous contaminants such as SO_2 and H_2S are toxic to vegetation (USDI, FWS, 1976; USDI, FWS, 1978a).

Impacts to the ecologically sensitive area can be substantially reduced or prevented by entirely avoiding this area and/or developing site-specific mitigation measures, which the lessee must follow in the plan of operations as submitted to the GS.

2. Wildlife

The construction of drill pads and access roads, whether for geothermal or sodium activities, will result in loss and alteration of vegetation and habitat for wildlife. The result is a reduction in the total wildlife population, a decline in carrying capacity, and possible reduction in diversity. The development stage of geothermal or sodium-related operations will increase the magnitude of loss and disturbance of wildlife habitat.

With the loss and/or disturbance to habitat, a number of animals will be displaced. Adjacent areas will become overcrowded and carrying capacities will likely be exceeded. Displaced animals will be subjected to increased stress, competition, and predation pressure and driven into marginal habitats (USDI, FWS, 1978b). This will lead to a decrease in population numbers particularly among the small mammals and reptiles. In turn, this will affect larger predatory species, such as coyotes, kit foxes, and raptors, by reducing the available prey.

Also, small mammals and reptiles may be killed or trapped in burrows due to vehicular, constructional, and drill operational activities. These physical disturbances also disrupt breeding, nesting, and brooding activities, especially those of the raptors. The Prairie Falcon has been known to vacate a nest with young because of minor human-related disturbances (Boyce & Garrett, 1976). Noise alone negatively affects birds and mammals near power sites or well heads (Romney, 1976) as well as reptilian auditory systems (Bondello, 1976).

Pipelines, powerlines, and access roads also serve as linear barriers to dispersal and movement patterns of small mammals and reptiles. Home ranges and mobility of large mammals as well as habitual foraging routes of carnivores are also affected (USDI, FWS, 1978b). Powerlines pose special problems for raptors as these birds tend to use the towers as perching and surveillance sites (Miller, 1975). An increased use of the towers will increase the probability of collision and electrocution (Nickerson, 1975). Interestingly, for the above reasons, powerlines may increase raptor densities, especially if nest boxes or platforms exist on the towers (Stahlecker, 1979).

The impact to wildlife habitat and populations in the lease areas can be expected to result in an overall reduction in habitat and population numbers by perhaps as much as 10 to 15 percent.

H. Visual Resources

Four key observation points were chosen along I-40 and Highway 66 from which to evaluate potential contrasts created by the proposed actions. Depending on viewing angles, existing structures, roads, and degree of screening provided by vegetation or topography, the contrasts can exceed, meet, or fall below limits established for each VRM class. Impacts are defined as those contrasts that exceed class limits.

1. Geothermal and Sodium Exploration

Test drilling will be the most noticeable activity in this phase. Potential impacts will result from the following: the removal of vegetation and leveling of areas during drill pad construction may create contrasts in line and color; mud pits may become sites of lighter-colored materials relative to the surrounding area; and the improvement of existing roads by grading or the addition of material to the surface may strengthen existing elements of color and line. New roads may or may not add significant contrasts depending on location. Most of the study area can absorb these contrasts without exceeding VRM class levels. The area that most likely could not absorb these contrasts is the Pisgah lava field, which is particularly sensitive to color contrast.

2. Geothermal Development

The construction of an operating plant will introduce a series of pipes and access roads. The study area has the potential to absorb substantial development because much of it could be screened by shrubs and distance. Contrasts to

color and line would be noticed but likely can be mitigated. The plant itself would add contrast to all elements, most notably to form and color. Much of the study area is readily visible from I-40 with little opportunity to use landform to reduce contrast levels. The ideal location for a plant would be the southwestern quadrant of the study area, where low-lying hills effectively screen all existing developments. In the rest of the area, construction would likely exceed contrast levels, regardless of any site-specific mitigation.

3. Sodium Development

Evaporation ponds will alter form and color significantly. The only area able to effectively screen this development is the southwestern quadrant where low-lying hills block the view from I-40. Other locations are more sensitive, but site-specific measures possibly would reduce contrasts to acceptable levels; for example, proper orientation of the ponds relative to the highway might prove effective.

I. Cultural Resources

Impacts to cultural resource sites could occur during all stages of geothermal and sodium development. The proposed actions will alter the surface thereby creating potentially destructive or damaging impacts to archaeological and historical sites. Increased human activity in the area may result in vandalism or unauthorized collecting of cultural materials. The major effect of unregulated activities would be the partial or total destruction of existing archaeological or historical sites. The intensity of development relative to the location of archaeological and historical values would determine the degree of impact to these resources.

J. Paleontology

Impacts to paleontological resources are expected to be similar to that of cultural resources.

K. Land Use

As much of the land in the study area is already committed to mining and mineral exploration activities, the greatest impact is that other uses will be further restricted, once the area undergoes geothermal and/or sodium resource development.

If sodium development takes place, the actual disturbed land is expected to be, at most, 5% of the total application area. If geothermal development occurs, 10 to 20% of the geothermal application area would be directly affected.

The possibility of adverse impacts on the various rights-of-way in the study area will increase due to a greater level of activity.

L. Socio-Economics

Impacts to socio-economics would be minimal during the exploration phases of both proposed actions. Preliminary exploration of the area would involve small crews of two to three people for several weeks to perhaps a year or more. Deep exploration drilling of one lease would employ ten or fewer people for perhaps several months. Only a few of these employees might be local residents.

The socio-economic impact derived from the development and production of sodium is expected to be quite low, as the number of individuals employed is small.

The impact of geothermal field development is based on a period of five years from completion of exploration to completion of a power plant. A peak employment of 135 people could occur near the end of this stage. Most of these people would come from outside areas due to the specialized nature of the work and union hiring practices. This influx of people into the area could be easily handled by the existing services.

During the production and operation stage, perhaps 40 people would be employed.

Also, geothermal development would affect tax rates. Taxes associated with geothermal development activity could result in increased spending for other services and/or lower tax rates. These beneficial actions would affect all county citizens.

M. Wilderness

Impacts to wilderness values in the study area are not anticipated due to the small amount of wilderness area and the location of such land in the extreme northeastern corner of the EAR area.

IV. MITIGATING MEASURES

A. Introduction

This chapter lists certain measures to mitigate the environmental impacts discussed in the previous chapter. The proposed actions of the lessees will not be implemented without the specified mitigating measures. Appendix B contains a summary of the measures to mitigate the impacts on the resources in the study area.

Most of the adverse impacts resulting from geothermal energy development can be mitigated through applicable Federal, State, and local laws and regulations, and standard permit or lease stipulations.

The following statement will be attached to all geothermal leases within the EAR area:

> Prior to the development of a Plan of Operations (43 CFR 3203.630 CFR 270.34), the lessee shall contact the Supervisor and Authorized Officer to review local ground rules, applicable regulations, GRO Orders, and special lease stipulations.

The Geothermal Resource Operational Orders 1-7 (USDI, USGS, 1976) state specific mitigating measures which relate to the following: exploratory operations; the drilling, spacing, and abandonment of wells; general environmental protection requirements; plans of operation; pipelines and surface production facilities; and production and royalty measurement, equipment, and testing procedures. These orders are a part of the proposed action.

Mitigation of cultural resources is provided in section 18 of the standard lease form (BLM Form 3200-21). Cooperative procedures for cultural resource protection are given in Cooperative Agreement WO 105.

B. Recommended Mitigation Measures

1. The lessee is responsible for maintaining all roads and providing adequate erosion prevention techniques to all sites of surface disturbance. Such maintenance and erosion prevention measures may include, but are not limited to, ditching, draining, installing culverts, graveling of roads, or the construction of water bars/berms (Applies only to sodium permits; GRO Orders provide such protection for areas under geothermal lease).

2. In those areas where geothermal and sodium leases/permits overlap or where a geothermal and/or sodium lease overlaps a valid mining claim, the lessee and permittee shall formulate an agreement among themselves and/or with the holder of any such valid claim, whichever the case, which allows for simultaneous operations on these lands. Such agreement is to be acceptable to the BLM and is to be prepared prior to any surface-disturbing activities in those areas of overlap.

3. Surface occupancy will not be permitted on the E½ of Section 32 and on the W½ S½ S½ of Section 28, T. 8 N., R. 6 E., for the protection of lava features for recreational uses and scientific study. This area contains numerous basalt lava tubes and caves which are visited year round by university and private groups. The tubes and associated basalt flows provide unique opportunities for various scientific investigations and cave exploration (applies only to CA-1028).

4. BLM reserves the right to require dust abatement measures on all areas of surface disturbance (applies only to sodium permits: GRO Orders provide this for geothermal leases).

5. Vehicular activity on areas other than permanent access roads will be avoided when soils are wet to prevent compaction.

6. The drilling of temperature gradient wells will require the use of portable mud pits for drilling mud (applies only to geothermal leases).

7. No surface-disturbing activities shall occur in the ecologically sensitive area within T. 8 N., R. 5 E., E½NE¼ and NW¼SE¼ of Section 24. This area contains an assemblage of galleta grass, creosote bushes, and mesquite which is unique to the study area and thus represents a sensitive ecological habitat of the Pisgah Crater Area.

8. For the protection of the Bighorn sheep and the Golden Eagle eyrie habitats, surface occupancy will not be permitted on the NE¼ of Section 23, T. 8 N., R. 6 E., (applies to CA-1076).

9. Screening, fencing, or similar devices should be constructed around sumps or open pits to prevent entry by wildlife.

10. Spent geothermal fluids will be reinjected into the geothermal reservoir to increase the life span of the resource, maintain production pressure, and prevent possible subsidence and seismicity.

11. Pipelines shall be constructed in such a manner to allow for the mobility of small animals.

12. The construction of power transmission lines will follow the suggestions as outlined in the Rural Electrification Bulletin (1975) or those of the Raptor Research Foundation (Miller, Boeker, Thorsell, Olendorff, 1975). This will reduce losses of raptors and other birds from electrocution.

13. The lessee will engage a qualified, professional archeaologist, acceptable to BLM, to conduct a thorough and intensive inventory (Class III) of all areas to undergo surface disturbance (applies only to sodium permits; Section 18 of geothermal lease provides for this).

14. Documentation of cultural sites to be disturbed by exploration activities will be forwarded to the Keeper of the National Register and a determination of eligibility will be received. Sites which are considered to be eligible for the Register will be subject to the Advisory Council on Historic Preservation Procedures, as outlined in 36 CFR 800 (applies only to sodium permits; Section 18 of geothermal lease provides for this).

15. When technically feasible, the permittee will avoid cultural or paleontological properties by shifting exploration sites to areas away from cultural or paleontological sites, at distances to be determined by the BLM and the U.S. Geological Survey Mining Supervisor. If avoidance is not possible, a cultural resource data retrieval program shall be conducted utilizing a research design to be approved by the BLM and the State Historic Preservation Officer (applies only to sodium permits; Section 18 of geothermal lease provides for this).

16. A qualified paleontologist, acceptable to the BLM, will be employed by the lessee to conduct a survey and salvage program of areas to be disturbed which contain sediments with a high potential for paleontologic remains.

17. Rehabilitation measures will be designed to restore disturbed areas to as near a natural condition as possible. The topsoil on these areas will be stockpiled for use in reclaiming sites and compacted areas will be scarified (applies only to sodium permits; GTO Orders provide for this).

18. Drill pads will be designed to have irregularly shaped or curvilinear boundaries to enhance visual quality of the area (applies only to sodium permits; GRO Orders provide for this).

V. UNAVOIDABLE ADVERSE IMPACTS

A. Introduction

This chapter describes the adverse impacts which could be expected to exist after the appropriate mitigation measures in the preceding chapter have been applied.

B. Geology

Induced subsidence and/or seismicity may result from the withdrawal of geothermal fluids which could locally affect man-made structures and natural features.

