Occidental Geothermal, Inc.
OXY GEOTHERMAL
PLANT NO. 1

Final Environmental
Impact Report

MASTER

DECEMBER 1981

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CALIFORNIA
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Occidental Geothermal, Inc.
Oxy Geothermal Power Plant No. 1

FINAL
ENVIRONMENTAL IMPACT REPORT

Prepared by
California Energy Commission
1111 Howe Avenue
Sacramento, CA 95825

SUMMARY

PROJECT

POWER PLANT

On January 29, 1981, Occidental Geothermal, Inc., (Oxy) filed an Application for Certification (AFC) with the California Energy Commission (CEC). The Oxy AFC contains a proposal to construct an 80 megawatt (MW) geothermal power plant at the Geysers-Calistoga Known Geothermal Resource Area (KGRA). The power plant, Oxy Geothermal Plant No. 1, would be located in Lake County near the Sonoma County line. Its appearance and operation will be basically the same as other geothermal units in operation or under construction in the KGRA. Steam to run the power plant will come entirely from within the Oxy leasehold.

STEAM FIELD

Unlike most geothermal developments in the KGRA, Oxy will be both the steam supplier and the steam user (i.e., they will develop the steam field and run the power plant). Thus, Oxy has a great potential for coordinating steam field and power plant development to reflect environmental sensitivity. Development of the well field precedes the construction of the power plant. Permit authority and jurisdiction over Oxy's well field development lies with the United States Geological Survey (USGS), whereas CEC has the authority to certify construction of the power plant.

For environmental documentation on the development of the Oxy steam field, the reader may wish to consult the following documents, all of which are available either through the Ukiah District Bureau of Land Management Office or at the USGS office in Menlo Park. Address any requests for USGS material to USGS, Conservation Division, Deputy Conservation Manager for Geothermal, 345 Middlefield Road, M.S. 92, Menlo Park, CA 94025, (415) 323-8111 ext. 2841. Address requests for The Geysers Mineral Reserve Lands (Five Tracts) E.A.R. to the Bureau of Land Management, 555 Leslie Street, Ukiah, CA 95482, (707) 462-3873.

1. ENVIRONMENTAL ASSESSMENT 174-81--U.S. Department of the Interior, Geological Survey, Deputy Conservation Manager for Geothermal, Menlo Park, California--July 14, 1981.
2. THE GEYSERS MINERAL RESERVE LANDS (Five Tracts)--Proposed Geothermal Environmental Assessment Record (draft). U.S. Department of the Interior, Bureau of Land Management, Ukiah District, California--September 1978.
3. ENVIRONMENTAL ASSESSMENT 121-9 (Checklist Analysis)--U.S. Department of the Interior, Geological Survey Area, Geothermal Supervisors Office, Conservation Division, Menlo Park, California--July 1979.
4. ENVIRONMENTAL ASSESSMENT 131-81--U.S. Department of the Interior, Geological Survey, Area Geothermal Supervisors Office, Menlo Park, California--December 1980.

5. FINAL ENVIRONMENTAL ASSESSMENT 149-80--U.S. Department of the Interior, Geological Survey, Conservation Division, Menlo Park, California--August 1980.

Basically all of the environmental documentation indicates the sensitivity of placing a geothermal development at the top of a relatively fragile watershed, which provides both potable and recreational waters for the people in the town below. CEC staff shares this concern as discussed in the Hydrology/Water Quality and Public Health sections of the EIR.

PROJECT FEATURES

Air Emissions Abatement Systems

Historically, public concerns focus on the air pollution and odor caused by geothermal developments. The incoming geothermal steam supply contains a number of potentially toxic substances. Of these, hydrogen sulfide (H_2S) presents the greatest potential for adverse impacts from spent steam emissions. Unabated emissions of H_2S may produce an increasing number of localized complaints about odor and the potential for disagreeable physical reactions in sensitive public populations. Because of the current level of geothermal development at The Geysers, the cumulative effects of H_2S emissions have resulted in violations of the state standard for ambient H_2S at the populated areas nearest the proposed Oxy power plant, although H_2S violations have decreased in recent years.

Oxy proposes the Stretford chemical "scrubbing" process in combination with surface condensers as the primary air emissions abatement system. Additionally, Oxy will use a Hydrogen Peroxide (H_2O_2) condensate treatment system to further reduce emission of air pollutants.

To reduce "stacking" impacts, Oxy will employ turbine bypass devices on each of the generating units. Such design features allow the steam to bypass either or both turbines and enter the surface condenser directly, after which the Stretford and condensate treatment systems remove H_2S from the steam before it enters the atmosphere. If only one turbine is out of operation, the excess steam will go to the operating turbine to generate power.

Site Preparation

Preparation of a level site for the power plant and related facilities (including access road to the power plant) will require alteration of approximately 18.5 acres. Oxy intends to balance the cut and fill and will use any excess material either on the power plant site itself or on roads and well pads within the 550 acre leasehold. Construction of the proposed power plant will not result in disposal problems for excess earth. Oxy intends to complete construction and begin operation by May 1984.

Power Plant Design

Key elements which affect the environment are identified below.

Steam Supply

The Oxy power plant will require approximately 1,600,000 pounds per hour of steam; it will probably require 7 to 12 wells initially to furnish this supply. Over the 30-year lifetime of the power plant, Oxy may require as many as 30 wells, depending on the flow rate and duration of each supply well. Steel pipelines will convey the steam to the power plant, where the steam flow will drive turbines, which in turn rotate the generator and produce electricity.

Twin Units

Oxy will employ twin turbines and generators, each of which could independently produce 80 MW of net electrical output in case one unit fails. However, the remainder of the plant is capable of removing only the waste heat produced by 80 MW net of power, so the system design includes governors on the generators which will limit the total combined electrical output to 80 MW.

Condensers

In order to increase the efficiency of the power plant, the design must condense the spent steam from the turbines. Heat is extracted from the spent steam in the unit condensers causing the steam to transform to the liquid state. The condensed spent steam provides the source of makeup water to replace water which is lost during the operation of the cooling system. The proposed power plant will use surface condensers, which capture a greater portion of the environmentally undesirable hydrogen sulfide with the noncondensable gases than the direct contact condensers used in the older units at The Geysers. Hydrogen sulfide contained in the noncondensable gas stream can be treated more economically than the hydrogen sulfide contained in the liquid condensate stream.

Cooling Towers

The heated circulating cooling water goes to the cooling towers where the heat is transferred to the air by contact with the air and evaporation. The proposed power plant will use two 4 or 5 cell cooling towers. The condensed spent steam also goes to the cooling tower to replace water lost during the cooling cycle. The cooling tower basins collect the condensate and the cooled circulating cooling water. The cooled waters are then pumped back to the unit condensers for additional condensation of spent steam.

The condensed steam exceeds the amount of water lost through evaporation during the cooling process. Therefore, no extra source of replacement water is required. The excess water which remains after cooling is piped back into the ground in a nonproductive well. Although no outside source of water is required to replenish the cooling water lost from evaporation, an initial supply has to be furnished from independent sources in order to start operating the power plant. This initial supply is approximately 1,000,000 gallons (3 acre-feet). Oxy will place it in the collecting basin at the bottom of the cooling tower. Oxy intends to furnish the initial start-up water from sources outside the leasehold.

TRANSMISSION LINES

Oxy plans to construct a transmission tapline from the power plant to an existing 230 kV transmission line in The Geysers. They identified two possible routes for the tapline, but the preferred one would go west over the ridge top and join the SMUDGE #1 tapline. This route would be 4,700 feet long and would require 3 transmission towers.

PROJECT-SPECIFIC AND CUMULATIVE ENVIRONMENTAL ANALYSES

This text summarizes both project-specific impacts and cumulative environmental impacts which will result from Oxy's proposal. The project-specific analysis deals only with impacts resulting from the power plant itself, access roads, and transmission lines, whereas the cumulative environmental analysis discusses impacts from activities which occur beyond the power plant site and outside the transmission line right-of-way. The discussion of cumulative impacts includes the results of full leasehold development and places the Oxy development in perspective with geothermal activities in the rest of the KGRA. Both the project-specific and cumulative impacts of the Oxy proposal are summarized below.

GEOLOGY

CEC staff believes that the power plant will be designed to withstand a reasonably predictable level of earthquake activity and that neither landsliding nor fault-rupture will endanger the power plant or appurtenant facilities.

Oxy's development, as a part of geothermal development of the entire KGRA, will add to the overall depletion of the steam reservoir. The rate of reservoir depletion, however, is uncertain.

SOILS

Project-specific erosion may occur during construction of the power plant facilities and for about three years afterwards near culverts, cuts, and fills until revegetation and stabilization occurs. Oxy will implement a series of mitigation measures to reduce the potential for erosion. CEC staff believes that these mitigation measures will be adequate to reduce erosion to a more acceptable level.

Total project development (including the steamfield) will disturb approximately 51 acres or 9 percent of the 550 acre leasehold. This amount of disturbance is not unusual in itself; however, the Oxy leasehold is located on highly erodible soils at the very top of a watershed, which supplies both recreational and domestic water for approximately 200 permanent and an additional 500 seasonal residents downstream of the Oxy leasehold. The potential for degrading the local people's source of water is therefore a sensitive matter. With respect to the entire KGRA, Oxy's project will add incrementally to overall soil losses in the Geysers area, and if mitigation measures are unsuccessful, soils from the leasehold could enter the larger Putah Creek drainage system and finally deposit in Lake Berryessa.

Oxy will mitigate erosion and degradation of local streams through the following methods:

- o Revegetate denuded slopes and fill surfaces,
- o Chip-seal the internal access road from drill site C to B prior to construction of the well pads,
- o Incorporate sound engineering practices such as water bars, drains, culverts, berms to control the flow of waters from their leasehold into local creeks, and
- o Oxy will participate in a water quality monitoring program which will identify whether further mitigation measures are necessary.

HYDROLOGY/WATER QUALITY

Clearing vegetation from the 18.5 acre plant site and surrounding area will temporarily increase the potential for erosion and sediment deposition into an intermittent tributary to Anderson Creek; however, revegetation efforts should restabilize the soil within about three years.

Oxy will install a system of ditches, drains, rip rap and straw bale dams to prevent soil eroded from the plant site from being washed into Anderson Creek.

The Oxy leasehold is located at the top of a watershed which supplies agricultural, recreational and domestic water to downstream residents. The total development of this project (power plant, access roads, and steam field) could place a high sediment load in these waters and thereby alter the water quality. Such degradation to local creeks could impact recreational and domestic use as well as alter the aquatic ecosystems which affect fish and other aquatic organisms.

Existing geothermal developments in the Area have already impacted Anderson Creek, which is the primary source of recreational water for local residents. Cumulative geothermal development has also impacted those portions of Gunning Creek which lie below Socrates Mine Rd. However, upper Gunning Creek, has been relatively untouched by geothermal development. Oxy's well pad B may adversely impact Gunning Creek, upon which 200 permanent and an additional 500 seasonal downstream residents rely for more than half their domestic water supply. Oxy has agreed to fund safeguards to the domestic water supply to minimize risk.

Transport of potentially toxic or harmful substances related to the H₂S abatement system(s) creates the possibility that these materials could be spilled and enter surface waters. The probability of major accidental spills during transport is relatively low and can be mitigated by improved safety precautions and training.

Based on historical data, condensate spills and drilling waste could also damage the waters. To prevent adverse impact to water quality, Oxy will implement appropriate mitigation measures listed under Soils. They will also

develop a contingency plan to promptly supply downstream users with domestic water in case toxic chemicals from the Oxy leasehold enter the potable water source.

Various regulatory agencies (Lake County, California Energy Commission, Central Valley Regional Water Quality Control Board, the United States Geological Survey, and Bureau of Land Management) have expressed concern over the potential degradation of this watershed due to geothermal development. In addition to Oxy's mitigation measures, these agencies will help Occidental and other developers who affect this watershed implement a monitoring program which will identify whether additional mitigation measures will be required.

BIOLOGY

Vegetation

Construction of the power plant site access road and transmission line will remove approximately 15 acres of vegetation. Disturbance of approximately 51 acres of total land within the Oxy leasehold will reduce various vegetation types. None of these losses are expected to directly impact legally protected species, species of special concern, or species of commercial importance.

Wildlife

As explained under Soils and Hydrology/Water Quality, sediment entering local streams could result in impacts to aquatic biota, which include (among others) the recreational species, rainbow trout. Should a toxic spill occur and enter the creeks, it could kill fish and other forms of aquatic life.

The loss of vegetation due to Oxy's full project will reduce habitat for a number of wildlife species; however, if mitigated, these impacts should not be significant. The one fully protected species which Oxy's development may affect is the ringtail. This small raccoon-like creature frequents riparian zones. Although CEC staff considers the Oxy leasehold likely to contain ringtail, the impacts to this fully protected species cannot be assessed due to lack of data concerning their existence on the leasehold.

Oxy's Well Pad B and access road between pads B and C infringe upon the riparian protection zone recommended in 1978 by the U.S. Bureau of Land Management to preserve wildlife habitat along creeks in the leasehold. Despite this 1978 assessment, the BLM made an exception and approved both Well Pad B and the access road from pad C to B.

AIR QUALITY

The Oxy project will contribute incrementally to an existing air quality problem caused by geothermal development in the KGRA. Oxy's incremental impact is insignificant singularly or when combined with the expected background. The Lake County Air Pollution Control Officer (LCAPCO) has the responsibility to determine whether the project will comply with applicable rules and standards. The LCAPCO issued (July 28, 1981) a positive Determination of Compliance which indicates that Oxy will use best available control technology (BACT) to

limit H₂S emissions to 8.0 pounds per hour. Compared to existing geothermal plants in the KGRA, the Oxy plant will be relatively clean in terms of H₂S emissions.

The Oxy #1 H₂S emissions will not cause ambient air quality violations in the KGRA. Regardless of Oxy's use of BACT, CEC staff does not expect a reduced number of violations, since existing unabated plant emissions are the major contributors to the violations and since the existing plants will not significantly reduce their emission by the time the Oxy plant begins operation in 1984.

Emissions of potentially deleterious substances which are present in geothermal steam and/or the cooling tower plume may be carried in the air and deposited on soils, vegetation, wildlife, and populated areas. The effect of small concentrations and cumulative deposition of substances such as mercury, arsenic, boron, and radon-222 daughters are not sufficiently understood, and the significance of the impacts is unknown. Oxy's design of the cooling towers and other facilities will reduce rates and amounts of such emissions.

CULTURAL RESOURCES

The Oxy development area contains one significant prehistoric hunting camp site, which is listed on the National Register of Historic Places. Oxy will establish a buffer zone to protect this site, although no construction activities are planned for the area. If Oxy implements all mitigation measures, no adverse impact to cultural resources should occur.

SOCIOECONOMICS AND PUBLIC SERVICES

CEC Staff anticipates significant socioeconomic impacts due to Oxy and other geothermal developments. These will occur primarily in Lake and Sonoma, and to a much lesser extent in Napa and Mendocino Counties. Specifically, there will be an increased demand for housing on an already impacted housing market and an increased burden on public schools, within Lake County.