Some damage to the lava flow may occur as a result of exploration and development activities.

C. Hydrology

Water will be consumed during plant operations, and thus, will be available for a limited number of other uses.

Evaporative loss from standard "wet" cooling towers of 3,500 to 4,000 acre-feet per year per 100 megawatt generating capacity may be expected. This could affect the local water supply if there is hydraulic connection between the geothermal reservoir and shallow ground water aquifers. No such effects have been observed to date from existing facilities.

In areas of critical water supply, dry cooling towers may be used. However, these lower the efficiency of the plant and may cause the project to become economically infeasible.

If cooling water is required from outside sources, there could be an impact on local water resources. In some cases, cooling water may be obtained by recycling the condensed steam or cooled fluids.

There is the possibility of ground water becoming contaminated which could adversely affect local ecosystems.

D. Soils

Some desert pavement areas will likely be disrupted, certain soil areas will be compacted, dust emission will be increased (especially, during the exploration and development phases of the proposed actions), and some unavoidable erosion will occur.

E. Air Quality

Noncondensible gases could be released into the environment, resulting in a reduction of air quality. The odor of H_2S may be present.

F. Vegetation and Wildlife

Vegetation will be completely lost in areas of extensive surface disturbance where reclamation will not be successful. This will lower wildlife populations and/or change the diversity.

Pollutants may be released by accident. These may kill wildlife or the invertebrates and/or plants that they feed on.

If vegetation is destroyed, then some habitats will be eliminated.

G. Visual Resources

Changes in form, line, color, and texture will take place which may not meet VRM requirements for Class III or IV lands.

H. Cultural and Paleontological Resources

Because of improved access and greater human activity in the area, there will be possible loss of cultural values due to collecting, vandalism, or ORV destruction. However, the area is now highly accessible, thus additional development will not significantly increase use in the area by ORVs, etc.

When mitigation necessitates the excavation or salvage of archeaological data, residual impacts will result due to limitations on current data retrieval techiques. Excavation destroys the relationship between the cultural or paleontological materials of a site and their environment, thereby eliminating some information that might be gained by the application of future collection methods.

I. Land Use

Once land is committed to geothermal development, other land uses will be restricted or precluded during the life of the geothermal activities.

J. Socio-Economic

No unavoidable adverse impacts are anticipated by the proposed actions.

VI. RELATIONSHIP BETWEEN LOCAL SHORT-TERM USE OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

A. Introduction

Due to the present lack of resource data, it is impossible to accurately estimate the life of the proposed projects. The sodium resource may last for decades and the geothermal resource may be expected to last more than thirty years. A short-term impact is one which affects the environment while the resource is being removed. A long-term impact occurs after the resources have been exhausted.

B. Geology

Seismicity and subsidence are potential short-term impacts. If subsidence occurs, there may be a permanent decrease in the underground water reservoir.

A short and long-term impact would be the possible destruction of portions of the lava flow due to exploration and development activities, which may result in the loss of information regarding the geology of the basalt flow.

C. Hydrology

Water which is used for geothermal operations would not be available for other uses and thus, would be a short-term commitment of resources.

Short and long-term impacts may result from contamination of underground water due to environmental accident.

D. Soils

There will be significant decreases in soil productivity in areas involving road, drill pad, or solar pond construction.

Short and long-term impacts would result from contamination, compaction, erosion, and topsoil removal.

Scarifying compacted soil or replacing topsoil will help to restore soil potential for plant growth after the area is abandoned.

E. Air Quality

Short-term impacts will develop due to increased levels of dust and non-condensible gases. State and Federal standards will probably be exceeded at various times and some pollutants could have noxious odors.

F. Vegetation and Wildlife

Wildlife will undergo short-term impacts due to increased noise levels and may temporarily vacate areas where exploration activity is occurring.

The vegetation and wildlife will receive long-term impacts as well. Revegetation can best occur only after the disturbed ground has been regraded and restored to its original condition. In general, efforts to revegetate disturbed desert areas have not been successful. A loss in vegetation will result in a decrease in the productivity of the environment.

G. Visual Resources.

The short-term impacts on the visual resource include the presence of buildings, roads, drill equipment, pipelines, and solar ponds.

After the disturbed sites are regraded and the area abandoned there will be long-term changes in the line, texture, form, and color of the landscape.

H. Cultural and Paleontological Resources

As archaeological and paleontological sites are non-renewable resources, any destruction of these sites would be a permanent loss.

I. Land Use

Use of the land for geothermal and sodium development will exclude or limit other resource uses in the study area. This is a short-term impact. The return of a desert area to its original state following reclamation is a very slow process. Evidence of the development activities will remain for years.

J. Socio-Economics

An increase in pollution levels and the odor of H_2S are regarded as short-term impacts. Long-term impacts are nil.

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

A. Introduction

Irreversible denotes a situation or process that is incapable of being reversed. Irretrievable refers to that which cannot be recovered.

B. Geology

Extraction of the geothermal and sodium resources represents the main commitment of resources. The geothermal resource may be replaced if heat is reintroduced to the area over geologic time.

Damage to the basalt flow may involve an irretrievable loss of geologic information.

C. Hydrology

Contamination of shallow ground water (e.g., by Na, Ca, K, Mg, Cl, HCO_3, SO_4, Li, etc.) could result in irretrievable losses of soil and vegetation/ wildlife resources. However, the ground water in most of the study area is of poor quality. Also, there are indications of ground water migration toward the Troy Playa area, in which substantial concentrations of total dissolved solids exist in the ground water regime.

D. Soils

Due to compaction, contamination, and an increase in erosion, soils could be left unable to support vegetation.

Disrupted areas of desert pavement will be very difficult to restore. Scars in such disturbed areas may remain visible for a long period of time.

If compacted soil is scarified and excavated soil is restored, irreversible and irretrievable commitment of soil resources will be minimal.

E. Vegetation and Wildlife

Certain areas are likely to be entirely denuded of vegetation depending on the severity of soil damage and the success of rehabilitation methods. Wildlife will also be lost from these areas and there will be a decrease in the carrying capacity of the community.

F. Visual Resources

Scars on the land due to development activities will cause a permanent alteration in the line, texture, form, and color of the landscape.

G. Cultural and Paleontological Resources

Archaeological or palentological resources which are destroyed or collected during mitigation efforts will involve an irretrievable loss of scientific information.

VIII. ALTERNATIVES TO THE PROPOSED ACTION

A. Introduction

Section 102(2)(c) of the National Environmental Policy Act (NEPA) directs Federal agencies to "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." This analysis has revealed no unresolved areas of conflict. As required by NEPA, the no action alternative is considered below.

Although no surface occupancy has been recommended for three areas (the ecologically sensitive area, the bighorn sheep area, and the sensitive area for geology and recreation),

casual use activities may still be performed. Various techniques may be used by the lessee and/or permittee to explore for and develop the mineral resources under these lands while preserving the sensitive values in the above-mentioned areas.

B. No Action

Under this alternative, no geothermal leases or sodium prospecting permits would be issued for public lands in the study area. Thus, electrical energy and sodium would have to be obtained from alternative sources or sites, which would cause impacts to other areas.

The production of calcium borates, for which exploration is now being conducted by Duval within the study area, involves similar operations as for the production of sodium minerals. Thus, the construction of pipelines and solar ponds may occur even if sodium permits and leases are not granted. Any sodium which is obtained from the brine concentrate in the ponds would have to be stockpiled if a permit or lease is not held. If the sodium is of commerical value, marketing would not be allowed if a permit and lease are not obtained. Therefore, this would represent a waste of a valuable resource and would not be in the public interest.

There is the possibility of geothermal exploration and development of private and State lands in the study area if leasing is not allowed. This will not only impact those lands but will affect adjacent Federal lands as well. This is because geothermal fluids under Federal lands will be withdrawn during field production. Also, if the public lands are not leased, then impacts to private lands would be intensified. This could lead to less efficient overall use of the geothermal resource in the area.

IX. CONSULTATION AND COORDINATION

A News Release was issued by the Riverside District Office on April 16, 1980, which notified the public that the Draft Pisgah Crater EAR was available for review and a public meeting on the EAR was to be held on April 30, 1980.

The public meeting was held in the City Hall Building in Barstow, California, and attended by eleven members of the public. The proposed actions of the geothermal and sodium operations were discussed, but the majority of time was spent receiving comments and responding to questions from those in attendance. Comments concerned the priority of rights in cases of overlapping leases and mining claims, water rights, the alleged presence of a rare plant in the EAR area, lava tubes which exist in portions of the basalt flow, suggestions on mitigation measures, and typographical or factual errors. Several changes were made in the text to reflect these concerns. It should be noted, however, that mitigations can be prepared as a result of field examinations of the lessee's plan of operations which will reduce or prevent adverse impacts to resource values.

The public review period for the Draft EAR was from April 23, 1980 to May 23, 1980. A listing of the individuals, groups, and agencies which were sent a copy of the draft is presented below. Comments on the draft and BLM responses to these comments are presented in Chapter X.

United States Department of the Interior

IN REPLY REFER TO
1791
(C-069.80)

BUREAU OF LAND MANAGEMENT
Riverside District Office
1695 Spruce Street
Riverside, California 92507

APR 21 1980

Memorandum

To: All Interested Parties

From: District Manager, Riverside

Subject: Draft Environmental Assessment Record for Proposed Non-Competitive Geothermal Leasing/Sodium Prospecting Permits in the Pisgah Crater Area, San Bernardino County, California

Enclosed is a copy of the Draft Environmental Assessment Record (EAR) for proposed geothermal leasing and sodium prospecting permits in the Pisgah Crater Area of California. This EAR analyzes the impacts which could result from full development of geothermal and sodium resources in the area. The EAR focuses primarily on geothermal development because the greatest potential impacts would result from this activity.

Most proposed actions by the geothermal lessee will undergo site-specific environmental assessments, which are prepared by the U.S. Geological Survey.

If you have any questions concerning this document, please call Jim Williams at (714)326-3896. Please address any comments concerning this EAR to:

Area Manager (C-069)
Cima Resource Area
Bureau of Land Management
P.O. Box 305
Needles, CA 92363

All comments will be considered in the preparation of the final EAR for this area. We would appreciate receiving all comments by May 23, 1980.

For those interested, a public meeting will be held on April 30 from 7 to 10 p.m. at City Hall, 220 East Mountain View Avenue, Barstow, California, to discuss the EAR. The meeting will be conducted by Dick Crowe, the Cima Resource Area Manager, and Jim Williams, the Geologist.

Thank you.

Richard D. Erwin
ACTING

Enclosure

IMMEDIATE

FOR RELEASE

CONTACT De Loris "Pete" Palmer (714) 787-1424
Jim Williams (714) 326-3896

CALIFORNIA BLM BUREAU OF LAND MANAGEMENT

News Release

UNITED STATES DEPARTMENT OF THE INTERIOR

Riverside District Office 1695 Spruce Street, Riverside, California 92507

RDO 80-20
April 16, 1980

PISGAH EAR

The proposed Bureau of Land Management environmental assessment review for noncompetitive sodium and geothermal leasing in the Pisgah Crater area is now available for review. The public meeting for discussion and questions is set for 7 - 10 p.m., April 30, at City Hall, 220 E. Mountain View, Barstow.

Copies of the EAR can be seen at BLM offices in Needles, the Barstow Way Station or the Riverside District Office, 1695 Spruce St., Riverside.

Conducting the meeting in Barstow will be Cima Area Manager Dick Crowe and geologist Jim Williams. Comments can be addressed to the latter at P. O. Box 305, Needles, CA 92363. The public comment period ends May 19.