Staff recognizes the potential for cumulative geothermal development (Oxy #1 and others) to exert a significant public service impact on the water system for Anderson Springs; however, Oxy's erosion mitigation measures, along with their safeguards to the domestic water supply, should adequately mitigate most immediate public health risks which geothermal development may pose to the domestic water.

LAND USE

The Oxy proposal is consistent with both Lake and Sonoma County General Plans. The project will add further geothermal development to the KGRA.

AESTHETICS

The Oxy project will be visible from portions of the Colloiyami and Longs Valleys to the east, and from part of Highways 29 and 175. It will be partially visible from the vicinity of Anderson Springs, Middletown and Whispering Pines. Other geothermal development is visible throughout the KGRA.

Oxy's preferred transmission corridor (westward over the ridge to SMUDGE #1) will be visible from the valleys to the east. However, the preferred route would be less visible than the alternate route which would traverse the ridge to the south-south-west.

Cumulative geothermal development (Oxy #1 and others) in this watershed will degrade the water quality of Anderson Creek. Anderson Creek mainly provides recreational waters for local residents, so the visual impact of increased sediment and pollution may lessen the creek's recreational appeal.

NOISE

If Oxy implements all proposed mitigation measures, operation of the power plant will not result in significant noise impact.

Sensitive receptors near the steamfield may hear such activities as production testing, unmuffled well venting, and wellhead master valve changes. These activities occur infrequently and can be restricted to daylight hours. Construction traffic along access routes to the leasehold may subject people along the route to intermittent noise levels which exceed the nighttime standard of the Lake County draft noise ordinance; such traffic should be limited to daylight hours.

WASTE MANAGEMENT

Hazardous substances stored at the power plant will be contained in appropriate vessels to ensure against accidental spills, but as a further precaution, Oxy will place curbs which are large enough to contain any spilled material around the entire plant site and around individual H₂S abatement and chemical handling areas.

Oxy #1's Stretford system will produce approximately 676 cubic yards of sulfur and sludge per year, and the H₂O₂ secondary abatement system may produce about 3.5 cubic yards of sludge per year. Oxy will contract for disposal of wastes at approved disposal sites in Martinez, Middletown, or Kelseyville.

Impermeable sumps will contain drilling muds and liquids during the lifetime of the well. When a well is abandoned, Oxy will test these muds and either remove them to appropriate disposal sites if they contain any toxic/hazardous substances, or bury them in the sump if there are no harmful substances. Geothermal drilling muds in the KGRA historically consist of natural soils and bentonite clays, neither of which is considered harmful to the environment.

Although the potential exists for a sump to fail and spill drilling muds into Anderson Creek which receives high recreational use, Oxy will mitigate this potential impact through proper construction and routine observation of sump levels and condition. CEC staff anticipates no adverse impact from hazardous wastes, provided Oxy stores and disposes of wastes according to regulation.

HEALTH

The project will contribute, albeit in relatively small amount, to existing violations of the California Ambient Air Quality Standard for H₂S. Although

experts do not know at this time if adverse health effects result from exposure to low levels of H₂S, the inference is that increasing H₂S concentrations will increase the possibility of public odor complaints as well as the possibility for adverse health impacts in The Geysers area. In addition, the project's emissions of nonregulated pollutants, combined with other power plant emissions, increase the possibility of adverse health impacts from these pollutants.

There is a possibility that the construction and operation of the Oxy facility may degrade local recreation and drinking water supplies. Oxy has agreed to periodically monitor water quality in Anderson and Gunning creeks to detect any chronic degradation so that appropriate corrective actions may be taken. Additionally, Oxy will fund mitigation measures which will help safeguard the existing water supply system against potential geothermal pollution.

TRANSPORTATION

CEC staff does not expect the small increase in light weight (auto/ truck) traffic due to Oxy's construction to significantly impact the local transportation network. Oxy's increase in heavy truck traffic, however, will worsen existing problems on Socrates Mine Road. If Oxy disposes of wastes in Middletown, their disposal trucks will add to an existing deterioration problem on Butts Canyon Road.

Oxy and other geothermal developers will share the costs of improving Socrates Mine Road, and construction has started with completion scheduled next spring or summer. CEC staff views the maintenance of Butts Canyon Road as a problem which the county can remedy, and Lake County has appropriated funds to repair the road.

ENERGY AND MATERIAL RESOURCES

The Oxy #1 plant would consume approximately 1,600,000 lbs/hr of geothermal steam. To prevent steam from venting unabated into the air during occasional shut-downs, Oxy will employ independent dual turbines so that one unit could run while the other shuts down. The design includes turbine bypass devices so that during a shut-down, steam would bypass the turbine and enter the air abatement system. Additionally, Oxy will use a governor to throttle back unwanted steam. Oxy could maximize the use of geothermal steam by incorporating a more efficient turbine design.

On a cumulative level, Oxy #1's use of energy and material resources is about on a par with other geothermal developments in the KGRA, although recent design technology indicates that Oxy could increase their turbine efficiency.

CEC staff estimates that by 1986 a total of 24 geothermal power plants may operate in the KGRA, and will consume an estimated 28,305,000 lbs/hr of geothermal steam.

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INTRODUCTION

THE PROPOSED PROJECT

Occidental Geothermal, Inc., (Oxy) filed an Application for Certification with the California Energy Commission on January 29, 1981, to construct and operate Oxy #1 geothermal power plant. Oxy's proposed power plant will have a net normal operating capacity of approximately 80 MW. It is scheduled for operation in 1984, provided that construction begins in spring 1982. Oxy indicates that the power plant would be operational for about 30 years (81-AFC-1).

Oxy #1 would be located on Oxy's privately owned land in western Lake County. A small portion of the leasehold extends into Sonoma County. The federal government holds subsurface mineral rights on the property, and Oxy has a 40-year lease from the U.S. Bureau of Land Management to develop the subsurface geothermal resource. Development of the steam field is administered by the BLM and USGS. The California Energy Commission has authority to review and approve construction and operation of the power plant, access road, and transmission lines. If the overall proposal is found to be suitable, the Energy Commission has the authority under state law to certify the power plant for operation.

THE FUNCTION OF THIS DOCUMENT

This Final Environmental Impact Report (FEIR) addresses environmental concerns according to the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA). The purpose of this study is to discuss and to allow the public an opportunity to comment on the environmental impacts which would be caused by the proposed 80 MW geothermal power plant.

This environmental impact report identifies the significant effects of the project on the environment; it identifies alternatives to the project and indicates the manner in which environmental effects can be mitigated or avoided. A significant effect on the environment is a substantial or potentially substantial change in the environment.

The FEIR is not meant to present a conclusion regarding the overall acceptability of the project. The Energy Commission will use this report, in combination with other materials, to determine whether, and under what conditions, the project should be approved.

The staff of the Energy Commission, hereafter referred to as "staff," prepared this FEIR in accordance with the NEPA, CEQA, the State EIR Guidelines, and the Energy Commission's regulations to implement CEQA. The technical staffs of BLM and USGS had input on the final document. Staff used information from both published and unpublished sources. The primary document the staff used was Oxy's AFC. The staff collected other information from the AFC proceedings (81-AFC-1), from federal, state, and local agencies, and from private groups or individuals. Although much of the information presented in this environmental document was originally provided by Oxy, the staff examined it for its reasonableness and technical accuracy and conducted its own independent verification. The analysis of the environmental impacts and the determination

of their significance were conducted by and are the responsibility of the staff.

The sections that follow discuss (1) the project as proposed by Oxy (Project Description); (2) the environment in the vicinity of the project as exists before the commencement of the project, from both a local and regional perspective (Environmental Setting); (3) the adverse consequences of the project, any significant environmental effects which cannot be avoided, and any mitigation measures to minimize significant effects (Impacts and Mitigations); (4) the potential feasible alternatives to the proposed project (Alternatives); (5) the significant unavoidable, irreversible, and long-term environmental impacts (Unavoidable Adverse Impacts); and (6) the Growth Inducing Impacts.

Where needed, the text includes graphic charts, tables, and figures to clarify the text. All references to graphics within the text refer specifically to graphics contained within that particular section of the EIR. For example, mention of Table 3 in the text on Noise refers to Noise Table 3.

An interdisciplinary team of environmental analysts from the Engineering and Environmental Division of the Energy Commission prepared this document. Specific staff are recognized under "Authors."

The depth of analysis of environmental effects is "in proportion to the severity and probability of occurrence" (Section 15140(e), State EIR Guidelines). Effects the staff considered insignificant are discussed in Appendix A, entitled Initial Environmental Impact Evaluation. Appendix A focuses on potentially significant impacts and documents why insignificant impacts were identified as such. Effects that staff classified as "unresolved" or "potentially significant" in the Initial Environmental Impact Evaluation are addressed in Chapter II which deals with both project-specific and cumulative environmental analyses.

Where the Final EIR (FEIR) incorporates changes in text from the Draft, they are underlined and marked at the right hand margin, so that the reader can readily identify changed portions.

In order to conserve on the amount of pages in the FEIR, where there is an undisputed subject with pages which are identical in the Draft, they have been deleted in the Final. Deleted items are as follows:

<u>Title</u>	<u>Location in DEIR</u>
Glossary	p. 262
Appendix A, Initial Environmental Impact Evaluation	p. 274
Appendix D, Soils	p. 351
Biology Table 2, Very Rare, Rare, and Endangered Plant Species	p. 65-70

REVIEW PROCESS

A 15-day public review will follow the release of the Final EIR. Staff encourages comments on this document, both with regard to substance of its content and to the clarity of its discussion. There are two ways in which to comment on the DEIR: (1) write to the Energy Commission at the address listed below and (2) contact CEC Project Manager Valerie Campbell, by phone: (916) 925-2329.

The Final EIR reflects comments made at the workshop(s) and in writing during the Draft review period.

Written comments should be submitted to:

Valerie Campbell
California Energy Commission
1111 Howe Avenue, MS-39
Sacramento, CA 95825
(916) 924-2329

I. PROJECT DESCRIPTION OBJECTIVES

Occidental Geothermal, Inc., proposes to construct and operate the Oxy Geothermal Plant No. 1 to provide an economic and nonfossil fuel source of 80 MW net electrical generation.

NEED

The California Energy Commission's Geothermal Policy Report, dated March 22, 1978, recognizes geothermal energy as a preferred technology for meeting electric power needs because (1) the geothermal resource is indigenous to California; (2) its development offers a stimulus to the state's economy; (3) the environmental impacts and power plant technology for dry steam resources are well understood; (4) geothermal power plants are relatively small (50 - 110 MW) and thus enable greater system reliability and flexibility; and (5) geothermal power plants may be planned and constructed in a shorter time frame than power plants using fossil or nuclear fuel.

In its 1979 Biennial Report, the California Energy Commission indicated that generation alternatives such as geothermal should be expanded because of their reliability and more stable costs. In the 1979 Biennial Report, the California Energy Commission declared: "We will continue to certify the maximum number of geothermal sites and facilities that demonstrate reasonably mitigable environmental impacts and that meet existing air and water quality standards. Any facility that meets these criteria will be deemed needed." (CEC, 1979) According to the AFC, the Oxy Geo #1 project would meet these criteria.

OVERVIEW

In The Geysers KGRA a typical geothermal development area contains steam wells, well pads, access roads, steam supply pipelines, a power plant, transmission lines connecting the power plant with the intended electricity service area. In most cases, the land or leasehold where the steam wells and power plant are located is owned by private individuals or the federal government. The land is then leased to a steam developer who supplies the steam to an electrical utility company. The steam supplier is also responsible for disposing of or reinjecting any steam condensate generated by the power plant.

Oxy is both the steam supplier and the steam user for the Oxy #1 project. Both the power plant site and geothermal steam field are located entirely on private land, under which Oxy holds the federal subsurface mineral lease. The federal government is primarily responsible for environmental documentation of well field development, and permitting authority for activities within the well field rests with the federal government (USGS) and with Lake County. For further information regarding activities on the leasehold, refer to the documents in the summary under Steam Field. Pacific Gas and Electric (PGandE) currently operates 15 geothermal power plants in The Geysers KGRA equalling a total installed electrical capacity of 908 MW. PGandE units 17 and 18 are under construction and are scheduled for operation in 1982. These PGandE plants will each have 110 MW of installed capacity. Also, DWR has a 55 MW power plant approved, the Northern California Power Agency (NCPA) has a 110 MW

plant currently under construction, and SMUD is building a 72 MW plant just west of the Oxy site all of which should be in operation by 1984. Completion of the currently certified power plants will bring the total installed electric capacity of the KGRA to 1,365 MW by 1984.

Power plants which are proposed but not yet certified by CEC are PGandE Unit 16 (110 MW), DWR South Geysers (55 MW), and Oxy Geo #1. If these plants are all certified and constructed on schedule, they will bring the total installed capacity at the KGRA to 1,610 MW by 1984. Projections for maximum development of the KGRA* indicate a maximum installation of 2,700 MW of dry steam production by 1992, and an additional 550 MW of hot water production by the year 2000.

HISTORY

On January 29, 1981, Oxy filed an Application for Certification (AFC) with the Energy Commission to construct and operate the Oxy #1 power plant. They have also filed appropriate applications with USGS and BLM to develop the well field. Previously, a lease was issued to Oxy by BLM to develop the subsurface geothermal resources. Subsequent involvement by BLM in lease activities is through the procedures and under the direction of USGS. The surface land is owned by Oxy.

Currently only 3 of the anticipated 7 to 12 steam supply wells have been drilled.

A Steam Resource Hearing was held by the CEC on March 2, 1981, to determine the adequacy and availability of steam to run the proposed geothermal power plant. As a result of this hearing, the steam field was deemed adequate.

LOCATION

The Geysers KGRA is a mountainous, rugged, and sparsely populated area located in the northern central portion of the Coastal Ranges (Description Figure 1). The proposed Oxy Geothermal #1 project and steam field are located approximately 66 miles north of San Francisco and 61 miles northwest of Sacramento. The site is located in western Lake County at an approximate elevation of 3,600 feet. The nearest communities are the unincorporated towns of Anderson Springs and Middletown, located in Lake County approximately 2-1/4 miles east southeast and 9 miles southeast of the site, respectively. The nearest major cities are Santa Rosa, located in Sonoma County, approximately 24 miles south of the site, and Lakeport, 22 miles north in Lake County.

The Oxy leasehold contains federal subsurface lease, CA 5636, which encompasses approximately 550 acres, located in Township 11 North, Range 8 West, Mount Diablo Base Meridian Section 21: lots 5, 6, 11, 12, NE 1/4 Section 22: NE 1/4 NW 1/4, NE 1/4 SW 1/4, W 1/2 W 1/2.

*CEC, Renewable and Alternative Technologies Synopsis, Staff Draft, CEC-9/1980, Pub. #500-80-012.

OXY GEOTHERMAL #1

FIGURE 1: DESCRIPTION-The Geysers-Calistoga KGRA

OXY GEOTHERMAL #1

Source: Oxy #1 AFC, 1981

FIGURE 2: DESCRIPTION—Leasehold Development Plan

Access to the site from the nearby community of Middletown in Lake County is via Highway 175 and Socrates Mine Road. Access from the west is via the Healdsburg-Geysers road from Jintown to The Geysers Resort and then past PGandE Geysers 14 to Socrates Mine Road.