-30-

Federal Agencies

U.S. Fish and Wildlife Ser.
Div. of Ecological Services
Sacramento, CA 95825

Federal Aviation Adm.
Los Angeles, CA 90009

Advisory Council on Historic Preservation
Washington, D.C. 20005

National Park Service
Los Angeles, CA 90012

Heritage Conservation and Recreation Service
San Francisco, CA 94102

Army Corps of Engineers
Los Angeles, CA 90053

Environmental Review Officer
U.S. Dept. of Interior
Washington, D.C. 20240

Federal Communications Commission
U.S. Courthouse
Los Angeles, CA 90012

Dept. of Energy
Albuquerque, NM 87185

Area Geothermal Supervisor
U.S. Geological Survey
Menlo Park, CA 94025

Regional Director
National Park Service
San Francisco, CA 91402

High Desert RC&D Prog.
USDA, Soil Conservation Service
Lancaster, CA 93534

Regional Director
Water and Power Resources Service
Boulder City, NV 89005

Water and Power Resources Service
Sacramento, CA 95825

Area Director
Bureau of Indian Affairs
Sacramento, CA 95825

U.S. Forest Service
Region 5
San Francisco, CA 94111

Area Oil and Gas Supervisor
U.S. Geological Survey
Bakersfield, CA 93301

State Agencies

Impact Analysis and Energy Resources Section
South Coast Air Quality Management District
District Headquarters
El Monte, CA 91731

Environmental Analysis Division
San Bernardino, CA

State Clearing House
Office of the Governor
Sacramento, CA 95814

Assemblyman Larry Chimbole
Apple Valley, CA 92307

State Historical Preservation Officer
Sacramento, CA 95811

Regional Water Quality Control Board
Sacramento, CA 95814

Senator Walter Stiern
Bakersfield, CA 93301

Regional Manager
CA Fish and Game
Long Beach, CA 90802

Dept. of Fish and Game
Blythe, CA 92225

County and City Governments/Agencies

San Bernardino County APCD
San Bernardino, CA 92116

San Bernardino County Museum
Redlands, CA 92373

San Bernardino County
Board of Supervisors
San Bernardino, CA 92401

Riverside County Planning Commission
Riverside, CA 92501

Imperial County Planning Commission
El Centro, CA 92243

Environmental Improvement Agency
San Bernardino County Plan Dept.
San Bernardino, CA 92415

Special Interest Groups/Individuals

Dept. of Earth Sciences
Univ. of CA, Riverside
Riverside, CA 92502

Sierra Club, San Diego Chapter
San Diego, CA 92101

Sierra Club
Riverside, CA 92507

Pat Keeling
Barstow, CA 92311

Germaine Moon
Barstow, CA 92311

Roy Shlemon
Newport Beach, CA 92663

Russell Harter, Southern Cal Grotto Assoc.
Venice, CA 90291

Mr. & Mrs. Lee Merick
Western Mining Council
JoLannesburg, CA 93528

Mr. Ike Eastvold
Highgrove, CA 92507

United Mining Councils of America
Barstow, CA 92311

Mr. Dick Moon, Pres.
CORVA
Buena Park, CA 90620

California Assoc. 4WD Club
Ron Cooke, Chairman
San Bernardino, CA 92404

Colorado River Indian Tribe
Parker, AZ 85344

Fort Mojave Indian Tribe
Needles, CA 92363

National Wildlife Federation
Bakersfield, CA 93302

Corporations

Burmah Oil and Gas Co.
Long Beach, CA 90801

Mantech of New Jersey Corp.
San Diego, CA 92121

Phillips Petroleum Company
Salt Lake City, Utah 84110

Lavic Stone Corp.
Newberry Springs, CA 92365

NL Industries
Newberry Springs, CA 92365

Getty Oil Company
Bakersfield, CA 93308

Hunt Oil Company
Dallas, TX 75202

Converse Davis Dixon
San Francisco, CA 94111

Sun Oil Company
Dallas, TX 75230

Oil Resources, Inc.
Billings, Montana 59103

Kerr-McGee Chemical Corp.
Trona, CA 93562

Mono Power Company
Rosemead, CA 91770

Stauffer Chemical Co.
Trona, CA 93562

American Potash and Chemical Co.
Trona, CA 93562

U.S. Borax and Chemical
Boron, CA 93516

Hydro-Search, Inc.
Reno, NV 89501

Sunedco
Dallas, TX 75251

Aminoil USA, Inc.
Santa Rosa, CA 95406

Standard Oil of California
San Francisco, CA 94120

Duval Corp.
Tucson, Arizona 85712

Anadarko Prod. Co.
Houston, TX 77001

X. INTENSITY OF PUBLIC INTEREST

Discussions were held with various governmental agencies, companies, special interest groups, and individuals to determine the kind and degree of public interest concerning the proposed geothermal leasing/sodium prospecting on public lands. In addition, a public meeting was held to receive public comments on the EAR (see previous section on consultation). From these sources, the greatest interest was shown by individuals and groups concerned with the protection of certain resource values, viz, the lava tubes and certain plant species. Written comments were received from one individual during the public meeting; these comments are presented in this section.

The Draft EAR was submitted for public review and comment in April and May, 1980. A copy of the memorandum which was attached to the Draft EAR and the News Release are presented below.

Nine comments were received and all were neutral relative to the issue of geothermal leasing/sodium prospecting in this area. These comments and BLM responses to significant issues are also given in the following pages.

Public Meeting April 30, 1980

From: Germaine L. Moon
1517 Paloma Street
Barstow, CA 92311

Note: Comments expressed below have been typed from handwritten pages submitted by Mrs. Moon.

Residence-30 miles from the Project

Subject: Pisgah Crater Proposed Geothermal Leasing/by Anadarko Prod. Co. Sodium Prospecting Permits/ by Duval Co., subsidiary of Penzoil Oil Co.

EAR

-- Personal interests relating to this proposal: (in order of importance) (p. 38 EAR)

-- personal safety as well as that of my neighbors, in the dangers of geothermal developments: a) air and water quality and seismic hazards, b) economic, c) ecology, d) recreational aspects.

-- Qualification: public services to my fellow man by working as a volunteer for the Mojave River Valley Museum at Barstow

-- by developing education programs for the community

-- by writing

-- by serving as reference searcher (historic research) for anyone who asks

-- by monitoring cultural, governmental, economic developments in the Mojave Desert, East and West, North and South of Barstow.

-- Special hobbies: photography, desert flora and fauna and geology as well as vista. Camping...in a word: LOVE for "my" desert environment.

First - I would like to congratulate the BLM (Cima) staff for the informative EAR Draft thus presented. Except for a few errors and omissions, I found the report adequate, especially viewed from the standpoint of the staff.

The report (EAR) alerts everyone to the irremediable economic impacts Anadarko's geothermal leasing will cause. P 41, under land use "once land is committed to geothermal development other land uses will be restricted or precluded during the life of the geothermal activities." And again p. 43, "Use of the land for geothermal and sodium development will exclude or limit other resource uses in the study area."

I have a few questions here - Who has primary rights?

1. The existing patented mine owners?

2. The existing unpatented mine leases, some are older than 50 years.

3. Although I am not too concerned by the Duval Co. sodium prospecting permits with eventual granting to actual mining developments. Why should they be granted the permits if they are only prospecting for sodium chloride... a plentiful commodity in the Mojave Desert? Which other rare non-metallic minerals are they really after? Calcium borate? Not rare-zeolite? Not so rare either. Where are the nine mining claims they presently claim? Your (p. 3) disturbs me - 1,120 acres in Sec. 23, 24, 26, and 35; T. 8 N., R. 5 E., are presently considered for leasing to both Anadarko or Duval Company, but at the same time overlap the older bentonite clay mines presently under BLM leases? Ditto for Duval's application 640 a/c in Sec. 22 and Sec. 27.

   Will Duval Co. and Anadarko "jump" the claim of NL chemicals? Or is it a BLM policy to lease the same mining grounds to more than a company at the same time? When will this ground be open to the highest bidder? Or will the Energy (geothermal) Co. brainwash the public in believing that this particular site is "mandatory" for "development of local (to be sold locally) electricity." That without this site no electric power will be available locally - whose funds will be used for this project, private or public? Not that it really matters since the customers will pay for it, even if studies are found not possible, anyway, in taxes or in services.

4. How compatible are the bentonite and sodium mining?

5. How compatible are geothermal developments with non-metallic mineral extraction?

In your report I did not find whether or not the geothermal studies and eventual production will really be needed in the future. For the past years I've monitored no less than six generating site proposals by energy companies, besides permits for power corridors, etc...at each meeting the public is being told that these projects are necessary to future energy needs. Who is kidding whom? Will the Southern California generating sites be located in the desert? And you now discuss environmental impacts from one project...combine those impacts with all the other already-under- way proposals!

What will be left of the desert? Who will be able to breathe? How will our flora and fauna survive this combined poisonous environment!

Why should the energy developments receive special treatment versus mining development? Is it because they wage a scare campaign, at their customer expenses, instead of being required to compete just in the business world, as mining does? Inflation! Well these utilities companies, electric and gasoline are surely the biggest culprits. I could go on and on about this subject but I am afraid no one will listen so instead let's talk about dangers-seismic danger and health hazzard (sic) - reference EAR p. 40, "the withdrawal of geothermal fluids could locally affect man-made structures and natural features" - and p. 55 "shock waves are propagated through the substratum" (during studies, geothermal) and reaching depths of 10,000 feet" (just short of 2 miles) (basaltic mantle lies 13.5 miles p.8) and p. 28 "Additional impacts (geology) related to geothermal activities could consist of induced seismic activity and subsidence." (I take this last word as meaning...wave going deeper) and p. 61, Appx. B "Possible induced seismicity and/or subsidence.

Do you mean that some company will be playing God with nature? Not knowing exactly the possible hazards they will be erecting. That by probing, drilling, and using explosives they may reach too far, encountering and unlashing Pisgah dormant wrath? How strong will be these purposely induced seismic waves? If coupled with a natural earthquake, what dangers would people be subject to? Has anyone studied the hazzards to the mine operators in the immediate area? To the private and public property? To the safety of travelers on the highways or railroad. Can you imagine workers being buried in the bentonite open pit, or man be crushed

(lava bombs mixed with cinders) by sending cinder material bouncing around the slopes of the mine? Can anyone picture seismic uproar, created by man and nature at the same time, suddenly snowballing forces and creating destruction on urban Barstow area; after all, we are only miles away and other earthquake faults surround our locality. I say this is much too close to home to allow such experiments. I also protest against the possible impacts this geothermal proposal will cause to the area's flora, fauna, air quality and water supply, not to mention human beings.

Flora-lease in SW¼ of Sec. 27 and the public land in Sec. 26 (T. 8 N., R. 6 E.) should be exempt from this proposal. This area contains a plant life community not found at other deseert places. This year some of us discovered a very rare penstemon (P. albomanginatus) in these sections. And spotted other plants not found naturally at that altitude or in this type of terrain. A fast inventory turned up over 145 plant species (in that area) I must say that your EAR p. 18, lacks knowledge of the vegetation in the study area; this remark applies to wild life also.

Health p. 20, carbon dioxide gas may collect in low pockets where miners now work, ditto for animal burrows.

Errors found in the EAR - or omissions

1. As late as April 29, 1980 neither the Barstow Way Station (of the BLM) nor the San Bernardino County branch library had received the Pisgah Crater EAR, therefore the public couldn't very well see it as per newspaper's articles (Sun: April 26, and Desert Dispatch April 29) nor study it! This public meeting should be a "breeze" with no opposition to the proposal.

2. Where will the generating plant (geothermal) be located? (p. 6) on Southern California Edison Company property? (Sec. 25 and 36-600 acres about, T. 8 N., R. 5 E.)

3. What are the location of Duval unpatented 9 mining claims?

4. What is "aa lava?" page 11.

5. You need to review your wording on flash floods, page 12 and 13; in the past this area suffered great property damage by flooding.

6. EAR is inadequate on vegetation and wildlife chapters (p. 18 and 19)

7. What are Pisgah Historic site "1 and #2? (p. 24)

8. Santa Fe Railroad Co. is not the largest landowner in the study area, Southern Pacific Land Co. is, (p. 26) by some 18.68% - not enough emphasis, nor consideration was made as to the reactions to the proposal by the absentee-small landowners, in the study area; were they (even) contacted? How about the presently active mining companies?

9. (p. 27) KOA camp is near Yermo not Daggett.

10. (p. 27) "Wilderness"; 5% of the study area is in the wilderness Sec. 13 and parts of Section 14, 23 and 24; T. 8 N., R. 6 E.

11. Funding whether public or for the geothermal studies and future developments.

Opinions

1. No geothermal leasing, b) but if permitted exempt penstemon area which should even now be blocked from vehicular traffic. (Exact entrance to heart of area 2/10 of a mile westerly, on old 66 Hwy, for the RR crossing).

2. Sodium leasing - unless I find different proof - no opposition.

   a) recommendations - that birds be prevented from landing in the evaporation ponds by an overhead screening; that potable water be offered in a smaller pond away from powerlines or access roads.

   b) That permanent facilities be painted (p. 34) even if distant 6 miles instead of 1 mile.

   c) No salt brush, tamarix be allowed to grow near the water, but that mesquite or other trees give a resting place to migrating, or local, birds that will naturally land near the ponds while sighting water.

Bureau of Land Management response to comments from:

Germaine L. Moon
1517 Paloma Street
Barstow, CA 92311

Many concerns and comments were expressed by the above individual. As a result, several modifications and corrections were made in the text as follows:

(1) The Multiple Mineral Development Act of 1954 is mentioned (Chapter I(A));

(2) Penstemon locality noted in Chapter II(H) and mitigation measure provided to protect this species (Chapter IV);

(3) Pisgah Historic Site #2 is a rock alignment (Chapter II(J);

(4) Correction to text - Southern Pacific Land Co. is the largest private landowner in the study area (Chapter II(L));

(5) Correction to text - KOA campground is near Yermo (Chapter II(M));

(6) Correction - a small amount of wilderness is present in the study area. Wilderness section is modified in Chapter II; a section is added in Chapter III and in the Impact and Mitigation Summary Table;

(7) Permanent facilities will be painted so as to reduce visual contrast regardless of location in study area (Chapter IV - Mitigation Measures).

The following plant listing was submitted during the public meeting of April 30, 1980.

Eco-system

Plant Listing for the Pisgah Crater-Newberry Lava Beds Area by Patricia Jernigan Keeling compiled from 1977-1980 with slides and prints.

I have found the following plants blooming and referenced from "Desert Wild Flowers" by Jaegar.

#	Common Name	Latin Name	Rare or Endangered Species
	Prickly Poppy	Argemone carymbosa A. platyceros	
	Dune Primrose	Oenothera deltoides	
	Desert Holly	Atriplex hymenelytra	
333	Small Blazing Star	Mentzelia albricaulis	
	Pincushion	Chaenactis Fremontii	
172	Fringe Pod	Thysomocarpus currepes eraditus/T. Lacinitus	
	Specular Pod	Dithyrea Californica D.	
750	Desert Chicory	Rafenesquia neomexicana	
	Sand Mat	Euphorbia polycarps E. E.	
678	Cheesebush	Hymenoclea Salsola	
757	Desert Dandelion	Malocolthrex californica glabrata	
	Buckhorn Cholla	Opuntia acanthocarpa	
	Wallace Erophyllum	Eriophyllum Wallacii	
539	Ground Cheery	Physalis crassifolia	
141	Little Gold Poppy	Eschs chaltzia menuliflora	
140	Desert Gold Poppy	E. Glyplosperma	
368	Lg. White Desert Primrose	O.	
371	Desert Primrose	Oenothera primiveris	
	Heart Leaved Primrose	O. cardiophylla	
	Yellow Cups	O. brevipes	
	Palmate-Leaved Gourd	Cucurbuta palmata	
532	Narrow-leaved Thornbush	Lycium andersonii and variety	
531	Frost Mat	Achyronycgia Cooperi	
132	Fremont Phacelia	Phacelia Fremontii	
451	Fat Leaved Phacelia	P. destans australis	
440	Mustard Yellow	Descurania pinnata	
159	White	D. brachycarpon	
159A.	Desert Alyssym	Lepidium Fremontii	
165			

#	Common Name	Latin Name	Rare or Endangered Species
174	Linear-Leaved Cambess	Oligomeris linifolia	
271	Lance-Leaved Ditaxis	Ditaxis lanceolata	
276	Broad-Leaf Stillingia	Stillingia spimulosa	
77	Yellow-Spiny Caps	Pxytheca luteola	Rare
247	Big Podded Locoweed	Austraglus oophorus	
123	Windmills	Allionia incarnata nudata	
542	Twinning Snapdragon	Antirrhinum filipes	
733	Chinch Weed	Pectes papposa	
746	Mojave Thistle	Cirsium Mohaveneses	
691	Coreopsis	Coreopsis Bigelovii	
687	Brittle Bush	Encelia farinoisa	
686	Acton Encelia	E. Action	
688	Rayless Encelia	E. fruitescence	
697	Woolly Marigold	Baileya pleneradiata	
699	Wild Marigold	Baileya multiradiata	
481	Broad Nutted Comb-Bur	Pectocarya platycarpa	
70	Spiny-Herb	Chroizanthe rigida	
		C.	
		C.	
	Creosote Bush	Larrea divaricata	
	Fiddle Neck	Amsenckia vernicosa	
212	Desert Cassis	Cassis armata	
198	Mesquite	Prosopis juliflora glandulosa	
344	Beavertail Cactus	Opuntai bassilaris	
228	White Ratany	Krameria Grayi	
307	Desert Mallow	Sphaeralcea ambigua	
306	Desert Five Spot	Malvastrum rotundifolium	
704	Spanish Needle	Palfoxia linearis	
639	Desert Aster	Aster abatus	
241	Mohave Locoweed	Astragalus mohavensis	
541	Desert Tobacco	Niotiana trigonophylle	
421	Davy Gilia	Gilia latiflora	
435	Rock Gilia	Gilia scopulorum	
429	Desert Calico	Langloisia Matthewisii	
428	Pink-spotted Gilia	Linanthus Maculata	
461	Purple Mat	Nama denieissum	
477	Plicata Coldenia	Coldenia plicata	
480	Arched-Nutted Comb-Bur	Pectocorya platycarpa	
590	Pursh Plantain	Plantago purshii	
592	Woolly Plaintain	Plantago insularis fastigiata	
673	Wooly-fruited Burbush	Franseria eriocentra	
68	Xantus Spiny-Herb	Chorizantha Xanti Leucotheca	
143	Blunt-Leaf Stinkweed	Clemonia obstusifolia	
42	Thomas Eriogonum	Eriogonum Thomasii	
43	Skeleton Weed	E. deflexum	

#	Common Name	Latin Name	Rare or Endangered Species
224	Yellow-Eyes	Lupinus flavoculatus	
195	Palo Verde	Cercidium floridum	
12	Desert Lily	Hesperocallis undulata	
460	Small Leaved nama	Nama Pusillum	
119	Sand Vervenia	Abronia Villosa	
		A. pogonantha	
18	Muilla	Muilla coronata var. mollissima	
232	Silk Dalea	Dalea mollis	
264	Desert Herons Bill	Erodium texanum	
264A.	Filaree	E. cirutarium	
	Desert Gilia	Gilia eremica	
	Chia	Salvia columbariae	
		S. var	
	Joint Fir	Ephedra Californica	
277	Desert Croton	Croton californicus nevadavensis	
276	Broad Leaved Stillingia		
406	Purple Climing Milkweed	Funastrum heterophyllum	
564	White Margin Penstemon	Penstemon albomarginatus	RARE
564	Long-Beaked Twist Flower	Streptanthella longerostris	
271	Dixaris lancelata		
489	Purple-Rooted F-G-N-N	Cryptantha micrantha	
495	Wing-Nut For-get-me-nots	Cryptantha barbigera	
502	Rough-Stemmed Forget-Me-Not	C. holoptera	
405	Desert Milkweed	Asclepias erosa	
324	Venus Blazing Star	Mentzelia nitens	
326	Yellow Comet	Mentzelia affinis	
327	Pygmy Blazing Star	Mentzelia reflexa	
491	Flexuous F.M.N.	Cryptantah dumetorum	
375	Br. Eyed Susan	O.	
367	Lg. Yellow Desert Primrose	Oenothera primivera	
365	Wooly Bottlewasher	O. decorticous desertotrum	
748	Scale Bud	Anisocoma acaulis	
755	Snakes Head	Malacothrix Coulteri	
760	Thorny Skeleton-Plant	Lygodesmia spinosa	

The Bureau of Land Management response to plant list submitted by Patricia Keeling:

The preceding plant list contains several misspellings and factual errors. Most important, Penstemon albomarginatus and Oxytheca luteola are identified as rare plants, yet these species are not considered to be rare by the California Native Plant Society, the Fish and Wildlife Service, or the State of California. Also, some of the scientific names on the list are outdated and no longer used by professional botanists. The following is a list of corrections to the Keeling List (All Latin should be underlined or italicized).

#	Common Name	
	Pricky Poppy	Argemone corymbosa
368	Dune Primrose	Oenothera deltoides
101	Desert Holly	Atiplex hymenelytra
333	Small-flowered Blazing Star	Mentzelia albicaulis
	Fremont Pincushion	Chaenactis Fremontii
172	Fringe Pod	Thysanocarpus curvipes eradiatus
	Spectacle Pod	Dithyraea californica
750	Desert Chicory	Rafinesquia neomexicana
	Sand Mat	Euphorbia polycarpa
678	Cheesebush	Hymenoclea salsola
757	Desert Dandelion	Malacothrix glabrata
	Wallace Eriophyllum	Eriophyllum wallacei
	Ground Cherry	Physalis crassifolia var. crassifolia
141	Little Gold Poppy	Eschscholzia minutiflora
140	Desert Gold Poppy	E. glyptosperma
371	Lg. White Desert Primrose	O. caespitosa
367	Lg. Yellow Desert Primrose	Oenothera primiveris
378	Heart Leaved Primrose	Camissonia cardiophylla
366	Yellow Cups	Camissonia brevipes
	Palmate-leaved Gourd	Cucurbita palmata
532	Narrow-leaved Box Thorn	Lycium andersonii
531	Thornbush	Lycium andersonii spp. deserticola
132	Frost Mat	Achyronychia cooperi
451	Fremont Phacelia	Phacelia fremontii
440	Fat leaved Phacelia	P. distans (Wild Heliotrope)
159	Mustard Yellow	Descurainaia pinnata ssp. menziesii
159A	White (?)	D. pinnata spp. halictorum
165	Desert Alyssum	Lepidium fremontii
276	Broad-Leaf Stillingia	Stillingia spinulosa
77	Yellow-Spiny Cape	Oxytheca luteola
247	Big Podded Locoweed	Astragalus oophorus
123	Windmills	Allionia incarnata
733	Chinch Weed	Pectis papposa