Oxy plans to construct the preferred transmission line from the plant site 4,700 feet west over the ridge, to join PGandE's existing 230 Kv line which leads out of Units 9 and 10 to Castle Rock Junction. In order to reach the PGandE tapline, Oxy will share two transmission towers with SMUDGE #1, but Oxy would construct three new towers in order to reach the SMUDGE towers. Each new tower will be located on an existing access road.

FEATURES

The proposed power plant will have the following main features:

- o Two single cylinder, two-flow, nonextraction condensing, 3,600 rpm turbines operating independently.
- o Two generators, each a 3,600 rpm hydrogen cooled, three phase, synchronous unit directly coupled to each main turbine shaft.
- o Stainless steel surface condensers will condense spent steam exhausted from the turbines and will effect an increase in partitioning H_2S and other noncondensibles from previously used direct contact type condensers which mix the cooling water with the spent steam.
- o Two four or five-cell wet (evaporative) crossflow cooling towers will be used to dissipate the heat gained by the circulating cool water during its passage through each surface condenser.
- o A 3,000 foot injection pipeline running from the cooling tower to an injection well at nearby well pad C will dispose of excess condensate in compliance with Waste Discharge Requirements adopted by the Central Valley Region Water Quality Control Board.
- o A Stretford hydrogen sulfide abatement system in which hydrogen sulfide is scrubbed from the vent gas steam and catalytically oxidized to elemental sulfur. Oxy will use a secondary abatement system in the event that the Stretford system does not adequately abate emissions to an acceptable level. The secondary abatement system will employ hydrogen peroxide with catalyst.
- o Abatement system chemical storage tanks (H_2 and CO_2).
- o A shop, warehouse, and administration office building.
- o An electrical switchyard.
- o Sewage treatment plant.

- o Three new transmission towers located between the Oxy site and the SMUDGE #1 site.
- o A 4,700 foot long transmission tapline connecting to an existing 230 kV transmission line to the west of the site.
- o A 7,200 foot paved access road (internal to the leasehold).
- o Approximately 2,600 feet of additional chip-sealed access road, within the leasehold.

STEAM SUPPLY WELLS

Oxy itself will supply the steam necessary to run the proposed geothermal power plant. CEC staff anticipates that up to 30 wells may be needed over the lifetime of the power plant. Oxy anticipates that the plant will require 7 to 12 wells to generate power initially.

Although the Steam Resource Hearing, held March 2, 1981, determined that there is adequate steam available to run the Oxy #1 project, the steam production of a well typically declines over a period of time as the reservoir it draws from is depleted. Thus, as steam production wanes, additional wells will be drilled. In addition, one or two reinjection wells are required to dispose of excess steam condensates and cooling tower blowdown.

To date, three wells have been drilled on the site, although drilling operations for more are planned. The permitting authority for wells rests with the USGS.

STEAM PIPELINES

Steam will be transported from the wells to the power plant in insulated steel pipelines supported above ground. Steam transmission lines are generally selected for the shortest distance to the generating unit, but the actual layout of the pipeline is largely dictated by the rugged terrain in The Geysers area. Where possible, pipelines will follow road alignments and will avoid unstable slopes.

WATER SUPPLY

Initial start-up water for the cooling tower will be supplied by Oxy using purchased water from outside the leasehold. Once the power plant is in operation, make-up water for the cooling towers will come from excess condensate. Oxy will inject additional excess condensate into a well at Pad C.

II. PROJECT-SPECIFIC ENVIRONMENTAL ANALYSIS

GEOLOGY

SETTING

REGIONAL GEOLOGY

The proposed project and the entire Geysers KGRA lie in the Central Mayacmas Mountains of the northern coast ranges. Works by McLaughlin (1977, 1978) and McLaughlin and Stanley (1976) describe the regional geology of the KGRA. Recent mapping of the area by the U.S. Geological Survey indicates that the Central Mayacmas Mountains represent a structurally complex mass of rock which was uplifted by folding and faulting (Geology Figure 1).

The Geysers region experienced a series of folding, faulting, and volcanic events over the last several tens of millions of years. The present range was produced by accelerated folding and faulting which occurred during the last three to six million years. The Collayomi and Maacama faults form the north-east and southwest boundaries, respectively, of the Mayacmas uplift. Volcanism occurred in the area during the last five million years and formed Cobb Mountain and other volcanic features in the Clear Lake region within the last two million years. Presently a large body of at least partially molten magma exists at a depth of about 6 miles (10 kilometers) below the Clear Lake area (Donnelly et al., 1977) (Geology Figure 2).

The principal faults within The Geysers region are associated with the complex horst* which forms the Mayacmas Mountains. The fumarole activity along Big Sulphur Creek at The Geysers is a surface phenomenon often associated with faulting in an area characterized by recent volcanism (Hamilton and Muffler, 1972).

REGIONAL SEISMICITY

Moderate seismic activity occurs in the KGRA region where the potential seismicity of the San Andreas, Maacama, and Rodgers Creek faults overshadow that of other possible sources (Geology Figure 3 and Geology Table 1). Few earthquakes of magnitude 5.5 or greater have occurred in The Geysers region. The largest historical earthquakes of importance for The Geysers area are the 1969 Santa Rosa earthquake (M 5.6 and 5.7) on the Rodgers Creek Fault and the 1906 San Francisco earthquake (M 8.25) on the San Andreas Fault.

Geologic and seismic evidence indicates that both the San Andreas and Rodgers Creek Faults have a significant potential for producing strong earthquakes. Although few strong seismic events can be confidently associated with the Maacama Fault, recent tectonic interpretations (Herd, 1978; Dott, 1979) and geologic evidence indicate that this fault has a significant potential for generating strong earthquakes.

*A portion of the earth's crust which has been elevated and separated from the surrounding land by faults.

OXY GEOTHERMAL #1

Source: McLaughlin and Stanley, 1975 AMENDED BY PG&E, OCTOBER 1977

Source: Geysers 18 Final EIR

FIGURE 1: GEOLOGY- Geologic Map of Geysers

Source; Geysers 18 Final EIR

FIGURE 2: GEOLOGY—Cross Section Through the Geysers–Clear Lake Region

Structural model for the Geysers geothermal system. Cross-section through The Geysers–Clear Lake region, from the Maacama fault zone on the southwest, to Mount Konocti on the northeast, depicting structural elements of The Geysers–Clear Lake geothermal system.

Source: "Field-trip Guidebook Castle Steam Field, Great Valley Sequence," April 29, 1978, 53rd Annual Meeting, Pacific Sections AAPG, SEPM, SEG. Modified by the California Energy Commission, February, 1979.

OXY GEOTHERMAL #1

REF: Modified after Jennings, C.W., 1975, Fault Map of California, Calif. Div. of Mines & Geol., Calif. Geologic Data Map Series, Map No. 1.

FIGURE 3: GEOLOGY-Regional Quaternary Faults

GEOLOGY TABLE I

CHARACTERISTICS OF SELECTED QUATERNARY FAULTS IN THE GEYSERS REGION

<u>CHARACTERISTICS</u>	<u>SAN ANDREAS</u>	<u>HEALDSBURG/ RODGERS CREEK</u>	<u>MAACAMA AND ASSOCIATED FAULTS</u>
DISTANCE FROM SITE (km)	53	32	13
MAPPED LENGTH (km)	1,200	42	16.5
TYPE OF FAULT	Right-lateral Strike-slip	Right-lateral Strike-slip probably some small vertical component	Right-lateral Strike-slip
ACTIVITY STATUS			
1) Historic activity	Yes	Yes	Yes
2) Features indicating Holocene activity	Yes	Yes	Yes
3) Features indicating Quaternary activity	Yes	Yes	Yes
Estimated maximum magnitude earthquake	8.3	6.5	6.75-7.0
Remarks	Maximum displacement of 6m in 1906	Magnitude 5.7 earthquake in October 1969	Magnitude 3 to 4.5 earthquakes in 1969, 1971 and 1977

<u>CHARACTERISTICS</u>	<u>COLLAYOMI</u>	<u>BIG SULPHUR CREEK</u>	<u>KONOCTI BAY/ CHILDERS PEAK</u>
DISTANCE FROM SITE (km)	2		
MAPPED LENGTH (km)	About 40	6.4	About 30
TYPE OF FAULT	Right-lateral Strike-slip possibly some vertical component	Normal with possibly some right-lateral strike-slip	Normal, high-angle
ACTIVITY STATUS			
1) Historic activity	None known	None known, possibly small earthquakes	None known, but small earthquakes in area
2) Features indicating Holocene activity	None observed	Yes, also geomorphic features	Geomorphic features suggestive of faulting
3) Features indicating Quaternary activity	Yes	Yes	Yes
Estimated maximum magnitude earthquake	---	---	---
Remarks	Offset terrace gravels with clasts dated as 0.4 million years old.		Offset Quaternary volcanics of the Clear Lake sequence

Modified from Borchardt, 1975

Other potential sources of earthquakes include The Geysers Peak, Konocti Bay, and Porter Creek faults. Due to their distance from the site, and their limited size, associated historical seismicity, and geologic evidence of activity, these faults are no more likely to produce damaging levels of shaking in the steam field than presently unrecognized sources closer to the site.

Recent microseismic studies by the U.S. Geological Survey indicate that microseismic activity increases in areas of existing power plant facilities. A magnitude 5 earthquake is a reasonable upper bound for this anomalous "steam production" area.* On the assumption that the entire steam field will become a steam production area within the next decade, the seismic characteristics of the present steam production area probably represent the entire steam field.

LEASEHOLD GEOLOGY

The leasehold is generally underlain by rocks of the Franciscan assemblage with a blanket of Plio-Pleistocene volcanic rocks covering the Franciscan assemblage in the northern half of the leasehold. The exposed Franciscan assemblage in the southern portion of the leasehold reveals complex geologic structures which indicate a history of much faulting and folding. Faults crossing the northeast portion of the leasehold have displaced volcanic rocks which are probably Quaternary in age; the faults may therefore be potentially active.

ECONOMIC MINERAL DEPOSITS

The closest mine is the Socrates Mine, located near the ridge crest on the south side of Big Sulphur Creek about two miles southwest of the leasehold. This mine was developed for the extraction of mercury and is now inactive.

IMPACTS

GEOLOGIC HAZARDS

The Initial Environmental Impact Evaluation section shows potential geologic hazards which could credibly affect the leasehold and power plant. Geologic hazards, such as liquefaction, expansive and collapsible soils, tsunamis and seiches, are not likely to occur within the leasehold. However, earthquake shaking and landslides could potentially damage the power plant and/or related facilities, thereby resulting in potential adverse impacts to public health and the environment or forcing a plant shutdown. For example, rupturing of steam pipelines would result in unabated steam releases into the atmosphere, or collapse of transmission towers and transmission lines could start fires. These are examples of "indirect" impacts which may result from earthquake shaking or landslides. These geologic hazards are discussed in more detail below.

*Conclusion reached at October 25 and 26, 1979, Seismic Hazards Evaluation Methodology Workshop.

EARTHQUAKE SHAKING

Earthquake ground shaking results from energy release when movement occurs along faults in the earth's crust. Earthquake shaking affects large areas, but generally, structures can be designed to adequately withstand this phenomenon. Based on present geologic knowledge, California Energy Commission staff believes it unlikely that faults within The Geysers steam field will produce any large damaging earthquakes due to either natural or induced activity during the economic life of the proposed facilities. The strongest shaking at the proposed site would most likely be caused by one of the larger regional faults, such as the Maacama Fault.

Due to its proximity to the steam field and the magnitude of earthquake which may occur along it, the Maacama Fault is the most significant potential source of earthquakes. However, the potential ground shaking from earthquakes on the San Andreas and Rodgers Creek faults, from the steam production area, and from "random" seismic events not clearly associated with any source is also considered in evaluating seismic hazards for The Geysers power plant units.

LANDSLIDES AND SLOPE INSTABILITY

Landsliding and slope instability are among the most significant geologic problems facing development of The Geysers geothermal resource (Bedrossian, 1978). Landslides and unstable slopes may endanger facilities in three ways: (1) a surface facility sited at the base of an unstable slope may be buried by landslide material if upslope materials fail and encroach upon the structure; (2) a facility sited on an unstable slope may be pulled downhill and torn apart if the underlying materials are involved in a landslide; and (3) a subsurface facility (such as a well) may be sheared off, torn apart, and/or severely deformed below the surface if it is sited on unstable materials at or near the ground surface. In the case of geothermal steam wells, such an event usually results in well blowouts at the surface.

FAULT RUPTURE

Faults which displace Quaternary volcanic rocks, and are therefore potentially active, cross the leasehold. It is not likely that these faults would rupture due solely to natural causes during the lifetime of the reservoir. However, subsidence induced by reservoir depletion may focus along such faults. This could rupture facilities intersected by the faults.

IMPACTS ON GEOLOGIC ENVIRONMENT

Potential impacts on the geologic environment include effects on local fumaroles and hot springs, on the steam reservoir itself, and inducement of landsliding, subsidence, and seismicity. Other impacts on commercial geologic resources (e.g., ores, fossil fuels, gems, which may be commercially exploited by mining, quarrying, or drilling) or on noncommercial geologic resources (e.g., caves, mineral collecting localities) which are of recreational or scientific interest in the vicinity of the proposed project are not considered significant by CEC staff.

MITIGATION MEASURES

EARTHQUAKE SHAKING MITIGATION

The proposed facilities can be designed to adequately withstand seismic shaking. Wells and transmission lines are relatively insensitive to seismic shaking and probably require no special treatment except properly sited (i.e., sited on stable ground) and engineered well pads and tower footings. Because of their flexibility, properly constructed transmission lines and pipelines should suffer little damage, even by severe shaking. If damaged, they can usually be quickly repaired.

Occidental proposes to use a seismic design which will ensure that the power plant will be out of operation for only about a week should a peak bedrock acceleration of 0.15g in the horizontal direction occur at the site. Based on probabilistic seismic hazard analysis performed for other generating units at The Geysers (Shah, 1980), the probability of exceeding this acceleration at the site in a 30-year facility lifetime is about 25 percent.

LANDSLIDE AND SLOPE INSTABILITY MITIGATION

CEC staff believes that the power plant facilities will not be endangered by landsliding. Landslides have been mapped within the leasehold, but none appear within the mapped power plant site. The generating unit, cooling towers, and H₂S abatement system will be located on bedrock, undisturbed by landslides.

FAULT RUPTURE MITIGATION

The power plant site is set back far enough from the faults that no damage due to fault rupture is expected. Of the other facilities, only damage to steam wells is considered significant (due to potential blowout of damaged wells). To minimize blowout potential, geothermal wells should be drilled so that they do not intersect such faults within 500 feet of the ground surface.

CUMULATIVE IMPACTS--GEOLOGY

SETTING

Much of the information needed to define the size and characteristics of The Geysers steam reservoir is owned by steam developers who consider it highly proprietary. The state Division of Oil and Gas currently estimates the geographical area of the steam reservoir to be about 16,000 acres, but cautions that this estimate could be in error by a factor of 2. Other reservoir characteristics are subject to equal or greater uncertainty.

In general, CEC staff and other geothermal experts consider the reservoir depletable. Thus, the geothermal heat and fluids consumed by each steam development project hasten depletion of the reservoir, although the long-term cumulative effects cannot be accurately evaluated at this time. Because surface geothermal phenomena (fumaroles, hot springs, etc.) depend on the heat and fluids contained in the reservoir, reservoir depletion will result in a decrease or cessation of these phenomena.

Studies by the U.S. Geological Survey indicate that geothermal development of the steam field induces seismicity and subsidence in the KGRA.

As discussed earlier, unstable slopes and landslides pervade the steam field and constitute a serious environmental consideration.

IMPACTS

At present, it is not possible to accurately evaluate the impact of this or any other development project on the steam resource or on surficial geothermal phenomena. The state Division of Oil and Gas is currently completing a report which better defines some important reservoir characteristics. In addition, CEC, in cooperation with DOG, is studying the feasibility and utility of mathematically modeling The Geysers steam reservoir. Potentially, such a model could provide an effective tool for assessing reservoir characteristics, capacity, longevity, and the effects of development.

Based on U.S.G.S. studies, induced microseismic activity and subsidence are unlikely to directly cause significant adverse impacts. They could result in increased potential for fault rupture and landslides in the steam field.

Slope instability and landslide potential need to be evaluated on a case-by-case basis. Presently, the potential for induced or accelerated landsliding in the steam field is being addressed by CEC for power plants and transmission lines and by DOG and U.S.G.S. for well pads.

MITIGATION MEASURES

It is not presently possible to determine what, if any, measures are necessary or desirable to minimize reservoir depletion. Based on results of a few hypothetical studies, it appears that to effectively increase reservoir longevity,

injection of fluids into the reservoir must be massive (200 percent or 300 percent of amount of produced fluid) and initiated early in the production history. The environmental costs of injecting this much water (most of which would be reclaimed surface water) may be prohibitive.

Induced seismicity and subsidence are probably not serious enough to warrant any mitigation efforts.

Landsliding should be evaluated and mitigated on a case-by-case basis as is presently done by DOG and CEC.

SOILS

SETTING

METHODOLOGY

Soil mapping of the Occidental leasehold (Soils Figure 1) was based mainly on unpublished material on file with the Soil Conservation Service (SCS) at the Soil Survey Office located in Lakeport, California.^{1*} A small portion of the lease is covered in the Sonoma County Soil Survey.² Refinements were based on additional aerial photo interpretation and a field reconnaissance by WESCO. A literature review of published geologic and soils information was also completed by Occidental. Sources consulted included Brice (1950),³ California Division of Mines and Geology (1946),⁴ McLaughlin (1974),⁵ McNitt (1968a),⁶ and Miller (1972).⁷

EXISTING CONDITIONS

Occidental's proposed lease area reposes on steep, upland terrain on the crest of the Mayacmas Mountains. Slopes tend to be very steep near Cobb Mountain and the ridgeline. Some gentler slopes occur on and around the serpentine area and on the rounded ridge between Anderson and Gunning creeks (Figure 1).

Because of the complex bedrock geology of the area, single soil series were not mapped separately. Soil complexes were delineated by land types. The strong interrelationships between the soils and the parent bedrock allow discussion of the soils by relating them to four landform units. These lithologic units include (1) serpentinitic rocks south of Anderson Creek, (2) rhyolitic rocks on uplands south of Cobb Mountain, (3) a stabilized landslide of mostly rhyolitic rock origin between Anderson and Gunning creeks, and (4) a large area of shale and graywacke of the Franciscan assemblage.

Serpentine Uplands

Henneke and Montara soils are the principal soils formed on the serpentine landform. These soils are shallow and generally infertile and typically support a sparse brush cover. They occur as an elongated body on a midslope position in this area. Erosion hazard is high. A magnesium-calcium imbalance greatly reduces revegetation potential by impairing calcium uptake. Erosion control and revegetation in these areas often require the use of topdressing and fertilization to establish cover.

Rhyolitic Uplands

Kidd, Forward, Forward Variant, and Etsel soils are the principal soils formed on fractured rhyolite. Depth varies from shallow to very deep over short distances due to variability in weathering. Slopes are generally very steep. Vegetation is mostly scattered conifers with a brush understory. In general, this landform type presents the least problems in terms of slope stability, erosion, and revegetation. Local problems of revegetation can occur on shallow south-facing soils.

*References for this section are located at the end of the Soils section.

OXY GEOTHERMAL #1

Source: Oxy #1 AFC, 1981

LEGEND

SOIL CLASS	DESCRIPTION
145	HENNEKE-MONTARA-ROCK OUTCROP COMPLEX, 15 TO 50 PERCENT SLOPES.
166	FORWARD VARIANT-KIDD COMPLEX 30 TO 50 PERCENT SLOPES.
170	KIDD-FORWARD COMPLEX 5 TO 30 PERCENT SLOPES.
389	HARBIN-WHISPERING COMPLEX 30 TO 50 PERCENT SLOPES.
534	MAYMEN-HOPLAND-WOODIN ASSOCIATION 30 TO 50 PERCENT SLOPES.
534S	MAYMEN-MONTARA COMPLEX 15 TO 30 PERCENT SLOPES.
536V	ROCK OUTCROP-ESTEL COMPLEX 60 TO 80 PERCENT SLOPES.
541	MAYMEN-ESTEL COMPLEX 30 TO 50 PERCENT SLOPES.

FIGURE 1: SOILS-Leasehold Soils Map

Stabilized Landslides

Harbin and Whispering soils are the principal soils associated with the stabilized landslide and deeper colluvial soils found along the eastern edge of the proposed project area. Parent bedrock is dominantly volcanic, with graywacke and shale in local areas. Although potential timber productivity is high, the dominant cover is dense brush with a sparse hardwood overstory. Conifers are found only in protected pockets. This reflects the history of fire in this area as well as high summer temperatures, which hinder regeneration. The soils of this landform type are generally more erodible and unstable, but successful revegetation is usually less difficult than on the other three land forms.

Sandstone and Shale Uplands

Maymen, Hopland, Woodin, and Etsel soils are the principal soils found on hard and fractured shale and graywacke of the Franciscan assemblage. Shallow soils with high erosion hazards are intermingled with moderately deep soils with moderate erosion hazard as a result of complex residual and colluvial patterns. The cover is brush with a density and composition reflecting variations in potential productivity. The soils are generally gravelly with low levels of fertility.

SOIL CHARACTERISTICS

Soil interpretations are presented in Table 1, Soils Appendix D. Much of this information relates to assessing erosion. The most up-to-date information for the area originates from the SCS. This information emphasizes use of the Universal Soil Loss Equation (USLE) in predicting erosion (Evans, 1976; Osborn, 1976; Soil Conservation Service, 1975; and Wischmeier, 1976).^{8,9,10,11}

The composition and associated characteristics of the soil map units are presented in Soils Appendix D, Tables 2, 3, and 4. This appendix provides information for evaluating the productivity, fertility, and revegetation potential of the soil complexes. Appendix A also provides an assessment by the SCS of various habitat elements and the suitability for four habitat types. Four soils provide good potential for woodland habitat; no soil rates better than fair as a rangeland habitat.

IMPACTS

During construction of the access road, power plant, and transmission line accelerated erosion may occur due to soil disturbance and the removal of the vegetative cover. Fill areas tend to be more susceptible to erosion than cut areas. Erosion may persist in the vicinity of culverts, cuts, and fills. After construction, a three-year period of stabilization should lead to an eventual return to near preconstruction rates.

The proposed power plant is located on gentle to moderately steep slopes and on thin, infertile soils with high erosion potential. (The Hydrology Section includes a discussion of erosion rates.) These soils overlie bedrock which will be exposed on the sites and will form a large portion of the fill material.

Soil productivity is limited because of shallowness, the type of parent material, poorly distributed rainfall, and extremely high summer temperatures. Special effort will be necessary in reestablishing vegetation on droughty, south-facing slopes.

There are no existing agricultural uses on the Oxy leasehold nor is there any potential for such uses. The capabilities of the soils on the leasehold limit their use to grazing by domestic animals and wildlife and the growth of timber and woodland vegetation. The major use of the area is to support wildlife and serve as a watershed for the community of Anderson Springs. As such, the Occidental project will have no impact on prime soils or the area's potential for agricultural production.

MITIGATION MEASURES

Several techniques are available for erosion control within the leasehold. Good erosion control is dependent upon proper engineering of cut slopes, fill slopes, and drainage systems. Cut slopes should be no steeper than 1.5:1 where conditions allow. These cut slopes shall be left as rough as possible to allow for seed and moisture catch points. In addition, long cut slopes should be terraced to visually soften the cut slope when viewed from a distance. Fill slopes shall be no steeper than a 2:1 gradient. Berms and interceptor ditches shall be provided to divert over the slope water away from all freshly graded slopes. Energy dissipators will reduce the force of the flow from leasehold drains prior to discharging runoff into natural channels.

Erosion control seeding methodology shall be site specific. Hydroseeding has proven to be an effective method of applying seed, fertilizer, and mulch. However, on coarse-textured fill slopes, broadcast seeding with coated seed and pelleted mulch may prove to be more effective. Final locations for each method should be reviewed following the completion of grading operations.

Timely application of erosion control materials is important for good germination and subsequent vegetation establishment. All erosion control work (grading, drainage, riprap, and seeding) will be completed prior to November 1 of the construction year, if construction is allowed to start as scheduled.

In addition to these erosion control measures, several additional preventive measures are also suggested. These are as follows:

- o Construction activities will be restricted to the smallest area feasible.
- o Earthmoving activities will be suspended during high precipitation periods, typically December through March, to avoid disturbance during the months of high intensity storms.
- o Except at road crossings a buffer zone of 250 feet (76 m) on each side of the stream will be established in which no ground disturbance will be allowed.
- o Filling operations will take place during the dry season, leaving adequate time before the heavy rains of late fall and winter for hydromulch

seeding of exposed soil to sprout and establish itself. The establishment of vegetative ground cover prior to the rainy season can be promoted by irrigating the hydromulch.

- o Revegetation efforts will take into account the low fertility of the soils involved. Topsoil will be stockpiled and replaced after construction. Fertilization and mulching will be provided and vegetative cover will be established on disturbed areas prior to the arrival of winter storms.
- o Dust will be controlled through surfacing the access road or at least regular watering. Road watering for dust control will be regulated to prevent runoff on natural drainage courses in compliance with Central Valley Regional Water Quality Control Board requirements.
- o A long-range fire management plan will be developed to accommodate the increase in fire hazard plus the historic trends toward natural fire in the region.
- o Temporary erosion control measures will be used during the construction of cut and fill slopes, the foundations, and grading operations at the site by directing the surface runoff away from the disturbed areas, by stabilizing the soil stock pile, and by establishing vegetative cover.
- o Cut slopes will be terraced to reduce sheet erosion, to dissipate runoff velocity, and to provide favorable sites for revegetation.
- o Runoff from the cut slopes will flow through a series of check dams or sediment ponds which will collect material eroding from the slope.
- o The plant site shall be bermed to control accidental spills.

MONITORING PROGRAM

The Oxy Geothermal Plant No. 1 water quality monitoring program will begin just prior to the onset of plant and access road construction (spring 1982), and it shall continue for four years (through 1986). Baseline data for the site has been collected and is reported in the AFC. A schedule for implementing the mitigation plan is shown in Table 5, and the schedule for the monitoring program is presented in Table 6. (See Soils Appendix D.) Monitoring methodologies are briefly discussed as follows:

Erosion, Sediment, and Spill Control Monitoring

The BLM requirement that Oxy chip seal the access road from Drill Pad C to B, coupled with Oxy's proposal to place crushed rock in the adjacent drainage ditch, will significantly decrease erosion from the roadway.

Occidental should be required to monitor the soil losses from fill slopes by keeping track of the tons of sediment removed from drain ditches and/or by the placement and periodic reading of slope stakes.

Pre-, during, and postproject photographs should be taken by Occidental to indicate the impacts of their construction on the soil resource. Occidental should take photographs after mitigation practices have been established to indicate the effectiveness of such practices to protect the soils and waters of the Anderson Creek watershed.

CUMULATIVE IMPACTS--SOILS

SETTING

The California Department of Conservation in 1972¹¹* described the problems affecting soils along the North Coast of California as follows:

"The degradation of soil resources in north coastal watersheds is indicated by accelerated soil erosion, soil mass movements, and accelerated stream bank erosion. These problems are largely man induced, resulting from over grazing, road construction, timber harvesting, and conversion of forest to rangeland. Watershed disturbances of this nature increase runoff, thereby accelerating stream bank erosion."

As an example they cite soil erosion rates of 15 tons/acre/year and 7 tons/acre/year in the Eel and Mad River basins, respectively. These rates are much higher than the one to three tons/acre/year these soils can sustain. Similar conditions exist on the Oxy leasehold. The predicted loss from the Oxy site of 200 tons/acre/year during construction and 6 tons/acre/year after construction exceed recommended rates.

Roads in areas impacted by urban development in California have increased erosion from 2 to 360 times existing levels depending on the total length of roads per unit of drainage area. A 1971 study by the Department of Conservation¹² indicated roads to be a major cause of soil erosion, as shown in the following table:

Water Erosion Due to Road Density

<u>Area</u>	<u>Density*</u>	<u>Erosion</u>
North Coast	1 mile/mile ²	0.03 tons/acre
Lake Tahoe	2 miles/mile ²	0.20 tons/acre
Colma Creek	13 miles/mile ²	8 tons/acre

*Density equals miles of road length per square mile of drainage basin.

Density of access roads in the Anderson Creek watershed portion of the Oxy leasehold will be 2.29 miles/mile². Steam lines add an additional 1.5 miles/mile² of disturbance. A study conducted by the U.S. Department of Agriculture and the California Department of Water Resources^{13,14} indicated that 51, 67, and 85 percent of the sediment recorded in the Klamath, Trinity, and Smith River basins, respectively, was due to road construction.

Roads comprise 0.4 percent of the land area in the Klamath, Trinity, and Smith River basins. The 11.7 acres of roads proposed for the Occidental leasehold

*Note: All footnotes in this section are keyed to Soils References, which are listed at the back of the Soils section.

will occupy 0.2 percent of the Anderson Creek watershed above the confluence with Putah Creek.

Most of the roads in the north coastal basin, unlike those proposed by Occidental, were unsurfaced. However, erosion from the road surfaces was characterized as an "added minor problem." The chief source of sediment was unstable cut banks which were necessarily wide in steep terrain.

Cut and fill surfaces on the Occidental site may not be as wide as those cited, but the terrain is steep, the soils erodible, and the Franciscan formation is subject to instability. Until the cuts and fills are revegetated, they will be subject to erosion and soil loss.