#	Common Name	Latin Name
746	Mojave Thistle	Cirsium mohavenese
691	Coreopsis	Coreopsis bigelovii
687	Brittle Bush	Encelia farinosa
686	Acton Encelia	Encelia actoni
688	Rayless Encelia	E. fruitescens
697	Wooly Marigold	Baileya pleniradiata
481	Broad Nutted Comb-Bar	Pectocarya platycarpa
70	Spiny-Herb	Chorizanthe rigida
	Creosote Bush	Larrea tridentata
	Fiddle Neck	Amsinckia vernicosa
212	Desert Cassia	Cassia armata
198	Mesquite	Prosopis glandulosa (var. Torreyana)
344	Beavertail Cactus	Opuntia basilaris
228	White Ratany	Krameria grayi
307	Desert Mallow	Sphaeralcea ambigua (ssp. ambigua)
306	Desert Five-Spot	Eremalche rotundifolia
704	Spanish Needle	Palafoxia linearis
639	Desert Aster	Aster tortifolia
241	Mohave Locoweed	Astragalus mohavensis (var. mohavensis)
541	Desert Tobacco	Nicotiana trigonophylla
421	Davy Gilia	Gilia latiflora (var. davyi)
429	Desert Calico	Langloisia matthewsii
428	Pink-Spotted Gilia	Linanthus maculatus
461	Purple Mat	Nama demissum (Var. demissum)
480	Arched-Nutted Comb-Bur	Pectocarya recurvata
590	Pursh Plantain	Plantago purshii (var. oblonga)
592	Wooly Plaintain	Plantago insularis
673	Woolly-Fruited Bursage	Ambrosia eriocentra
68	Xantus Spiny-Herb	Chorizanthe xanti (ssp. leucotheca)
143	Blunt-Leaf Stinkweed	Cleomella obstusifolia
119	Sand Verbena	Abronia villosa
18	Muilla	Muilla coronata
	Desert Gilia	Eriastrum eremicum
277	Desert Croton	Croton californicus (var. mohavensis)
406	Purple Climing Milkweed	Sarcostemma hirtellum
157	Long-Beaked Twist Flower	Strepthanthella longirostris
489	Purple-Rooted F-G-M-N	Cryptantha micrantha (ssp. micrantha)
491	Flexnous F-G-M-N	Cryptantha dumetorum
375	Br. Eyed Susan	Camissonia claviformis (ssp. claviformis)
365	Woody Bottlewasher	Camissonia boothii (var. desertorum)
755	Snakes Head	Malacothrix coulteri

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WESTERN REGION
P. O. BOX 92007, WORLDWAY POSTAL CENTER
LOS ANGELES, CALIFORNIA 90009

May 1, 1980

Bureau of Land Management
Riverside District Office
U. S. Department of the Interior
1695 Spruce Street
Riverside, California 92507

Gentlemen:

We have reviewed the draft environmental assessment for the proposed non-competitive geothermal leasing/sodium prospecting permits in the Pisgah Crater Area of San Bernardino County.

The only concern which we have identified at this time is the lack of addressing obstructions to navigation. It is recommended that you include in the assessment the affect of transmission lines upon navigable airspace. Federal Air Regulation (FAR) Part 77 provides guidance for addressing this issue.

Royal W. Mink

ROYAL W. MINK
Regional Planning and
Appraisal Officer

Bureau of Land Management response to comments from:

Department of Transportation
Federal Aviation Administration
Western Region
P.O. Box 92007
Los Angeles, CA 90009

Comment #	Reponse
1	Navigible airspace will not be affected by possible transmission line construction. The area already possesses several transmission lines. Transmission lines from a geothermal power plant in this area will be, at most, a few miles in length to connect with the utility corridor, as proposed by the Desert Plan for each alternative.

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS
Sacramento Area Office
2800 Cottage Way
Sacramento, California 95825

Natural Resources

MAY 7 1980

Area Manager (C-069)
Cima Resource Area
Bureau of Land Management
P. O. Box 305
Needles, California 92363

Dear Sir:

We have reviewed the Draft Environmental Assessment Record for Proposed Non-Competetive Geothermal Leasing/Sodium Prospecting Permits in the Pisgah Crater Area, San Bernardino County, California, and found no Indian lands under the jurisdiction of this office are involved.

Sincerely,

Eddie V. Edwards

FOR William E. Finale
Area Director

Jim Williams

SAN BERNARDINO COUNTY MUSEUM
2024 Orange Tree Lane · Redlands, CA 92373 · (714) 792-1334 & 825-4825

County of San Bernardino
GERALD A. SMITH
Director, County Museums

BLM/Cima
Resource Area
RECEIVED
MAY 13 1980

May 8, 1980

Dick Crowe, Area Manager ((C-069)
Cima Resource Area
Bureau of Land Management
P.O. Box 305
Needles, CA 92363

Dear Mr. Crowe,

The Draft E.A.R. for geothermal and sodium prospecting in the Pisgah Crater area of San Bernardino County does not adequately address the potential for impacts to significant non-renewable vertebrate fossils which might be located in Quaternary sediments within the area of proposed prospecting.

The extent of paleontologic remains is as yet unknown because there has been no intensive inventory or data retrieval program. The potential for paleontologic remains is high in Pleistocene lacustrine sediments in the area. The Pleistocene older alluvium and fanglomerate in the area has an unspecified potential for containing paleontologic remains.

When such potentials exist on County supervised lands or Forest Service lands, specific measures for mitigation are required.

1. A preproject survey is necessary to determine whether sediments with an unspecified potential can be evaluated as having a low or high potential for the presence of vertebrate fossils.
2. Sediments having a high potential for the presence of paleontologic remains need preconstruction survey and salvage and a qualified paleontologic monitor during construction which includes grading, excavation, and augering, but not necessarily drilling.

I am surprised that adequate evaluation of the paleontologic potential was omitted from the writing of this report since I did help Chris Hardaker prepare the preliminary draft. If you need further information or assistance, please feel free to contact me at the County Museum.

Sincerely,

Robert E. Reynolds
Curator, Earth Sciences

RER/jr

Bureau of Land Management response to comments from:

San Bernardino County Museum
2024 Orange Tree Lane
Redlands, CA 92373

Comment #	Response
1	The text has been revised to state that a high potential exists for finding paleontologic remains along the fault lines and in Pleistocene lacustrine sediments in the EAR area. In addition, a mitigation measure was added which states that a qualified paleontologist will survey and salvage those areas to be disturbed which have been identified as high potential sites for paleontologic remains.

Jim Williams

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2711
LOS ANGELES, CALIFORNIA 90053

SPLED-E

9 May 1980

Area Manager (C-069)
Cima Resource Area
Bureau of Land Management
P.O. Box 305
Needles, California 92363

Dear Sir:

This is in response to a letter from the Riverside District Office of the Bureau of Land Management dated 21 April 1980. The cited letter requested review and comments for the Draft Environmental Assessment Record for Proposed Non-Competitive Geothermal Leasing/ Sodium Prospecting Permits in the Pisgah Crater Area, San Bernardino County, California.

The study area (Pisgah Crater) is located about 50 miles northeast and downstream of Mojave Dam which is owned and maintained by the Corps of Engineers. We believe that the proposed geothermal permit program will not have any effect on the flood control facility at Mojave Dam.

Thank you for the opportunity to review and comment on this document.

Sincerely,

Robert L Hall

NORMAN ARNO
Chief, Engineering Division

May 17, 1980

Area Manager (C-069)
Cima Resource Area
Bureau of Land Management
P.O. Box 305
Needles, California 92363

Dear Sir:

We understand from the draft Environmental Assessment Record dated April 21, 1980, that lease applications for geothermal and sodium exploitation have been filed on lands near Pisgah Crater. This area is of particular interest to us because of caves that are located in the lava flows of Pisgah.

The Southern California Grotto, formed more than thirty years ago, is a local chapter of the National Speleological Society. As members of the National Speleological Society we share a common interest in pursuing the conservation, study, and exploration of caves. California generally is cave-poor compared to various other parts of the country, making the numerous lava caves of Pisgah unique in the Southern California area. The caves at Pisgah are worthy of special management consideration in order to provide for their protection.

Careful consideration of the impacts on caves should be made at every step of geothermal exploration and use. In order to assure the future existence and values of caves at Pisgah, we feel that the Pisgah area needs an active and coherent long term cave management policy.

Sincerely,

Vance Nelson

Vance Nelson, Chairman
Southern California Grotto
1828 Alpha Avenue
South Pasadena, CA 91030

Bureau of Land Management response to comments from:

Southern California Grotto
1828 Alpha Avenue
South Pasadena, CA 91030

Comment #	Response
1	Areas of the flow known to contain lava tubes have been recommended for no surface occupancy (Chapter IV - Mitigating Measures). This action will protect these sensitive features from disturbance or destruction due to geothermal activities. Lava tubes or caves which are discovered in other areas of the flow can be preserved by on-site mitigations during field examinations of the lessee's plan of operations.

United States Department of the Interior
WATER AND POWER RESOURCES SERVICE
~~BUREAU OF RECLAMATION~~
LOWER COLORADO REGIONAL OFFICE
P.O. BOX 427
BOULDER CITY, NEVADA 89005

IN REPLY
REFER TO: LC-159
120.3

MAY 19 1980

Memorandum

To: Area Manager (C-069), Cima Resource Area, Bureau of Land Management, P. O. Box 305, Needles, California 92363

From: Regional Environmental Officer

Subject: Draft Environmental Assessment Record for Proposed Non-Competitive Geothermal Leasing/Sodium Prospecting Permits in the Pisgah Crater Area, San Bernardino County, California (your memorandum dated April 21, 1980)

We have reviewed the draft Environmental Assessment Record and have no comments to offer.

Thank you for the opportunity to review the document.

DEPARTMENT OF FISH AND GAME
350 Golden Shore
Long Beach, CA 90802
(213) 590-5113

May 19, 1980

Dick Crowe
Area Manager (C-069)
Cima Resource Area
Bureau of Land Management
P.O. Box 305
Needles, CA 92363

Dear Mr. Crowe:

We have reviewed the Draft EAR for Proposed Non-Competitive Geothermal Leasing/ Sodium Prospecting Permits in the Pisgah Crater Area, San Bernardino County and offer the following comments for your consideration.

The mitigation measures which appear on pages 37, 38, and 39 are satisfactory to protect the biological resources which may be affected by the geothermal aspects of this activity. However, should a sodium deposit be located which is considered worthy of development, additional measures to protect wildlife should be required. Our past experiences with solar evaporation ponds in the Searles Lake and Amboy areas revealed that some problems occur involving wildlife losses. These losses have been primarily to waterfowl and other water oriented birds. The losses occur from actual contact with the concentrated brines, which causes salt crystals to form on the feathers to the point that the birds cannot fly, swim, or walk and eventually die. If some of the brine is ingested the birds usually die from salt poisoning.

We recommend that provisions for protection from such wildlife losses should be included in the mitigation measures in Chapter IV. Fencing and covering the ponds could be quite costly depending on the size of the area. If fencing were used, it should be of non-metallic materials for durability.

The minimum requirement would be for providing some means of scaring birds away from the area and keeping them off the solar ponds. The use of propane scare guns has been tried in other areas and is effective until birds become accustomed to the noise. Firing is automatic and can be adjusted for different intervals. One listed supplier for these types of scare guns is:

Mark Schreiner
Route #7
Yakima, Washington Phone: 509-453-8560

Estimated Cost Per Unit: $100 (1970 dollars)

The physical presence of a patrolman in the ponds area can also aid in scaring away birds, but this method is not automatic or fully reliable.

This issue should be completely discussed and a contingency mitigation solution stated. The solution should be applied if wildlife losses occur. Also, all losses should be immediately reported to the Department of Fish and Game.

Thank you for the opportunity to review and comment on this proposal. If you have any questions, please contact Ronald E. Powell at our Blythe office, P.O. Box B-D, Blythe, CA 92225. The telephone number is (714) 922-5613.

Sincerely,

Bruce E. Eliason for

Fred A. Worthley Jr.
Regional Manager
Region 5

Bureau of Land Management response to comments from:

Department of Fish and Game
350 Golden Shore
Long Beach, CA 90802

Comment #	Response
1	The subject EAR involves sodium prospecting permits which will give the permittee the right to explore for sodium in the permit areas. The resource may be developed, which may involve solar pond construction, only under a preference right lease. The subject of specific mitigations for the protection of waterfowl from solar ponds will be addressed if and when the permittee determines and proves that a valuable sodium deposit exists in the area.