Near The Geysers KGRA the Dry Creek Basin in Sonoma County yielded sediment at a rate of nine tons/acre/year,¹⁵ the highest rate in the Russian River Basin. The erosion is attributed to the conversion of 40 percent of the forest land to rangeland in the basin in the early 20th century.

IMPACT

Oxy will remove the vegetation and disturb soils on 50 acres or 9 percent of their leasehold. Ordinarily the amount of disturbance proposed by Occidental would not be alarming were it not for the fact that the disturbance is at the headwaters of Anderson and Gunning creeks. Not only is there potential to lose the soil and vegetation resources but also to degrade a domestic water supply.

Of particular concern is the proximity of Drill Pad B to Gunning Creek and the encroachment on Anderson Creek of the access road from Drill Pad C to Drill Pad B. The Maymen-Etsel and Harbin-Whispering Soil Associations underlying Drill Pad B are highly erodible and repose on steep (30 - 50 percent) slopes. The U.S. Geological Survey¹⁶ characterized the revegetation of the 60 foot cut and fill slopes as "extremely difficult of accomplishment." As stated earlier, the conversion of forested and woodland slopes to grassland has resulted in excessive soil losses under similar circumstances. Initial revegetation of cut and fill slopes with grasses, as proposed by Occidental, will result in higher soil losses than if the brush covered slopes remained undisturbed.

The access road from Drill Pad C crosses five soil complexes and associations en route to Drill Pad B. However, the majority of the route is underlain by the Maymen-Hopland-Woodin Association and Maymen-Estel Complex, particularly where it crosses Anderson Creek. Not only are these soils highly erodible but also the fertility value is low with a magnesium-calcium imbalance. Taken together these properties indicate a high erosion potential and difficulty in revegetation of disturbed slopes. Similar soils developed on the Franciscan Formation at the University of California Experiment Station at Hopland, produced 10 times as much sediment (1.9 tons to 19 tons per acre) after the native vegetation had been removed and the slopes reseeded.¹⁷

What has been said for Drill Pad B and the access road from Drill Pad C to B could also be said for the other drill pads. In the "Five Tract EAR"¹⁸ the Bureau of Land Management stated that generally the soils on Tract D (Occidental leasehold) are low in fertility, with nitrogen the most limiting

nutrient. However, the soils developed from/on serpentines, e.g., Henneke (Drill Pad C), are very deficient in nitrogen phosphorous and calcium and moderately so in sulfur, molybdenum, and potassium.¹⁹ Calcium/magnesium imbalances will inhibit the establishment of vegetative cover unless corrected by the application of fertilizer and/or soil amendments.

Infiltration into the soils is moderately rapid. However, the soils are mostly shallow over nearly impervious bedrock with low water holding capacity. Any loss of native soils due to the anticipated high rates of erosion will further exacerbate a somewhat ungenerous environment for revegetation of cut and fill slopes.

Existing erosion hazards are high. The hazard will become higher yet when slopes are denuded of vegetation. The removal of existing vegetation under these conditions is a calculated risk. Whether or not it is a good or bad calculated risk depends on the effectiveness of the mitigation proposed by Oxy and the frequency, intensity, and duration of rainfall during and after construction.

MITIGATION

Oxy will utilize similar mitigation for Drill Pads A, C, and D as described for the power plant site. The surface of the access road from Drill Pad C to B will be chip sealed and the drainage ditches filled with crushed rock to slow the flow and capture the sediment. Extensive mitigation measures are planned and being implemented at Drill Pad B, which include:

1. Replacing the topsoil, fertilizing, and hydroseeding;
2. Placement of jute netting on the fill slope;
3. Installation of a 10 foot wide rock, rip rap apron at the toe of the fill slope; and
4. Installed placement of a silt screen composed of straw bales located downslope of the fill.

Oxy will divert the majority of the runoff from Drill Pad B away from Gunning and into Anderson Creek.

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HYDROLOGY

SETTING

WATERSHED DESCRIPTION

Occidental leasehold, CA 5636 and CA 5637, is located on the south face of Cobb Mountain along the ridgeline between Lake and Sonoma counties, California. The 7.4 acre plant site will be located in Lake County. Water Figure 1 shows major stream systems within the 550 acre leasehold. Drainage basin boundaries in the vicinity of the leasehold appear on Water Figure 2.

Surface flow from 85 percent of the leasehold drains south and east into Putah Creek via Anderson and Gunning creeks. Runoff from the remainder of the leasehold flows south and west into Big Sulphur Creek.

Anderson Creek, a tributary of Putah Creek, originates on the leasehold and drains 380 acres or 73 percent of the leasehold. Eighty-five acres in the northeastern corner of the leasehold drain into Gunning Creek, a tributary of Anderson Creek which rises immediately north of the leasehold boundary and flows southeastward across it. Tributaries of Big Sulphur Creek drain a thin 85 acre slice along the western boundary of the leasehold in Sonoma County.

Anderson Creek is a perennial stream with a total drainage of 8.8 square miles above its confluence with Putah Creek. Gunning Creek, which is also perennial, drains 1.3 square miles upstream from its junction with Anderson Creek. Above its confluence with Gunning Creek, Anderson Creek drains 1.6 square miles. Big Sulphur Creek dissects The Geysers KGRA as it flows northwest to its confluence with the Russian River. Along its course Big Sulphur Creek drains 82 square miles¹ (WRI 77-21) of the western slope of the Mayacmas Mountains before emptying into the Russian River at Cloverdale (USGS Gage 11-4632). Table 1 lists drainage areas for the various streams and tributaries in the vicinity of the leasehold.

Dry Creek near Middletown (USGS 11-4532) contains the closest stream gaging station suitable for correlation with peak runoff from Anderson and Gunning creeks.² Streamflow records at this station were collected for 13 years between 1959 and 1972.³ The drainage area above the station contains 8.35 square miles.⁴

PRECIPITATION

The majority of precipitation in the site vicinity occurs during the late fall and winter months. Rantz and Thompson (1967)⁵ reported that about 80 percent of the annual precipitation falls during the period November to March. The bulk of the rain comes during intense storms of relatively short duration. Snow falls occasionally on the leasehold, but the snow cover seldom lasts for more than a few days.

Precipitation in the vicinity of the site is measured at "The Geysers" (National Weather Service Station No. F90-8885). The rain gage is located 4.5 miles west of the site at an elevation of 1,668 feet.⁶ Mean annual precipitation for 38 years of record is 56.94 inches. Normal snowfall for the area averages 20 inches per year.⁷

OXY GEOTHERMAL #1

Source: Oxy #1 AFC, 1981

FIGURE 1: WATER-Area Streams

OXY GEOTHERMAL #1

Source: Oxy #1 AFC

LEGEND

No.	NAME
I	PUTAH CREEK ABOVE ANDERSON CREEK
II	GUNNING CREEK
III	ANDERSON CREEK ABOVE PUTAH CREEK
IV	BEAR CANYON CREEK

FIGURE 2: WATER-Drainage Basins Near the Leasehold Area

WATER TABLE 1
DRAINAGE AREA OF STREAMS IN SITE VICINITY

<u>Stream Description</u>	<u>Drainage (sq mi)</u>	<u>Area (ac)</u>
Anderson Creek upstream of Putah Creek	8.8	5632
Bear Canyon Creek upstream of Anderson Creek	3.3	2112
Anderson Creek upstream of unnamed tributary	3.5	2240
Gunning Creek upstream of Anderson Creek	1.3	832
Unnamed tributary upstream of Anderson Creek	0.8	512
Anderson Creek upstream of leasehold boundary	0.5	320
Gunning Creek upstream of leasehold boundary	0.3	192
Leasehold area within Big Sulphur Creek Basin	0.1	64
Putah Basin Creek upstream of Anderson Creek	4.9	3136

Source: Calculated from USGS The Geysers and Whispering Pines 7 1/2" Quadrangles

WATER TABLE 2
HIGHEST RECORDED ANNUAL PRECIPITATION
(1940 - 1974)

<u>Item</u>	<u>Duration (hr)</u>							
	<u>1/4</u>	<u>1/2</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>6</u>	<u>12</u>	<u>24</u>
Highest Annual Precipitation at Station 8885 (depth in inches)	0.92	1.25	1.74	2.03	2.48	3.74	5.91	9.58
Transposition Ratio	1.22	1.22	1.22	1.27	1.32	1.36	1.38	1.41
Transposed Highest Annual Precipitation at Occidental Site (depth in inches)	1.12	1.53	2.12	2.58	3.27	5.09	8.16	13.51
Record Year	1958	1958	1958	1966	1966	1962	1940	1955

Water Table 2 shows maximum annual precipitation at "The Geysers" for specified durations. These values represent the highest recorded during the period 1940 through 1974.⁸ Annual precipitation at the plant site is approximately 80 inches, based on a mean annual precipitation map prepared by Rantz in 1969.⁹

Water Table 2 presents comparable values for the leasehold. Oxy consultants developed the values using the Rantz method for transposing recorded precipitation data from one site to another, based on the ratio of mean annual rainfall at the sites.¹⁰ Water Table 3 describes frequency-intensity-duration data for the site area for various return periods.

Probable Maximum Precipitation (PMP)

Storms in the site area are generally either the frontal-type general storm which occurs from October through April or the convective-type thunderstorm which occurs during the summer and early fall. Values for the one square mile Probable Maximum Thunderstorm (PMT) for the site area appear in Water Table 4. The equivalent winter Probable Maximum Precipitation (PMP) monthly values are given in Water Table 5.

RUNOFF

The leasehold is located on the south face of Cobb Mountain. The plant site and Drill Pad A repose on a northwest to southeast trending ridge line, while Drill Pads B and D sit on the nose of ridges extending south from Cobb Mountain. All four sites are situated well above nearby streams and possess little upslope drainage. Therefore, CEC staff anticipates that the only runoff would come as the result of direct precipitation.

Site C is also located on a topographic ridge. Presently, runoff from upper slopes finds its way to the drainage arroyo where the sump fill is to be placed. However, the ditches of the access road (now under construction) and the drainage diversion ditch planned above Site C will intercept and redirect the runoff from the slopes away from the site of construction. The only runoff remaining is that generated from the drill site slopes and nearby natural slopes. Such runoff is directed through paved or rock-lined ditches to culverts that discharge into natural drainage channels below the construction. Energy dissipators are employed in all culvert outlets.

The ephemeral seeps located in areas to be covered by the sump fill will be drained by underdrains, keyway drains, and drain blankets. The underdrains will discharge into the natural drainage channel below the fill. It is anticipated that the quantity of water from these ephemeral seeps will be substantially diminished due to the redirection of surface drainage from the slopes above.

The transmission towers are not subject to flooding because of their elevated position. Generally, the same is true of the access roads. An exception would be where the access road from site C to B crosses Anderson Creek. Steam lines will not be vulnerable to flooding as long as the crossings of Anderson Creek are properly designed and situated.

WATER TABLES

Table 3
RAINFALL FREQUENCY - DURATION
(Point Values of Accumulated Rainfall Depth in Inches -
from Annual Records)

Return Period (yr)	Duration (hr)						
	<u>1/2</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>6</u>	<u>12</u>	<u>24</u>
1	0.5	0.6	1.2	1.7	2.7	4.0	5.1
2	0.6	0.8	1.4	1.8	3.0	5.0	7.2
5	0.8	1.0	1.6	2.1	3.6	6.4	9.4
10	0.9	1.1	1.8	2.4	4.0	6.8	10.6
25	1.0	1.3	2.0	2.7	4.7	8.4	12.0
50	1.1	1.5	2.3	3.2	5.2	9.4	13.7
100	1.3	1.6	2.5	3.4	5.8	10.4	15.4

Source: Miller, Frederick, and Tracey. 1973.

Table 4
THUNDERSTORM PMP DEPTH - DURATION
(1 sq mi)

	Duration (hr)					
	<u>1/4</u>	<u>1/2</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>6</u>
Accumulated Depth (inches)	2.4	4.0	6.0	7.9	9.1	10.5

Table 5
WINTER STORM PMP - DURATION
(1 sq mi, Depth in Inches)

<u>Month</u>	<u>1/2</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>6</u>	<u>24</u>
Oct.	2.8	4.0	5.2	8.1	12.6	31.7
Nov.	2.7	3.8	5.0	7.7	12.3	32.1
Dec.	2.5	3.6	4.7	7.6	12.1	32.8
Jan-Feb.	2.4	3.5	4.6	7.4	12.0	33.2
Mar.	2.4	3.4	4.4	7.2	11.8	32.1
Apr.	2.4	3.4	4.4	7.1	11.3	30.1

Source: Hansen, Schwarz, and Riedel, 1971.

Rainfall intensity and duration, ground slope, vegetative cover, and soil conditions govern the amount of surface runoff. Ground slope in the leasehold is relatively steep (0.5 ft/ft or 50 percent) with the steepest slopes in the northwest portion of the leasehold. Two hundred and fifty cfs is expected to runoff the 320 acres in the Anderson Creek drainage during the 1:100 flood. CEC staff calculated the 250 cubic feet per second (cfs) using flood frequency equations developed by Waanen and Crippen¹¹ for the North Coast Region and developed 1:100 runoff quantities for the gaging station on Dry Creek near Middletown (Gage No. 11-4532).

FLOOD HAZARD

There is little likelihood of flooding at the plant site or drill sites A, B, C and D because of their elevated position and limited upstream drainage. However, the removal of existing vegetation and scalping of soils will increase the runoff from an additional 50.8 acres in The Geysers KGRA. The replacement of natural terrain, soils, and plant cover with buildings, paved lots, and denuded slopes will decrease infiltration and lag time and increase velocity, peak flows, and runoff volume from the affected areas.¹² Because of the small acreages involved, there would be little regional impact.

This project alone would not increase the flood hazard to downstream residents. The 50 acres slated for disturbance in the Anderson Creek watershed amounts to less than 1 percent of the drainage area. However, the continued development of plant sites, roads, and drill pads could result in higher runoff, flooding, and sediment deposition within the Anderson Creek watershed.

EROSION, SEDIMENT YIELD, AND SEDIMENT TRANSPORT

Erosion

Soil loss due to erosion is governed by rainfall energy, soil characteristics, amount of ground cover, plus the length and steepness of slopes. Rainfall in The Geysers area is known for its highly erosive nature. The highest recorded rainfall at The Geysers exceeded the 1:1000 recurrence interval for rainfall received during 15 and 30 minute durations and also for the 1:200 one-hour storm.¹² Storms of high intensity and short duration are expected during the life of the Occidental power plant.

Soils underlying the leasehold erode badly when exposed to direct rainfall and overland flow (see Soils section). Natural ground slopes in the leasehold range from 20 to 100 percent. Ground cover consists mainly of brush, annual and perennial grasses, and scattered coniferous trees. Taken together, intense rainfall and erodible soils could lead to accelerated erosion on the leasehold.