CORPORATION

4715 EAST FORT LOWELL ROAD TUCSON ARIZONA 85712

May 21, 1980

Area Manager
Cima Resource Area
Bureau of Land Management
P.O. Box 305
Needles, CA 92363

RE: Draft Environmental Assessment Record for Proposed Non-Competitive Geothermal Leasing/Sodium Prospecting Permits in the Pisgah Crater Area, San Bernardino County, California

Dear Sir:

Thank you for this opportunity to comment on the Draft Environmental Assessment Record for proposed geothermal leasing and sodium prospecting permits in the Pisgah Crater Area of California. After reviewing the Draft EAR and attending the public meeting in Barstow, California, I feel that your Final EAR should be modified with regards to the following issues.

Section I, D on page 7 of the Draft EAR states, "This exploration program has been in operation for nearly one year and, thus far, twelve holes have been drilled. On the basis of this drilling and additional evidence, Duval has determined that the area contains sodium deposits. Apparently, a brine reservoir exists at a depth of near 2,000 feet (610 meters) which contains commingled leasable and locatable minerals. Although the sodium is of secondary interest to Duval, the Company believes that it is prudent to obtain a permit for sodium chloride, in case commercial quantities are discovered."

I would like to emphasize that, at this time, Duval has not discovered any sodium deposit in this area. Colemanite deposits commonly contain sodium borate minerals and, therefore, it may be "prudent" to apply for sodium prospecting permits. In addition the sentence referring to a brine reservoir containing commingled minerals should be identified as a hypothesis being advanced by the Bureau of Land Management, rather than a conclusion arrived at by Duval. I would also request that the term "sodium chloride" be corrected to read "sodium minerals".

I am very concerned that Sections II. L and III. K, both relating to Land Use, failed to make mention of local planning and land use guidelines. The lands in question have, for the most part, been designated at M-2 zones by the San Bernardino County Planning Commission. This category provides for such uses as primary metal industries, mining and oil-well drilling. It should be mentioned that operations associated with Duval's permit application are compatible with this land use classification.

In reference to Section I.D.1. on page 8, the paragraph describing the production of a sodium resource should also be modified. As stated previously, Duval has not discovered sodium minerals in this area at this time and, hence, has not formulated a plan of operations for the extraction of sodium minerals. In the event that a valuable deposit of sodium minerals is discovered, Duval will, at that time, submit a plan for its development.

I hope that these comments will assist you in formulating the Final Environmental Assessment Record on this activity.

Sincerely,

DUVAL CORPORATION

R. G. Fleming
Landman

RGF:jlm

Bureau of Land Management response to comments from:

Duval Corporation
4715 East Fort Lowell Road
Tucson, Arizona 85712

Comment #	Resonse
1	The text has been revised in accordance with the suggestion by Duval.
2	A statement on San Bernardino County's land-use plans for this area has been included in the text.
3	The text has not been changed. The discussion concerning the production of a sodium resource presents a situation that may occur if a valuable sodium deposit is located and exploited by a company.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Conservation Division, MS 92
345 Middlefield Road
Menlo Park, CA 94025

MAY 2 1980

Mr. Richard Crowe, Area Manager
(C-069) Cima Resource Area
Bureau of Land Management
P.O. Box 305
Needles, California 92362

Dear Mr. Crowe:

Enclosed is a copy of our comments on the Draft Environmental Assessment Record for the proposed geothermal leasing and sodium prospecting permits in the Pisgah Crater Area, California.

If you have any questions concerning the comments, please contact Fran Firek of this office at FTS 467-2848.

4/15

Sincerely,

William F. Isherwood
Acting Deputy Conservation
Manager - Geothermal

Enclosure

Comments of Draft EAR for Proposed Non-Competitive Geothermal Leasing/Sodium Prospecting Permits in the Pisgah Crater Area, San Bernardino County, California

p. 2, para 4, line 1: We suggest rewording this sentence to read "this type of system" so as to not infer the Pisgah Crater system specifically is being discussed.

p. 4, para 6, line 7: Slim holes is not a generally accepted term for gradient holes, which usually do not exceed 2000 feet in depth.

p. 5, para 1, line 6: Tables 1-1 and 1-2 do not, in themselves, indicate 20% of the lease area may be disturbed. A sentence should be noted that perhaps 6 multi-well pads would be needed resulting in disturbance of about 15% of the land surface, perhaps as much as 20% in rough terrain.

p. 6, Table 1-1 and Table 1-2: In Table 1-1 the term "well" is used. This should be multi-well pad. It should be noted in both tables that the total figures for "Acres Disturbed" represent the total area disturbed not the non-reclaimable areas. Apparently the disposal pond refers to a sump, a source of disturbance which is included in the well pad area. This item might best be deleted.

p. 7, para 1: Which mining laws are applicable here? Do mining exploration plans conflict with geothermal regulations?

p. 10, Figure 2-1: The small index map used in p. 3 would also be helpful in this map. Credit should be given for the geology. Was the legend derived from actual field experience, or was this information from another person's work?

p. 12, #4, Geologic Hazards: Can this section be expanded to be more specific? For example, how likely is the area to have flash floods and remove large quantities of soil, sediment, etc? What is the probability of slumping after development of the field?

p. 12, para 6: Since flash flooding is a potential hazard, please give maximum 24-hour rainfall intensities along with annual totals.

p. 13, para 5: Since groundwater flows often parallel surface topography, the geologic map (figure 2-1) suggests ground water flow would move to the southeast towards Lavic Lake. Is the flow really toward the northwest as stated, rather than from the northwest?

p. 13, para 7: Coverage of this subject is not very detailed. Since water analyses have been completed, please list the chemical composition of ground water on the east and west sides of Pisgah Fault.

p. 16, para 4: Is an air monitoring station, 30 miles from the EAR area, sufficiently close to use results?

p. 16, para 9: Reference is made throughout to specific activities that will add to ambient noise levels, but no decibel level is ever mentioned. What will geothermal do to the existing noise levels?

p. 17, Table 2-1: This material is dated 1974. Are the air quality standards the same now? EPA has been reviewing some of these values in the past 2-3 years.

p. 18, para 2: Little is reported on expected wildlife population densities, and the accounts of song birds, reptiles, small and large mammals, are very brief. The plant section is also inadequate. The data would not meet environmental baseline needs if a resource is found and developed. Therefore, we recommend that the BLM run some plant and animal transects, and capitalizing on the work at Coso KGRA by comparing the results with the large data base summarized in the Coso EIS.

p. 19, Figure 2-3: No legend is given for the patterns on the map. This figure is consequently very confusing. The title mentions four wildlife species and the names of these species are never referred to clearly in the text or figure.

p. 20, para 2: The introduction to this section states no threatened or endangered species inhabit the study area, yet in this paragraph several raptor species, the legally protected Goldgen Eagle, are listed as inhabiting the study area. What is the density of these species' populations throughout the year, and does nesting occur in the study area or vicinity?

p. 21, para 7: Please include a list of the scenic quality values (for example "B" and "C" are used) which define the various categories.

p. 29, para 1: This paragraph gives the impression that no geothermal laws are in effect. However, the Geothermal Steam Act of 1970, associated regulations, and Geothermal Resource Operatons Orders (GRO Orders) have stipulations to protect the environment. In addition the EPA is preparing regulations under the Safe Drinking Water Act and the Resource Conservation and Recovery Act which will also insure precautions against seepage from the well sump, etc.

If cooling water for a power plant is obtained from sources outside the study area, what impacts would this have on local water sources?

p. 29, para 2: The 10% figure for disturbed land during leasing is reasonable but inconsistent with the figures given on page 5. A range of 10 - 15% might be used here.

p. 30, para 2: The discussion of the impact to global climatology is overstated for this proposal, especially since it is stated geothermal activities will not impact the regional climate. In any event, the CO_2 release per MW of electric power is much less than would be the case with either oil or coal, both of which are hydrocarbon fuels.

p. 31, para 1: The figure of 0.25 to 1 acre of vegetation per drill pad is valid for shallow temperature gradient holes. If the well is for deep exploration, then 2.5 - 3 acres is typical.

p. 31, para 1, line 5: This area is "totally destroyed" for the duration of of the project, which would be a few decades if a productive 3 resource is found. However, reclamation activities will be required upon abandonment. This sentence needs to be modified to make this clear.

p. 32, para 2: "Displaced" animals usually die.

p. 32, para 3: Experience has shown that pipelines, especially when above ground, do not limit movement patterns of animals. Typically the pipelines are about three feet off the ground, and mitigation measures are feasible if this is deemed inadequate.

p. 33, para 4: How much area will be disturbed if both geothermal and sodium leases are let? A discussion is needed of how sodium activities may restrict geothermal and visa versa. Will one commodity have priority over the other?

p. 38, #5: This would be appropriate as a lease stipulation.

p. 38, para 6: What is meant by "spent" geothermal fluids? Injection of fluids released from a power plant would be required to protect the Federal geothermal resource, but injection of fluids from a well flow test would not be practical. Fluids from well tests are usually allowed to evaporate. (The sump is typically, fenced during this period to reduce hazard to livestock and wildlife).

p. 41, section G: Will this occur even with mitigation? Is the reader to assume this whole section makes the assumption that there are no existing laws for geothermal? Earlier in the document it is stated that geothermal development will meet VRM requirements. This should be clarified for the reader.

p. 41, section I: Does this conflict, or will it conflict with final results of the California Desert Conservation Area EIS? Also, it seems a bit strongly worded, we suggest it read "...restricted, and some may be precluded during the life of the geothermal 4 activities". We are unsure, however, just what would be precluded.

p. 44, para 7: This paragraph is very vague. This section should be strengthened with more specific comments. Which species and what time periods are involved?

p. 48, para 1: It may be feasible to make the more significant geologic features, such as lava flows and tubes, non-surface occupancy areas? If the features of interest are sufficiently localized, this could meet public concerns without significantly inhibiting development. If the features are very widespread, we could be happy to explore other ideas with respect to accomodating these concerns.

Bureau of Land Management response to significant comments from:

U.S. Geolgical Survey, USDI
Conservation Division, MS 92
343 Middlefield Rd.
Menlo Park, CA 94025

Comment	Response
P. 4, Paragraph 6, Line 7	"Slim holes" will be retained as the term indicates small-diameter holes.
P. 10, Figure 2-1	Credit given for geology.
P. 13, Paragraph 5	Ground water gradients generally conform to the regional slope of the land; however, the gradients are reversed in this area due to pumping from ground water in storage (California Dept. of Water Resources, 1967).
P. 16, Paragraph 4	The Barstow station is the closest to the EAR area.
P. 16, Paragraph 9	Decibel level is given in Appendix A.
P. 17, Table 2-1	Air quality standards have not changed significantly in this area since 1974.
P. 19, Figure 2-3	A legend is given for this map.
P. 20, Paragraph 2	Nesting in the study area is shown on Fig. 2-3; Mitigating measure #8 will provide sufficient protection for this species.
P. 29, Paragraph 1	Text revised; Quantitative impacts to local water sources are discussed.
P. 29, Paragraph 2	Text revised as suggested.
P. 31, Paragraph 1	Text revised for clarity as suggested.
P. 31, Paragraph 1, Line 5	Sentence modified as suggested.

U.S. Geological Survey, USDI

Comment	Response
P. 33, Paragraph 4	The Multiple Mineral Development Act of 1954 was enacted to provide for the operation of various types of mineral leasing on the same tracts of public land. The lessees will develop an agreement which allows for such simultaneous operations on these lands (Chapter IV).
P. 38, #5	The mitigation measures listed in Chapter IV (B) will be included as lease stipulations.
P. 38 #6	"Spent" geothermal fluids are geothermal fluids which have passed through turbine/condenser system of a power plant.
P. 41, Section G	The sentence has been modified to state that changes in the basic elements may occur which may not meet VRM requirements.
P. 44, Paragraph 7	It is virtually impossible to be precise without knowing the location and degree of development activities.
P. 48, Paragraph 1	Flow areas containing lava tubes have been recommended for no surface occupancy; exploration and development within other basalt flow areas will be by methods least damaging to the flow (Chapter IV).

The following is a list of additional significant changes made to the Draft EAR as a result of conversations with the public and BLM personnel involved with the EAR (page numbers refer to the Draft EAR).

LIST OF FIGURES

Page iv - Delete Figure Numbers 3-1 and 3-2 and corresponding headings.

Remaining figures made more legible by enlarging section numbers and indicating Pisgah Crater.

1. INTRODUCTION AND DESCRIPTION OF THE PROPOSED ACTION
   B. Background

   Page 2 - Change first sentence of the second paragraph to indicate correct filing date of geothermal lease applications.

II DESCRIPTION OF THE EXISTING ENVIRONMENT

   L. Land Use

   Page 26 - Add a paragraph concerning land use for the study area as envisioned by the California Desert Plan.

III ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

   B. Geology

   Page 28 - Add a paragraph explaining potential impacts to the lava flow near Pisgah Crater.

   G. Vegetation and Wildlife

      1. Vegetation

      Page 31 - Add the following paragraph: Impacts to the ecologically sensitive area can be substantially reduced or prevented by entirely avoiding this area and/or developing site-specific mitigation measures which the lessee must follow in the plan of operations as submitted to the GS.

   H. Visual Resources

   Page 32 - For clarity, delete second paragraph and add sections on visual impacts expected from geothermal and sodium exploration and development.

   Page 34 and 35 - Remove Figures 3-1 and 3-2 because figures suggest inflexibility in the management of the visual resource with respect to the proposed actions in this area.

J. Paleontology

Page 33 - Delete sentence and replace with the following: Impact to paleontological resources are expected to be similar to that of cultural resources.

IV MITIGATING MEASURES

Pages 37 to 39 -

B. Recommended Mitigating Measures

Mitigating Measures (MM) 15 - Delete as this is provided for in GRO Orders

MM's 1, 2, 11, 12, 13, 14 - Add statement indicating that the measure applies only to sodium permits; GRO Orders or Section 18 of the geothermal lease (dealing with archaeology) provide protection to appropriate resources from geo thermal activities.

MM 11 - Modify to state that all areas to be disturbed shall undergo a Class III inventory.

MM 13 - Add a sentence stating that if avoidance of a cultural site is not possible, a data retrieval program shall be conducted utilizing methods approved by the BLM and SHPO.

MM 4 - Add sentence stating that this measure applies only to geothermal leases.

MM 5 - Modify to reflect precise legal subdivision of the sensitive area; "ecologically sensitive" area is explained.

MM 6 - Change to give precise area of no-surface occupancy.

Add the following four mitigating measures:

1. In those areas where geothermal and sodium leases/permits overlap or where a geothermal and/or sodium lease/permit overlaps a valid mining claim, the lessee and permittee shall formulate an agreement among themselves and/or with the holder of any such valid claim, whichever the case, which allows for simultaneous operations on those lands. Such aggreement is to be acceptable to the BLM and is to be prepared prior to any surface-disturbing activities in those areas of overlap.

2. Surface occupancy will not be permitted on the E½ of Section 28, T. 8 N., R. 6 E., for the protection of lava features for recreational uses and scientific study. This area contains numerous basalt lava tubes and caves which are visited year round by university and private groups. The tubes and associated basalt flows provide unique opportunities for various scientific investigations and cave exploration (applies only to CA1028).

3. A qualified paleontologist, acceptable to the BLM, will be engaged by the lessee to conduct a survey and salvage program of areas to be disturbed which contain sediments with a high potential for paleontologic remains.

4. Drill pads will be designed to have irregularly shaped or curvilinear boundaries to enhance visual quality of the area (applies only to sodium permits; GRO Orders provide for this).

V. UNAVOIDABLE ADVERSE IMPACTS

B. Geology

Page 40 - Add the following sentence: Some damage to the lava flow may occur as a result of exploration and development activities.

VI. RELATIONSHIP BETWEEN LOCAL SHORT-TERM USE OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

B. Geology

Page 42 - Add the following sentence: A short and long-term impact would be the possible destruction of portions of the lava flow due to exploration and development activities, which may result in the loss of information regarding the geology of the basalt flow.

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

B. Geology

Page 44 - Add the sentence: Damage to the basalt flow may involve an irretrievable loss of geologic information.

VIII. ALTERNATIVES TO THE PROPOSED ACTION

A. Introduction

Page 46 - Add a paragraph explaining that no surface occupancy is recommended for the ecologically sensitive area, the area within one mile of bighorn sheep habitat, and the sensitive area for geology and recreation; however, casual use activities are permissible in these areas.

IX. CONSULTATION AND COORDINATION

Page 47 - Section revised to state that a public meeting and review period were provided. Major comments received during the public meeting are noted. A list of those persons, groups, and governmental agencies which were sent a copy of the Draft EAR is also presented.

X. INTENSITY OF PUBLIC INTEREST

Page 48 - Section modified as follows: BLM informational material concerning the Pisgah Crater EAR which was sent to the public is presented. Public correspondence received during the public review period and BLM responses comprise a major portion of this section. Additional significant changes to the Draft EAR, as a result of conversations with the public and BLM personnel involved in preparing the document, are noted as well.

Appendix B

Impact and Mitigation

Summary Table

Pages 61 to 64 -

Mitigation Measure numbers (MM#) changed to reflect the additional mitigation measures.

Page 61 -

Line added to Geology section indicating a potential impact to the lava flow with a mitigation measure.

Page 64 -

Line added to Paleontology section indicating potential impact to paleontologic resources with a mitigation measure; a Wilderness Section is added explaining the potential impact to wilderness values with a mitigating measure.

XI. PARTICIPATING STAFF

Jim Williams, Team Leader, Geology/Hydrology

John Adams, Soils

John Bailey, Outdoor Recreation - VRM/Wilderness

Jim Bicket, Biology

Ruth Musser, Archaeology

Chris Hardaker, Archaeology

Mariana Taylor, Native American Concerns/Socio-Economics

Frank Sierra, Illustrator

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APPENDIX A

GEOTHERMAL RESOURCE DEVELOPMENT STAGES

The following discussion outlines the stages and activities which may result during the exploration and development of geothermal resources. Variations may occur and all or only some of the activities of any one stage may be carried out, depending on the success of each preceding activity. The discussion is modified from Raschen and Cook (1976).

1. Preliminary Exploration Stage

Initial exploration activities include a literature search, broad geologic studies, aerial photography or imagery, and airborne magnetic surveys. These investigations are not surface oriented, thus there is no impact on the region.

A geological mapping program and geochemical studies (water sampling and soil/rock analysis) may be conducted as well. Data is generally gathered on foot with some ORV use. These activities are considered casual use and result in no surface disturbance. When performed on public land, no lease or permit is required.

More intensive exploration methods (all of which require prior approval) include various geophysical techniques ranging from gravity, magnetic, and resistivity surveys to drilling shallow seismic and temperature gradient holes.

Most of the above activities involve crews of two or three people and small trucks for transportation of the crew and truck-mounted and hand-held equipment. Existing roads within the study area probably could accommodate most of the activities. Exceptions are the active seismic and temperature gradient studies which generally require temporary access roads and a clearing of 30 feet by 30 feet (10 meters by 10 meters) for the drill site. In addition, the latter investigations typically involve 10-15 people and 5-7 small trucks. A short discussion of these activities is given below.

In active seismic studies, information is obtained about a substratum's composition and structure. Elastic shock waves are artificially generated at a specific point. The waves are then reflected from various subsurface interfaces and detected by a system of geophones on the surface.

Such waves may be produced by one of three methods: (1) Vibration method - 4 or 5 truck-mounted vibrators operate in unison; (2) Thumping method - heavy weights are dropped to the ground from trucks (the geophone arrangement remains unchanged while the trucks move from station to station; weights may range from 300 pounds mounted on a 3/4-ton pickup to very heavy units mounted on 5-ton trucks); (3) Explosive method - a small truck-mounted rotary drill is used to drill shallow (several hundred feet), 3-5 inch (8-13 centimeters) diameter holes spaced up to .5 mile (.8 kilometer) apart. Water and gel are generally used as the circulating medium and portable metal mud pans are common. The drilled shot hole is loaded with several pounds of explosives and filled with water. The explosive is then detonated, the water blown out of the hole, and shock waves are propagated through the substratum. Geophones arranged in a specific pattern around the hole detect the resulting waves.

Shallow temperature holes are utilized to measure thermal gradients. Usually, the holes are no deeper than 500 feet (150 meters) using the methods described above for seismic shot holes. Upon completion, a one-inch (2.5 centimeters) diameter tube is placed in the hole, the hole is filled with water, capped, and left undisturbed for about a week. Thermal gradients can be established by measuring the temperature at various depths using a temperature recording device. Initial hole spacing is 2-5 miles (3-8 kilometers) apart but is reduced as exploration progresses.

Observation holes may also be drilled to obtain more information on the subsurface geology before selecting the final location for a deep exploratory well. These holes may be 2500 feet (750 meters) or deeper and 6½ to 7½ inches (15½ to 19 centimeters) in diameter. A surface area of about 40 X 60 feet (12 X 18 meters) may be cleared and a 3-6 feet (1-2 meters) deep mud pit constructed with a bulldozer. This operation may involve three crews of three people each and intermittent vehicular traffic on existing or temporary access roads. Typically, drilling is completed within two weeks.

2. Exploration Drilling Stage

This stage involves drilling deep geological information or exploratory wells and test flow operations. Large drill equipment is needed for reaching depths of 10,000 feet (3048 meters) or more.

(a) Road Construction

At this point, roads are of much better quality than the temporary roads required for some of the earlier phases of exploration. They are designed to carry heavier loads, withstand a more constant traffic burden, and function year-round, if necessary.

Surfacing with rock, gravel, volcanic cinders, or mixing oil with the soil may be used to achieve a high-quality road. In hilly terrain, cut-and-fill construction may be required and means for surface water runoff will need to be provided.

(b) Drill Pad Construction

A drill pad is an area which is leveled and cleared of vegetation. The pad must be large enough to accommodate the drilling rig and accessories, temporary structures, and crew parking. The required surface, including the drill sump, varies from less than one acre to 2.5 acres (.4 to 1 hectare). In hilly areas, cut-and-fill techniques may be employed in pad construction. Rock or gravel may be used where vehicle or foot traffic is heavy.

(c) Sump Construction

A reserve pit, called a "sump", is required for the containment of waste fluids and drill cuttings. The size of the sump depends on the anticipated depth of the hole, therefore the surface can range from less than a hundred to several thousand square feet (several hundred square meters) and the depth from five to ten feet (1.5 to 3 meters) or more.

As the sump is designed to contain fluids, the bottom and sides are lined with an impervious material. The sump is positioned about 35 feet (11 meters) from the drill hole and, thus, is favorably located adjacent to the drilling rig. In a developing field, the same sump may be used for drilling several development wells.

After the road, drill pad, and sump are completed, a 26 to 36-inch (65 to 90 centimeters) diameter hole is drilled with an auger to a depth of 50 to 100 feet (15 to 30 meters). A 20 to 30-inch (45 to 75 centimeters) diameter conductor pipe is inserted and cemented to the surface.