Sediment Yield

CEC staff used Universal Soil Loss Equation¹³ to estimate annual soil losses due to sheet erosion on a pre-, during, and postconstruction basis. They used composite soil erodibility factors (K) in the equation which were taken from the Occidental AFC. During the first three years after construction, erosion rates could be as high as six tons per acre per year,

which still exceeds the rates at which upland soils form. The mitigation measures proposed by Occidental, if successful, could reduce postproject losses to one ton per acre per year on a long-term basis. One ton per acre per year is within the one to three tons per acre per year which could be tolerated by leasehold soils. Annual preproject erosion was estimated to be 3.2 tons per acre. During construction when soil surfaces are fully exposed on steep slopes, erosion losses could increase to more than 200 tons per acre.

Waterborne sediment from the Anderson and Gunning creeks watershed may travel as far down Putah Creek as Lake Berryessa during years of high runoff. The majority of suspended sediment is transported during the period November through March, which corresponds with the period of heaviest rainfall, greatest runoff, and highest erosion potential. Experience has shown that 90 percent or more of the annual sediment yield may occur in 1 or 2 days of flood flow.¹⁴ The USGS gaging station on Putah Creek near Guenoc recorded levels of total suspended solids for the water years 1962 through 1973. Daily records were taken from December 1964 through March 1965. A summary of these records appears in Water Table 6. During this very high runoff period, the mean sediment concentration exceeded the "nondrinkable" level (27 mg/l)¹⁵ on 24 days. In 1965 two geothermal plants in the KGRA produced only 24 megawatts of electricity. Presently this known geothermal resource area contains 15 sites with a total output of 908 megawatts. Therefore, the sediment loads do not reflect the potential disturbance due to geothermal development in the Putah Creek Watershed. On the other hand, sediment loads carried by Northern California streams during the very wet 1964-65 water year were probably two to five times as great as would normally be expected.¹⁶

Brown and Caldwell¹⁷ recently completed a study of the Anderson Springs water gathering system on behalf of Occidental Geothermal, Inc. Based on existing records and data collected by them, they found water quality downstream from the Occidental leasehold to be generally good, with occasional high values for turbidity, iron, manganese, chromium, sulfate, and total dissolved solids.

They concluded that after heavy rainfall, water supplied by the Anderson Springs Water Company may violate California Department of Health Services criteria for turbidity. Increases in suspended solid concentrations were observed in Gunning Creek at the Ford Flat Road crossing after locally heavy rainfall. See Water Table 7.

Between March 1978 and February 1980, PGandE and Aminoil, Inc., conducted a two-year water quality monitoring program of the Upper Putah Creek drainage basin. This program consisted of monthly sampling during the first year and quarterly sampling the second (Water Table 8). Based on the one year of data, the interim report for the first year of the two-year water quality monitoring program contained some interesting insights into the relative water quality of streams in the Anderson Creek drainage basin.¹⁸

Only those tributaries of Anderson Creek which could be influenced by activities on the Occidental Leasehold have been included. See Figure 3 and Table 8.

It was noted that the water quality characteristics of Anderson Creek change as it flows towards its mouth due to inflow from several tributaries. Inflow from the intermittent tributary which flows from PGandE's Unit 13 along the Socrates Mine Road contributed both dissolved and suspended solids during run-off periods. This inflow resulted in increased specific conductance and higher turbidity. Further downstream, the higher quality inflow from Gunning Creek caused a noticeable drop in specific conductance, total dissolved solids, and sulfates in Anderson Creek.

Water Table 9 also summarizes the number of turbidity samples taken at each station (16) and the number of those samples which exceeded the corresponding maximum contaminant level (MCL).* As many as nine samples per station exceeded the MCLs for turbidity.

Note that turbidity increased in the downstream direction on both Gunning and Anderson creeks. All of the maximum turbidity values exceeded the monthly average MCL of 1.0 turbidity unit for surface water sources not exposed to significant sewage hazards or significant recreational use. CEC staff points out, however, that the average turbidities at stations G-1.2 (0.45 mg/l) and G-0.3 (0.67 mg/l) on Gunning Creek were less than the MCL.

LOCAL AND REGIONAL GROUNDWATER AQUIFERS

Regional

No regional groundwater aquifers of significant yield have been reported in the rock formations of the Mayacmas Mountains in The Geysers area. The area is principally underlain by fractured sedimentary rock belonging to the Franciscan formation of the Jurassic-Cretaceous age. Franciscan rocks are generally classified as nonwater bearing except along fracture zones, which may contain minor amounts of groundwater. Small quantities of groundwater may also be present in unconsolidated surficial materials, especially in landslide deposits.¹⁹

Significant groundwater basins exist in the alluvium of the valleys at the base of either side of the Mayacmas mountain range. United States Geological Survey Water-Supply Papers²⁰ and State of California Department of Water Resources^{21,22} bulletins contains well locations, records of water levels, and groundwater contour maps for these valley areas.

Local

Test borings and subsurface exploration at the Oxy project site indicate that no significant groundwater aquifers exist within 75 feet of ground surface.²³ Occidental's investigation of the leasehold also revealed no significant groundwater resources in the project site vicinity. However, free water was encountered in all test borings at the plant site.²⁴ Energy Commission staff observed standing water in drill holes on Pad "D" during June of 1981.

*"MCL" is the level of contaminant which, if exceeded, would present a risk to the health of humans when used continually for drinking or culinary purposes. These standards are contained in the "California Domestic Water Quality and Monitoring Regulations," Title 22, CAC.

Springs which feed Anderson Creek and Gunning Creek from the northeast occur generally at the base of the Cobb Mountain Rhyolite, with their recharge area lying at higher elevations on Cobb Mountain. Activities at the proposed site should not affect or be affected by groundwater, because the groundwater rises at higher elevations and is separated from the proposed power plant site by a number of drainages. Recharge characteristics and topography of the proposed plant site indicate that groundwater, other than perched or trapped water, lies at a depth of several hundred feet.

WATER TABLE 6
SUSPENDED SEDIMENT - PUTAH CREEK NEAR GUENOC, CALIFORNIA
 December 1964 to March 1965
 Loads are estimated where no concentrations are reported.

DECEMBER				JANUARY		
DAY	SUSPENDED SEDIMENT			SUSPENDED SEDIMENT		
	MEAN DISCHARGE (cfs)	MEAN CONCENTRATION (ppm)	TONS PER DAY	DISCHARGE (cfs)	MEAN CONCENTRATION (ppm)	TONS PER DAY
1	74	----	0.4	709	----	23
2	76	----	0.4	1210	210	1800
3	61	----	0.2	3310	425	4280
4	53	----	0.1	2910	339	3630
5	50	----	0.1	10100	1890	64000
6	45	----	0.1	4660	949	12600
7	42	----	0.1	2490	346	2520
8	40	----	0.1	1410	110	419
9	38	----	0.1	1000	33	89
10	36	1	0.1	787	20	42
11	43	----	0.2	689	----	30
12	42	----	0.2	568	----	21
13	36	----	0.2	467	----	18
14	34	----	0.2	400	----	15
15	35	----	0.2	354	----	12
16	33	----	0.2	308	----	11
17	31	----	0.2	282	----	9.1
18	31	----	0.2	256	12	8.3
19	229	39	35	242	----	7.2
20	983	244	850	229	----	6.2
21	7230	1240	30700	208	----	4.5
22	14800	1580	67000	194	----	2.6
23	6930	866	18800	1340	459	4190
24	2630	438	3450	1580	119	598
25	1270	108	392	745	27	54
26	2300	515	5000	545	16	24
27	2160	241	1500	439	----	17
28	1370	62	229	377	----	12
29	1230	46	153	311	----	8.9
30	1140	37	114	296	----	6.4
31	991	25	67	272	----	5.1
TOTAL	44063	----	128293.3	38708	----	94463.3

WATER TABLE 6 (con't)

SUSPENDED SEDIMENT - PUTAH CREEK NEAR GUENOC, CALIFORNIA

December 1964 to March 1965

Loads are estimated where no concentrations are reported.

FEBRUARY

MARCH

DAY	MEAN DISCHARGE (cfs)	SUSPENDED SEDIMENT		DISCHARGE (cfs)	SUSPENDED SEDIMENT	
		MEAN CONCENTRATION (ppm)	TONS PER DAY		MEAN CONCENTRATION (ppm)	TONS PER DAY
1	249	----	4.0	101	----	0.8
2	227	----	3.1	98	----	0.8
3	210	----	2.3	93	----	0.8
4	208	----	2.8	90	----	0.7
5	532	35	55	90	----	0.7
6	331	9	8.0	95	3	0.8
7	260	----	3.5	92	----	0.7
8	331	----	3.6	86	----	0.7
9	212	----	1.7	83	----	0.4
10	194	----	1.0	82	----	0.4
11	182	2	1.0	82	2	0.4
12	173	----	0.9	81	----	0.4
13	---	----	---	78	2	0.4
14	157	----	0.8	76	----	0.4
15	148	----	0.8	75	----	0.4
16	141	----	0.8	72	----	0.4
17	134	----	0.7	71	----	0.4
18	128	----	0.7	69	----	0.2
19	125	----	0.7	67	----	0.2
20	120	----	1.0	64	----	0.2
21	115	3	0.9	62	----	0.2
22	114	----	0.9	61	----	0.2
23	109	----	0.9	60	----	0.2
24	104	----	0.8	58	----	0.2
25	102	----	0.8	57	----	0.2
26	99	----	0.8	60	----	0.2
27	131	3	1.1	203	32	24.
28	109	----	0.9	118	----	2.2
29	---	----	---	92	----	1.2
30	---	----	---	86	----	0.9
31	---	----	---	86	----	0.7
TOTAL	5007	----	100.4	2588	----	40.4

Source: USGS 1965. "Quality of Surface Waters of the United States," Parts 9 through 11, Colorado River Basin to Pacific Slope Basins in California.

WATER TABLE 7
RAINFALL AND SUSPENDED SOLIDS DATA FOR
SPOT SAMPLING OF GUNNING CREEK - 1980-81

Date	Rainfall, ^a Inches	Suspended solids, mg/l	
		Gunning Creek	Tributary
12-12	0.00	<0.4	1
12-21	4.65	2	0.4
12-22	0.00	0.4	<0.4
12-23	0.00	0.4	<0.4
12-24	0.00	1	<0.4
1-16	0.87	0.7	4
1-17	0.79	0.4	4
1-18	0.00	<0.6	0.7
1-19	0.68	2	0.7
1-20	0.63	0.7	0.4
1-22	0.20	2.5	13
1-23	1.59	4.6	5.1
1-24	0.01 ^b	1.4	1.1
1-25	0.00	1.3	1.5
1-26	1.30	1.1	0.8
1-27	3.91	7.4	8.2
1-28	0.81 ^b	4.4	4.9
1-29	0.20	3.2	1.5
1-31 ^c	0.01	2.7	0.9
2-1	0.00	1.8	1.1

^aRainfall data taken at PGandE Power Plant 13, located about 2,300 meters south and 200 meters higher than the water quality monitoring stations.

^bSome rainfall data lost due to rain gage malfunction.

^cNo suspended solids samples taken on January 30, 1981, owing to snow which prevented site access.

WATER TABLE 8a

WATER QUALITY CHARACTERISTICS AT STATION A2.7, 1977-1980

Characteristic	Units	3/6/78	4/4/78	5/1/78	6/8/78	7/5/78	8/1/78	9/6/78	10/4/78	11/7/78	12/5/78	1/3/79	2/5/79	5/8/79	8/22/79	11/7/79	2/4/80
Steam Flow	gpm	11,100	9,300	2,370	950	1,200	200	730	50	46	177	120	1,170	3,320	310	1,700	1,900
Water Temperature	°C	10.5	9.5	13.0	18.5	17.0	20.0	15.0	14.0	11.5	7.0	6.0	6.0	10.5	13.5	12.0	10.5
pH		8.1	8.0	7.8	7.9	7.9	7.5	7.5	7.3	7.3	7.2	7.7	7.8	7.8	7.4	8.0	7.9
Specific Conductance	umho/cm	142	163	179	181	163	150	146	149	132	183	158	204	181	150	209	167
Turbidity	JTU	1.90	6.30	0.60	0.30	0.20	0.40	0.30	1.30	0.30	1.30	1.00	1.00	1.80	0.33	7.8	1.2
Total Dissolved Solids	mg/l	73	116	96	164	86	86	102	110	108	116	76	123	94	103	116	100
Total Suspended Solids	mg/l	4.0	4.6	0.8	1.6	2.0	0.8	0.8	12.0	<0.8	4.4	2.8	183	1.6	1.2	3.8	2
Chemical Oxygen Demand	mg/l	—	<5	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dissolved Oxygen	mg/l	10.6	10.6	9.9	8.5	8.6	7.8	8.7	9.0	9.6	10.7	13.4	11.0	11.0	9.4	9.8	9.9
Alkalinity	mg/l as CaCO ₃	65	—	—	82	—	—	67	—	—	78	—	—	89	72	98	78
Hardness	mg/l as CaCO ₃	62	—	—	76	—	—	59	—	—	70	—	—	92	65	99	76
Oil and Grease	mg/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ammonia, Total	mg/l as N	<0.05	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.02	0.01	0.09	<0.05
Ammonia, Unionized	mg/l as NH ₃	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	—	—	—	—
Nitrate Nitrogen	mg/l as N	<0.01	0.01	0.02	0.08	<0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	0.01
Nitrite Nitrogen	mg/l as N	<0.002	<0.004	0.004	<0.004	<0.004	<0.004	0.004	0.005	<0.004	<0.004	<0.004	<0.004	<0.004	<0.001	0.005	0.001
Sulfate	mg/l	3.8	4.1	5.1	4.4	4.2	3.7	3.9	3.7	4.3	6.3	5.9	6.9	5.1	2.8	8.6	4.7
Sulfides	mg/l	<0.008	<0.007	<0.009	<0.005	<0.030	<0.005	<0.010	<0.010	<0.020	<0.030	<0.020	<0.160	—	—	—	—
Aluminum	mg/l	<0.1	—	<0.1	—	<0.1	—	<0.1	—	0.1	—	0.1	—	0.1	0.1	1.0	0.1
Arsenic	mg/l	<0.001	—	<0.001	—	<0.001	—	<0.001	—	<0.001	—	<0.001	—	—	—	—	—
Boron	mg/l	0.16	0.11	<0.10	<0.10	<0.10	0.14	<0.10	—	0.10	0.18	<0.10	0.20	0.01	0.15	0.10	0.10
Cadmium	mg/l	<0.001	—	<0.001	—	<0.001	—	<0.001	—	<0.001	—	<0.001	—	—	—	—	—
Copper	mg/l	<0.001	—	0.003	—	0.004	—	0.002	—	<0.001	—	<0.001	—	—	0.005	—	—
Chromium	mg/l	0.00	—	<0.01	—	<0.01	—	<0.01	—	<0.01	—	<0.01	—	0.038	<0.001	0.015	<0.001
Iron	mg/l	0.27	—	0.08	—	<0.02	—	0.17	—	0.17	—	0.20	—	0.05	<0.01	0.66	0.22
Lead	mg/l	<0.001	—	<0.001	—	<0.001	—	0.003	—	<0.001	—	0.005	—	<0.001	<0.001	0.010	0.006
Mercury	mg/l	0.05	—	<0.02	—	<0.02	—	<0.02	—	<0.02	—	0.30	<0.02	<0.02	<0.02	<0.02	<0.02
Nickel	mg/l	0.003	—	0.004	—	<0.001	—	0.004	—	0.007	—	0.018	—	0.004	0.019	0.022	0.002
Selenium	mg/l	<0.002	—	—	<0.002	—	—	<0.002	—	—	<0.002	—	—	—	—	—	—
Vanadium	mg/l	<0.1	—	—	—	—	—	<0.1	—	—	—	—	—	—	—	—	—
Zinc	mg/l	0.005	—	0.001	—	<0.001	—	<0.001	—	0.007	—	0.013	—	0.020	0.026	0.005	0.001

Sources: Brown and Caldwell, 1979 and 1980; PGandE, 1979.

WATER TABLE 8b
WATER QUALITY CHARACTERISTICS AT STATION A2.8, 1977-1980

Characteristic	Units	3/6/78	4/4/78	5/1/78	6/8/78	7/5/78	8/1/78	9/6/78	10/9/78	11/7/78	12/5/78	1/3/79	2/5/79	5/8/79	8/22/79	11/7/79	2/4/80
Steam Flow	gpm	11,700	8,800	1,710	920	330	140	630	70	42	120	100	670	2,220	200	1,100	1,400
Water Temperature	°C	10.5	9.8	13.0	18.0	17.0	19.5	14.5	14.0	11.5	7.5	6.0	6.0	10.5	13.5	12	10.5
pH		8.1	7.8	7.6	7.9	7.8	7.5	7.5	7.3	7.5	7.2	7.6	7.7	7.7	7.3	7.9	7.9
Specific Conductance	umho/cm	120	148	147	159	148	150	147	148	124	161	133	163	160	145	180	143
Turbidity	JTU	1.60	2.40	0.50	0.25	0.20	0.40	0.30	0.30	0.30	0.35	0.25	0.50	0.35	2.7	0.65	0.75
Total Dissolved Solids	mg/l	94	92	72	152	88	82	106	112	114	92	86	108	89	99	116	101
Total Suspended Solids	mg/l	1.7	2.4	0.8	<0.8	0.8	0.8	<0.8	0.8	<0.8	2.8	<0.8	2.0	<0.8	1.2	1.2	<1
Chemical Oxygen Demand	mg/l	—	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dissolved Oxygen	mg/l	10.0	10.6	9.9	8.6	8.8	7.7	8.8	9.0	9.6	10.7	13.2	12.0	11.0	9.2	9.8	10.0
Alkalinity	mg/l as CaCO ₃	53	—	—	70	—	—	68	—	—	68	—	—	77	70	82	64
Hardness	mg/l as CaCO ₃	51	—	—	64	—	—	58	—	—	50	—	—	77	64	80	64
Oil and Grease	mg/l	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ammonia, Total	mg/l as N	0.05	<0.05	<0.05	0.06	0.12	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.02	0.01	<0.01	<0.05
Ammonia, Unionized	mg/l as NH ₃	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	—	—	—	—
Nitrate Nitrogen	mg/l as N	<0.01	0.01	0.01	0.06	<0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
Nitrite Nitrogen	mg/l as N	0.003	<0.004	0.004	<0.004	0.004	<0.004	0.004	0.005	<0.004	<0.004	<0.004	<0.004	<0.004	<0.001	0.003	<0.001
Sulfate	mg/l	3.4	3.9	4.8	3.9	3.2	4.0	3.9	4.1	4.1	7.0	4.9	6.2	4.6	2.9	6.1	4.2
Sulfides	mg/l	<0.008	<0.007	<0.005	<0.005	<0.010	<0.008	<0.010	<0.010	<0.020	<0.010	<0.010	<0.020	—	—	—	—
Aluminum	mg/l	0.2	—	<0.1	—	<0.1	—	<0.1	—	<0.1	—	<0.1	—	<0.1	<0.1	0.2	<0.1
Arsenic	mg/l	<0.001	—	<0.001	—	<0.001	—	<0.001	—	<0.001	—	<0.001	—	—	—	—	—
Boron	mg/l	0.14	<0.10	<0.10	<0.10	<0.10	0.15	<0.10	<0.10	<0.10	0.10	<0.10	<0.20	0.08	0.13	<0.10	0.10
Cadmium	mg/l	<0.001	—	<0.001	—	<0.001	—	<0.001	—	<0.001	—	<0.001	—	—	—	—	—
Copper	mg/l	0.002	—	0.002	—	0.003	—	0.002	—	<0.001	—	<0.001	—	—	0.001	—	—
Chromium	mg/l	0.00	—	<0.01	—	<0.01	—	<0.01	—	<0.01	—	<0.01	—	<0.001	<0.001	<0.001	<0.001
Iron	mg/l	0.15	—	0.08	—	<0.02	—	0.13	—	0.13	—	<0.02	—	<0.01	0.03	0.22	0.08
Lead	mg/l	0.001	—	<0.001	—	<0.001	—	0.002	—	<0.001	—	0.008	—	<0.001	<0.001	0.004	0.001
Mercury	mg/l	<0.02	—	<0.02	—	<0.02	—	<0.02	—	<0.02	—	0.45	<0.02	<0.02	<0.02	<0.02	<0.02
Nickel	mg/l	0.003	—	<0.005	—	0.002	—	0.003	—	0.007	—	0.012	—	<0.02	0.007	0.033	0.003
Selenium	mg/l	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Vanadium	mg/l	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Zinc	mg/l	0.005	—	<0.001	—	0.001	—	0.001	—	<0.001	—	0.005	—	<0.001	0.001	<0.001	0.010

Sources: Brown and Caldwell, 1979 and 1980; PGandE, 1979.

WATER TABLE 8c

WATER QUALITY CHARACTERISTICS AT STATION G1.2 1977-1980

Characteristic	Units	3/6/78	4/4/78	5/1/78	6/8/78	7/5/78	8/1/78	9/6/78	10/9/78	11/7/78	12/5/78	1/3/79	2/5/79	5/8/79	8/22/79	11/7/79	2/4/80
Steam Flow	gpm	5,200	2,000	1,000	1,200	1,000	770	810	265	370	211	360	400	1,060	600	680	2,900
Water Temperature	°C	11.0	10.6	13.5	15.0	15.0	16.5	13.1	14.0	11.5	9.0	9.0	6.0	10.5	13.5	12.0	12.0
pH		7.9	7.8	7.3	7.7	7.6	7.4	7.2	7.1	7.2	6.9	7.2	7.4	7.2	7.1	7.5	7.5
Specific Conductance	umho/cm	70	75	73	83	81	86	84	81	72	87	76	74	77	78	84	74
Turbidity	JTU	0.63	1.30	0.45	0.30	0.25	0.40	0.35	0.55	0.30	0.35	0.35	0.35	0.30	0.37	0.40	0.63
Total Dissolved Solids	mg/l	80	76	52	116	64	42	78	62	86	60	72	70	72	71	71	65
Total Suspended Solids	mg/l	1.2	2.8	1.8	1.2	1.6	1.6	0.8	6.0	<0.8	2.8	0.8	<0.8	2.4	2.4	1.8	2
Chemical Oxygen Demand	mg/l	—	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dissolved Oxygen	mg/l	9.9	10.4	9.5	9.1	9.2	8.8	9.5	9.4	9.6	10.4	13.0	12.3	11.2	9.3	9.6	9.3
Alkalinity	mg/l as CaCO ₃	29	—	—	37	—	—	39	—	—	36	—	—	36	38	39	35
Hardness	mg/l as CaCO ₃	23	—	—	27	—	—	29	—	—	28	—	—	28	27	30	25
Oil and Grease	mg/l	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ammonia, Total	mg/l as N	<0.05	<0.05	0.05	<0.05	0.24	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.02	<0.01	<0.01	<0.05
Ammonia, Unionized	mg/l as NH ₃	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	—	—	—	—
Nitrate Nitrogen	mg/l as N	<0.01	0.01	0.02	<0.04	<0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrite Nitrogen	mg/l as N	<0.002	<0.004	<0.004	<0.004	<0.004	<0.004	0.004	0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.001	<0.003	<0.001
Sulfate	mg/l	<1.0	<1.3	2.1	1.1	0.9	<1.9	<1.9	2.0	2.2	3.5	<1.0	2.1	1.1	1.0	<2	1.1
Sulfides	mg/l	<0.008	<0.007	<0.005	<0.005	<0.015	<0.007	<0.010	<0.010	<0.020	<0.005	<0.005	<0.020	—	—	—	—
Aluminum	mg/l	0.2	—	<0.1	—	<0.1	—	<0.1	—	<0.1	—	<0.1	—	<0.1	<0.1	0.1	<0.1
Arsenic	mg/l	<0.001	—	<0.001	—	<0.001	—	<0.001	—	<0.001	—	<0.001	—	—	—	—	—
Boron	mg/l	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	<0.10	<0.20	0.02	<0.10	<0.10	<0.10
Cadmium	mg/l	<0.001	—	<0.001	—	<0.001	—	<0.001	—	<0.001	—	<0.001	—	—	—	—	—
Copper	mg/l	0.002	—	0.002	—	0.002	—	0.002	—	0.004	—	<0.001	—	—	0.005	—	—
Chromium	mg/l	0.00	—	<0.01	—	<0.01	—	<0.01	—	<0.01	—	<0.01	—	0.033	<0.001	<0.001	<0.001
Iron	mg/l	0.09	—	0.08	—	<0.02	—	0.13	—	0.23	—	0.09	—	0.10	<0.07	0.44	0.06
Lead	mg/l	<0.001	—	<0.001	—	<0.001	—	<0.001	—	<0.001	—	0.008	—	0.004	<0.001	0.005	0.006
Mercury	mg/l	<0.02	—	<0.02	—	<0.02	—	<0.02	—	<0.02	—	0.26	<0.02	<0.02	<0.02	<0.02	<0.02
Nickel	mg/l	0.002	—	0.006	—	0.007	—	0.001	—	0.007	—	0.011	—	<0.001	0.009	0.035	0.003
Selenium	mg/l	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Vanadium	mg/l	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Zinc	mg/l	0.002	—	<0.001	—	0.006	—	<0.001	—	0.006	—	0.004	—	0.014	0.007	<0.001	0.009

Sources: Brown and Caldwell, 1979 and 1980; PGandE, 1979.

OXY GEOTHERMAL # 1

Characteristics	Unit	3/6/78	4/4/78	5/1/78	6/8/78	7/5/78	8/1/78	5/6/78	10/9/78	11/7/78	12/5/78	1/3/79	2/5/79	5/8/79	8/2/79	11/7/79	2/4/80
Stream Flow	gpm	65,400	15,100	4,430	2,500	2,140	1,040	1,150	1,520	416	500	490	1,480	4,600	1,090	2,800	6,900
Water Temperature	°C	11.5	10.8	14.0	19.0	17.0	19.5	15.6	15.0	12.5	8.0	6.0	6.0	9.9	18.0	12.0	10.5
pH		7.7	7.8	7.8	7.9	7.9	7.5	7.4	7.2	7.3	7.2	7.5	7.8	7.7	7.6	7.9	7.9
Specific Conductance	µmho/cm	129	151	161	146	128	126	118	116	99	136	111	167	177	123	183	143
Turbidity	JTU	3.0	8.90	0.75	0.40	0.25	0.40	0.45	1.30	0.65	2.10	1.20	7.50	7.10	0.75	23.00	1.30
Total Dissolved Solids	mg/l	74	128	96	84	68	60	88	92	82	98	72	111	101	85	126	91
Total Suspended Solids	mg/l	6.2	6.4	1.2	1.6	2.4	<0.8	<0.8	1.6	<0.8	5.2	<0.8	3.2	13.2	1.2	20.0	3.0
Chemical Oxygen Demand	mg/l	<5	<5	6	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Dissolved Oxygen	mg/l	10.0	10.8	9.6	8.8	9.0	8.5	9.3	9.4	9.9	11.0	12.0	12.4	11.4	9.2	9.9	10.0
Alkalinity	mg/l as CaCO ₃	58			68			55			59			87	59	84	68
Hardness	mg/l as CaCO ₃	54			60			41			48			87	51	83	63
Oil and Grease	mg/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ammonia, Total	mg/l as N	0.05	<0.05	<0.05	0.06	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.02	<0.01	<0.01	<0.05
Ammonia, Unionized	mg/l as NH ₃	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrate Nitrogen	mg/l as N	<0.01	0.10	0.01	0.07	<0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	0.03	<0.01
Nitrite Nitrogen	mg/2 as N	0.003	0.005	0.004	<0.004	0.005	<0.004	0.004	0.006	<0.004	0.004	0.004	<0.004	0.005	<0.001	0.005	<0.001
Sulfate	mg/l	3.2	3.1	4.0	2.3	4.9	3.9	2.2	2.0	2.4	4.0	2.8	5.8	5.9	1.8	5.9	3.4
Sulfides	mg/l	<0.008	<0.007	<0.007	<0.005	<0.025	<0.015	<0.020	<0.010	<0.020	<0.040	<0.030	<0.040				
Aluminum	mg/l	0.1		<0.1		<0.1		<0.1		<0.1		<0.1		1.2	<0.1	2.6	<0.1
Arsenic	mg/l	<0.001		<0.001		<0.001		<0.001		<0.001		<0.001					
Boron	mg/l	0.17	<0.10	<0.10	<0.10	<0.10	0.19	0.14	<0.10	<0.10	0.18	<0.10	<0.20	0.05	<0.10	0.10	<0.10
Cadmium	mg/l	<0.001		<0.001		<0.001		<0.001		<0.001		<0.001					
Copper	mg/l	0.001		0.003		0.003		0.001		0.004		<0.001					
Chromium	mg/l	<0.00		<0.01		0.01		<0.01		0.02		<0.01		0.04	<0.00	0.01	<0.00
Iron	mg/l	0.27		0.12		0.02		0.10		0.33		0.09		0.80	0.04	1.90	0.24
Lead	mg/l	0.037	0.011	<0.001		<0.001		0.003		<0.001		0.003		0.010	0.001	0.008	<0.001
Mercury	mg/l	0.04		<0.02		<0.02		<0.02		<0.02		0.48	<0.02	<0.02	<0.02	<0.02	<0.02
Nickel	mg/l	0.003		0.003		0.003		0.001		0.014		0.015		0.003	0.028	0.046	0.002
Selenium	mg/l																
Vanadium	mg/l																
Zinc	mg/l	0.004		0.068	0.003	<0.001		<0.001		<0.001		0.001		0.011	0.031	0.003	0.013

TABLE 8d: WATER-Water Quality Characteristics at Station A 1.8, 1977-1980

Source: Brown & Caldwell (1981)

FIGURE 3: WATER-Surface Water Courses and Location of Sampling Stations

OXY GEOTHERMAL # 1

Parameter	Station A 1.8	Station A 2.7	Station A 2.8	Station G 0.3	Station G 1.2
	Samples/exceeded MCL	Samples/exceeded MCL	Samples/exceeded MCL	Samples/exceeded MCL ^a	Samples/exceeded MCL
Primary standards					
Arsenic	6/	6/	6/	6/	6/
Cadmium	6/	6/	6/	6/	6/
Chromium	10/	10/	10/	10/	10/
Lead	11/	10/	10/	10/	10/
Mercury	11/	11/	11/	11/	11/
Nitrate	16/	16/	16/	16/	16/
Turbidity	16/9	16/8	16/3	16/3	16/1
Secondary standards					
Copper	7/	7/	7/	7/	7/
Iron	10/3	10/1	10/	10/	10/1
Zinc	11/	10/	10/	10/	10/
Total dissolved solids	16/	16/	16/	10/	10/
Specific conductance	16/	16/	16/	16/	16/
Sulfate	16/	16/	16/	16/	16/

^aSamples = total number of samples analyzed for parameter during two-year survey. Exceeded MCL = total number of samples analyzed during two-year survey which yielded values that exceeded maximum contaminant level (MCL) for parameter. A number is not listed if no sample exceeded MCL.