(d) Drilling Procedures

Drilling equipment, technology, and methods are similar to those employed in oil and gas operations. A detailed discussion of drilling procedures may be found in the document by Raschen and Cook (1976). The largest piece of equipment used during the drilling of an exploratory or development well is the drill rig,

which may stand well over 100 feet (30 meters) high. The drilling assembly is composed of a variety of accessories, which may include: (1) mud tanks measuring approximately 40 X 8 X 6 feet (12 X 2 X 2 meters) for mixing and/or storing drilling mud; (2) blowout prevention equipment; (3) air compressors for air drilling; (4) a pipe rack for storing pipe, generally thousands of feet in 30 feet (9 meters) segments; (5) mud pumps; (6) 500 to 1000 horsepower engines; (7) a cooling tower up to 30 feet (9 meters) tall used for cooling the drilling mud during the later stages of drilling; (8) fuel tanks; and (9) water tanks.

Also, several temporary structures, such as office and storage buildings and/or trailers, need to be located near the drill site.

Both "permanent" or rig and "temporary" or service personnel are associated with a drilling rig. The total number of rig personnel ranges from 17 to 22 and service personnel from 10 to 15. However, the maximum number of persons expected on the site at any one time should be no more than five to ten.

The drilling process itself may range from 12 to 50 days or more, depending on several variables. The rotary method is most commonly used and requires a changeable drill bit, drill pipe, and drilling mud or air as a circulation method.

In mud drilling, the mud is pumped down through the drill pipe, exits through jets in the drill bit, and travels up the space between the drill bit, and travels up the space between the drill pipe and the hole. The mud is directed to the sump pits and from there may be pumped for recirculation back into the hole. About 500 to 1000 barrels of water per day will be used in drilling a well with water.

Drilling mud serves several purposes:

(a) Transporting drill cuttings to the surface
(b) Controlling rock formation pressures
(c) Maintaining borehole stability
(d) Protecting productive formations
(e) Protecting against corrosion
(f) Cooling and lubricating the bit and drill string

In air drilling, the same basic functions, as listed above, are fulfilled with some exceptions. There is no effective weight to the column of air, so it does not control formation pressures. However, this is usually no problem as the rock is typically hard and impermeable.

Because particulate matter is "blown" out of the hole during this process, equipment is installed to divert the dust, steam, and air to the sump. A small amount of silty material may settle onto the immediate vicinity of the drill site.

Noise levels during air drilling may approach 125 db (decibels). This drilling phase lasts from one to three weeks.

When drilling is completed, the geothermal well is tested for production by allowing the well to flow to the surface and gauging the volumes and temperatures of effluents. Flow is directed to the sump, through a series of mufflers, or under water to further reduce the noise. This flow is composed of fluids and noncondensible gases. The testing phase lasts generally for two to three days.

It is difficult to estimate the quantities of fluids that may need disposal. Assuming an electrical model, the number of wells per power plant would vary according to well temperatures and reservoir characteristics. It may be reasonable to assume 10 to 20 wells for a 55 MW plant, with a spacing of one well per 20 to 40 acres (8 to 16 hecatares). As for non-electrical applications, the amount of fluids for disposal will be increased because these methods utilize the liquid form of the geothermal resource whereas electrical production uses the high temperature steam.

Depending on the depth and type of hole drilled, formations encountered, and other factors, various schemes of abandoning a hole are utilized. These techniques involve filling the well bore with certain quantities of drilling mud, cement, cement plugs, and casing. All equipment, structures, and refuse are removed and the site is graded.

3. Field Development Stage

This phase depends on successful exploration drilling. The power plant, pipelines, and transmission lines will be constructed and connected by a series of access roads. Exploration will continue during this stage in an effort to determine the extent of the resource.

(a) Powerplant Construction

The first phase in plant construction is the selection of a site. The site selected is generally fixed by the location of the geothermal wells. Legal boundaries, the available surface, and engineering hazards such as slope stability are factors that affect the selected site.

The typical plant site occupies from two to five acres (1 to 2 hectares). Rarely, up to ten acres (4 hectares) may be utilized, including parking facilities, tool storage buildings, etc.

A power plant will consist essentially of a turbine generator, steam condenser, and cooling towers.

(b) Pipeline Construction

After plant construction, pipelines are run from each well to the plant and then from the plant to an injection well, creating a surface network of pipes. Pipes about 20 inches (45 centimeters) in diameter are connected at intervals with expansion loops. The size of the network will depend on the number of wells required to power the steam turbine. A typical well will have a productive capability of three to five MW. These pipes will carry geothermal fluid at a temperature above 200-400° F (93-204°C) and pressures no greater than 200 pounds per square inch.

(c) Transmission Line Construction

To transport the electrical power which is generated, it is necessary to use transmission lines and towers. The towers occupy a surface area of probably not more than 400 square feet (36 square meters) each on 90 feet (27 meters) rights-of-way.

4. Production and Operation Stage

By this phase of the operation, all facilities have been erected. Therefore, no additional impacts are created directly from construction activities. Some noise, noxious gases, and toxic elements in the geothermal waters will continue, although to a lesser degree than during the testing phase. During the production and operation stage, activities consist mainly of the operation and maintenance of the power plant and existing wells, drilling of new wells, waste disposal, and water utilization. Electrical energy generation may be expected to continue for many years.

Exploration and development are usually conducted in other parts of the geothermal field simultaneously with the production and operational activities.

Repair, maintenance, and monitoring of an operating field will require the periodic use of access roads.

During this stage, the disposal of spent fluids becomes most significant because of the volume needing disposal. Methods of disposal vary depending on the quality and quantity of effluent involved. Two disposal methods are by-product development, in which useful minerals are extracted from the geothermal fluids, and reinjection, in which excess water is reinjected into nonproductive zones of the geothermal field.

5. Closedown Stage

This stage consists essentially of site abandonment and would occur when the geothermal resource is depleted. Knowledge of geothermal reservoirs is not yet sufficient to predict the economic life span, but for the purposes of this EAR, 30 years is assumed. This time period is actually the steam plant amortization period.

The close-out stage includes the removal of all surface facilities, abandonment and capping of wells, and surface rehabilitation. Well abandonment and pad rehabilitation may occur during stages 2, 3, and 4, as well.

APPENDIX B

IMPACT AND MITIGATION SUMMARY TABLE
(assuming full development)

Resource (Chapter 2)	Impact (Chapter 3)	Mitigating Measure (Chapter 4 - "MM" refers to mitigating measures as listed in this chapter; "GRO" refers to Geothermal Resource Order)	Extent by which Mitigating Measures Reduces Impact	Residual Impact (Chapter 5)
Geology	Possible induced seismicity and/or subsidence	Reinjection of spent geothermal fluids (MM #10 and GRO #4)	Greatly reduced	Low possibility of induced seismicity and/or subsidence
	Damage to lava flow due to exploration and development activities	No road building, exploratory drilling, and development on lava flows in the vicinity of Pisgah Crater (MM #3)	Greatly reduced	None
Hydrology	Water consumption	None	Not Applicable (N/A)	Water not available for other uses
	Possible contamination of shallow ground water	GRO #4	Decrease possibility of contamination	Some accidental contamination is possible
Soils	Soil compaction	Vehicle travel will be avoided on areas other than permanent access roads when soil is wet (MM #5); minimize construction of new roads (GRO #4)	Soil compaction minimized	Some soil will still be compacted
	Soil destruction due to road, drill pad, solar pond construction	Stockpile topsoil for reclamation purposes and recontour/scarify disturbed sites (MM #17 and GRO #4)	Will help to restore soil to productive state	Some areas may never be fully restored

IMPACT AND MITIGATION SUMMARY TABLE
(Continued)

Resource (Chapter 2)	Impact (Chapter 3)	Mitigating Measure (Chapter 4 - "MM" refers to mitigating measures as listed in this chapter; "GRO" refers to Geothermal Resource Order)	Extent by which Mitigating Measures Reduces Impact	Residual Impact (Chapter 5)
	Water erosion of Soil	Install erosion devices (MM #1 GRO #4)	Water erosion of soils reduced	Some water erosion will occur in disturbed areas
	Wind erosion/increased dust	Sprinkle disturbed sites particularly roads (MM #4 and GRO Orders)	Decrease dust	Some increased dust is expected
	Soil sterilizaton	Use portable mud pits during exploration (MM #6)	Reduce some sterilization	Some soil sterilization will result
Climatology	None	N/A	N/A	N/A
Air Quality	Escape of non-condensible gases	Applicable air quality laws	Conformability to state standards	Some reduction in air quality, presence of odor
Noise	Adverse impact on wildlife from increased noise levels	No surface disturbance in or near sensitve habitat (MM #7 and #8)	Will reduce impact to sensitive areas	Some wildlife may leave the area
	Impact on people	None	N/A	Insignificant
Vegetation and Wildlife	Construction of roads, parking lots, drill pads, sumps, ponds, pipelines, etc., will destroy or disturb vegetation and wildlife habitat.	No surface disturbance in or near sensitive habitat (MM #7 #8)	Reduce chances of impacting sensitive habitat	Some vegetation/wildlife habitats due to air and water-borne pollutants can occur

IMPACT AND MITIGATION SUMMARY TABLE
(Continued)

Resource (Chapter 2)	Impact (Chapter 3)	Mitigating Measure (Chapter 4 - "MM" refers to mitigating measures as listed in this chapter; "GRO" refers to Geothermal Resource Order)	Extent by which Mitigating Measures Reduces Impact	Residual Impact (Chapter 5)
		Screens or fences around sumps or ponds to protect wildlife (MM #9)	Most animals will not come into contact with toxic chemical	Small animals and birds may still enter the sumps or ponds
		Pipelines shall be constructed so as to allow for the mobility of small animals (MM #11)	Will help to maintain wildlife range and foraging areas	The range of animals may still be restricted
		Reclamation and revegetation (MM #17 and GRO #4)	Increase the chance of successful revegtation	Revegetation may be impossible in some areas
	Bird collisions with transmission lines	Follow guidelines of the Rural Electrification Bulletin (1975) and Raptor Research Foundation (1975) (MM #12)	Losses will be greatly reduced	Some losses will occur
Visual	Construction of roads, parking lots, drill pads, sumps, ponds, pipelines, buildings, form, line, color, and texture of landscape	Reclaim, recontour disturbed sites (MM #17 and GRO #4); permanent facilities located within the study area are to be painted so as to reduce visual contrast (GRO Orders); no road building, exploratory drilling, and development on the lava flows in vicinity of Pisgah Crater (MM #3)	Visual contrast will be reduced	Some changes in form, line, color, and texture will

IMPACT AND MITIGATION SUMMARY TABLE
(Continued)

Resource (Chapter 2)	Impact (Chapter 3)	Mitigating Measure (Chapter 4 - "MM" refers to mitigating measures as listed in this chapter; "GRO" refers to Geothermal Resource Order)	Extent by which Mitigating Measures Reduces Impact	Residual Impact (Chapter 5)
Cultural	Destruction of cultural sites and the archaeological context due to development activities, increased ORV use, etc.	Conduct an intensive cultural inventory and data retrieval program of areas to be disturbed by development, in advance of surface disturbance (Section 18 of lease form and MM #13)	Most sites will be found before damage occurs	Some sites may be totally destroyed
		Avoidance of known culural sites may be required by shifting development sites away from cultural sites (MM #15, Coop. Agreement WO-105, and Section 18 of lease form)	Damage to cultural resources avoided or reduced	Some damage may still occur
Paleontology	Destruction of possible paleontologic resources	Survey and salvage program by a paleontologist of areas to be disturbed which contain sediments with a high potential for paleontologic remains (MM #16); shift development sites away from identified paleontologic properties (MM #15)	Damage to paleontologic resources prevented or reduced	Some damage may occur
Land Use	Other uses of land restricted	None		Some lands uses may continue to be restricted
Socio-Economics	None	N/A		None
Wilderness	Impairment of wilderness values	MM #8 would effectively prevent entry into the wilderness study area	Impacts prevented	None