Source: PGandE - Aminoil two-year water quality monitoring program of the Anderson Creek drainage.

Note: See Figure 3-1 for location of sampling stations.

TABLE 9: WATER-Anderson Creek Water Quality Monitoring Results to Selected Water Quality Standards

WATER QUALITY

SETTING

Occidental conducted a review of historical data which described chemical and physical characteristics of the waters in the Anderson and Gunning creek drainages. The data were assembled to document conditions existing prior to the Occidental leasehold development. Oxy evaluated the available data in terms of the closeness of sampling locations to the Occidental site, the number of highflow-lowflow cycles sampled, the water quality indicators investigated, and the dates the work was performed.

HISTORICAL DATA

In 1981, Brown and Caldwell, Inc.,²⁵ prepared for Occidental the most complete site-specific and recent data for the Anderson and Gunning creeks watersheds. The study included the collection of historical water quality information plus limited additional water quality sampling and analysis. Brown and Caldwell incorporated, in their most recent report, the results of a two-year baseline monitoring study which they conducted for PGandE and Aminoil, Inc. During the earlier study (1978-80) they established 15 sampling sites throughout the upper Putah Creek drainage at which streamflow and water quality were monitored. They gathered water quality samples monthly during the first year and quarterly during the second year of the study. During the current investigation, Brown and Caldwell took spot samples of Gunning and Anderson Creek for general water quality, radiological content, and suspended solids during high flow periods (see Water Tables 7 and 10).

Of the 15 stations in the Putah Creek drainage (see Water Figure 3), CEC staff considered only 5 on Anderson and Gunning creeks reflective of disturbance on the Oxy leasehold. Three of the stations were located within one mile of the Occidental leasehold and would most directly reflect adverse impacts of site development. The nearest station was on Gunning Creek below the Ford Flat Road, 1.2 stream miles (G1.2) above its confluence with Anderson Creek. The other two stations were on Anderson Creek, 2.7 and 2.8 stream miles (A2.7 and A2.8) above the confluence of Anderson and Putah creeks. Both were near the Anderson Creek/ Twin Creeks bridge on Socrates Mine Road. One was placed above and the other below the confluence of Anderson Creek with an unnamed tributary, which flows along the Socrates Mine Road and drains the site of PGandE Unit 13.

Of the remaining two stations, one was located on Gunning Creek above its confluence with Anderson Creek (G0.3). The other (A1.8) was situated on Anderson Creek below its confluence with Gunning Creek.

Water Tables 10 through 15 present the results of three years of sampling at these five stations. Table 11 summarizes water quality data from single-event sampling during 1975 and 1976. These data were taken from the 1975 Environmental Impact Report (EIR) for the Castle Rock Springs geothermal steam area and PGandE's Geysers Unit 16 site-specific studies.^{26,27} As Water Tables 11 and 12 indicate, drinking water quality standards were exceeded only twice, once for mercury and once for turbidity. Both samples were collected from Anderson Creek near the community of Anderson Springs.

WATER TABLE 10
RESULTS OF SPECIAL SAMPLING OF ANDERSON
AND GUNNING CREEKS

Parameter ^a	Anderson Creek	Gunning Creek	Parameter ^a	Anderson Creek	Gunning Creek
Arsenic	<0.0005	<0.0005	2, 4, 5-TP Silvex	^b	^b
Barium	<0.1	<0.1	Bacteriological	>16 ^c	>16 ^c
Cadmium	<0.001	<0.001	Turbidity	0.25	0.35
Chromium	<0.01	<0.01	Color, units	8	5
Fluoride	0.13	0.11	Copper	<0.001	<0.002
Lead	0.001	0.001			
Mercury	<0.0001	<0.0001	Iron	<0.01	0.04
Nitrate	<0.05	<0.05	Manganese	<0.01	<0.01
Selenium	<0.0005	<0.0005	Odor-threshold, units	2	1
Silver	<0.001	<0.001	Foaming agents, (MBAS)	<0.025	<0.025
Endrin	^b	^b	Zinc	<0.01	<0.01
Lindane	^b	^b	Total dissolved solids	116	83
Methoxychlor	^b	^b	Specific conductance, umhos/cm	125	77
Toxaphene	^b	^b	Chloride	1.0	1.1
2, 4-D	^b	^b	Sulfate	4.2	<1.0

^aIn mg/l unless otherwise noted.

^bNone detected. Detection limits are as follows: endrin, 0.0001 mg/l; lindane, 0.00005 mg/l; methoxychlor, 0.0002 mg/l; toxaphene, 0.001 mg/l; 2, 4-D, 0.0005 mg/l; silvex, 0.0001 mg/l.

^cColiform counts exceeded 16/100 ml as determined by the multiple-tube fermentation technique.

Source: Samples taken by BC personnel on November 20, 1980, and analyzed by Environmental Sciences Division of BC.

WATER TABLE 11
SUMMARY OF HISTORICAL WATER QUALITY DATA
RESULTING FROM SINGLE-EVENT SAMPLING

Parameter ^a	Gunning Creek	Anderson Creek		
	8-12-75 ^b	8-12-75 ^c	A 0.3 10-18-76	A 1.6 10-18-76
Primary standards	-	-	-	-
Arsenic	-	-	-	-
Barium	-	-	-	-
Cadmium	-	-	-	-
Fluoride	0.08	<0.02	-	-
Lead	-	-	-	-
Mercury	<0.001	0.0022 ^d	<0.001	<0.001
Nitrate	<0.01	0.01	-	-
Turbidity, JTU	0.3	0.4	0.35	63 ^d
Secondary standards				
Copper	-	-	-	-
Iron	0.03	0.03	-	-
Manganese	<0.05	<0.05	-	-
Zinc	-	-	-	-
Total dissolved solids	63	84	230	180
Specific conductance, umhos/cm	75	120	-	-
Chloride	2.5	3.5	-	-
Sulfate	0.5	3.3	3.2	0.36

^aUnits in mg/l unless otherwise noted.

^bStation location unknown.

^cStation located just before confluence with Putah Creek.

^dValue exceeds maximum contaminant level.

Source: 1975 data - EIR for Castle Rock Springs Geothermal Steam Area,
prepared for Burmah Oil and Gas Company, August 1975.

1976 data - PGandE's Geysers Unit 16 Site Specific Studies,
Preliminary Investigations of Water Quality Characteristics,
April 1977.

Note: See Figure for location of sampling stations.

WATER TABLE 12
CALIFORNIA DRINKING WATER STANDARDS

Parameter ^a	Maximum Containment Level	Parameter ^a	Maximum Contaminant Level
Primary standards		Secondary standards	
Inorganic chemicals		Consumer acceptance limits	
Arsenic	0.05	Color, units	15
Barium	1	Copper	1.0
Cadmium	0.010	Corrosivity	^e
Chromium	0.05	Iron	0.3
Fluoride, ^b if added	0.8 - 1.7	Manganese	0.05
if naturally occurring	1.4 - 2.4	Odor - threshold, units	3
Lead	0.05	Foaming agents (MBAS)	0.5
Mercury	0.002	Turbidity, units ^f	5
Nitrate, as NO ₃	45	Zinc	5.0
Selenium	0.01		
Silver	0.05	Mineralization	
Organic chemicals		Total dissolved solids	
Endrin	0.002	Recommended	500
Lindane	0.004	Upper	1,000
Methoxychlor	0.1	Short-term	1,500
Toxaphene	0.005		
2, 4-D	0.1	Specific conductance,	
2, 4, 5-TP Silvex	0.01	micromhos/cm	
		Recommended	900
		Upper	1,600
		Short-term	2,200
Radioactivity		Chloride	
Radium-226 + radium-228, pCi/l	5	Recommended	250
Gross Alpha particle activity, pCi/l	15	Upper	500
Tritium, pCi/l	20,000	Short-term	600
Strontium-90, pCi/l	8		
Gross Beta particle activity, pCi/l	50	Sulfate	
Bacteriological ^c	-	Recommended	250
Turbidity, units ^d	1	Upper	500
		Short-term	600

^aIn milligrams per liter (mg/l) unless otherwise indicated.

^bVaries with ambient temperature.

^cMaximum contaminant level depends upon analytical technique.

^dSurface water source not exposed to significant sewage hazards or significant recreational use; no consecutive two-day average can exceed 5 units.

^eRelatively low.

^fApplies to water in the distribution system.

WATER TABLE 13
SUMMARY OF HISTORICAL WATER QUALITY DATA
RESULTING FROM SEMIANNUAL SAMPLING

Parameter ^a	Anderson Creek ^b			Unnamed Tributary ^c			Gunning Creek ^d		
	2/5/76	8/25/76	2/9/77	2/5/76	8/25/76	2/9/77	2/5/76	8/25/76	2/9/77
Primary standards									
Fluoride	0.16	0.24	0.24	0.16	0.22	0.12	0.07	0.14	0.12
Mercury	<0.001	<0.001	<0.001	<0.001	0.002	0.001	<0.001	0.0015	<0.001
Nitrate	<.44	<.44	<.44	<.44	<.44	<.75	<.44	<.44	<.44
Turbidity, JTU	<0.5	<0.5	5.8 ^e	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Secondary standards									
Iron	<0.2	<0.2	0.75 ^e	<.02	<.02	.45 ^e	<.02	<.02	<0.1
Manganese	<0.05	<0.06 ^e	<0.06	<.05	<.06 ^e	.07 ^e	<.05	<.05 ^e	<.06 ^e
Total dissolved solids	125	130	160	200	280	140	80	110	32
Specific conductance, umhos/cm	180	150	220	375	400	270	80	70	73
Chloride	2.5	1.6	3.2	4.7	4.3	2.6	1.3	0.9	1.1
Sulfate	4	6	11	6.0	18	97	<0.5	<1.0	2.0

^aUnits in milligrams per liter.

^bAnderson Creek above Putah Creek.

^cUnnamed tributary of Anderson Creek above Station A 2.7.

^dGunning Creek below Socrates Mine Road.

^eValue exceeds maximum contaminant level.

Source: PGandE - Aminoil two-year water quality monitoring program of the Anderson Creek drainage.

Note: See Figure 1 for location of sampling stations.

OXY GEOTHERMAL #1

Parameter ^a	Station A 1.8		Station A 2.7		Station A 2.8		Station G 0.3		Station G 1.2	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Primary standards										
Arsenic	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
Cadmium	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
Chromium	0.00	0.043	0.00	0.038	0.00	0.01	0.00	0.047	0.00	0.033
Lead	<0.001	0.037	<0.001	0.01	<0.001	0.008	<0.001	0.006	<0.001	0.008
Mercury	<0.00002	0.00048	<0.00002	0.00003	<0.00002	0.00045	<0.00002	0.00065	<0.00002	0.00026
Nitrate	<0.01	0.10 ^b	<0.01	0.08 ^b	<0.01	0.06 ^b	<0.01	0.05 ^{b,c}	<0.01	0.04 ^b
Turbidity, NTU	0.25	23 ^b	0.20	100 ^b	0.20	2.70 ^b	0.20	2.40 ^{b,c}	0.25	1.30 ^{b,c}
Secondary standards										
Copper	<0.001	0.006	<0.001	0.005	<0.001	0.003	<0.001	0.004	<0.001	0.004
Iron	0.02	1.9 ^d	<0.01	0.66 ^d	<0.02	0.50 ^d	<0.01	0.54 ^d	<0.02	0.44 ^d
Zinc	<0.001	0.068	<0.001	0.026	<0.001	0.005	<0.001	0.045	<0.001	0.014
Total dissolved solids	60	128	73	164	72	152	44	128	42	116
Sulfate	1.8	5.9	2.8	8.6	2.9	7.0	<1.0	3.1	0.9	3.5

^a Units in mg/l unless otherwise noted.

^b Value exceeds monthly average MCL of 0.5 turbidity units.

^c Average turbidities (NTU) by station are as follows: G 0.3 - 0.67; G 1.2 - 0.45.

^d Value exceeds MCL.

TABLE 14: WATER-Summary of Anderson Creek Drainage Basin Water Quality Monitoring Results (1978-1980)

WATER TABLE 15
WATER QUALITY IN THE ANDERSON SPRINGS WATER COMPANY
DISTRIBUTION SYSTEM

Parameter ^a	Anderson Creek Source ^b	Gunning Creek Source ^c
Primary standards		
Fluoride	0.1	0.1
Nitrate	1.5	0.4
Secondary standards		
Fluoride	0.01	0.01
Manganese	0.01	0.01
Turbidity, units	0.35	0.25
Total dissolved solids	228	111
Chloride	7.0	4.0
Sulfate	6.7	4.5

^aUnits in mg/l unless otherwise noted.

^bSample point located at Wyrick hose bibb below tank 3. Sample taken April 19, 1979.

^cSample point located at Szymanski's hose bibb. Sample taken May 8, 1979.

Source: State Department of Health Services, Sanitary Engineering Section.

Semiannual water quality sampling was conducted between February 1976 and February 1977 and was included in the Draft EIR for Aminoil's East Ford Flat Road Geothermal Project.²⁸ Selected data from this monitoring effort appear in Water Table 13; the table identifies values which exceed MCLs (maximum contaminant level). This data shows that the water quality in Anderson Creek is generally good except during winter periods of high flow when turbidity, iron, and manganese exceed standards for drinking water. The quality of Gunning Creek water was excellent throughout, with only a slight (0.01 mg/l) overage in manganese.

Between March 1978 and February 1980 Brown and Caldwell,²⁹ on behalf of PGandE and Aminoil, conducted a two-year water quality monitoring program of the upper Putah Creek watershed. This program consisted of monthly sampling during the first year and quarterly sampling the second year at stations which included those shown on Water Figure 3. This figure identifies the stations by the first letter or letters of the stream on which they are located and the projected horizontal distance in miles from the mouth of that stream. Data collected during the two-year study provided interesting insight into the relative water quality of streams in the Anderson Creek watershed. Note that the characteristics of Anderson Creek change as it flows towards its mouth due to inflow from several tributaries.

Streamflow from the intermittent tributary, which flows from PGandE Unit 13 along the Socrates Mine Road, contributed dissolved but particularly suspended solids during runoff periods (Station A2.7). Current improvements to Socrates Mine Road may reduce these levels. This caused increased specific conductance, higher turbidity, and a slight increase in alkalinity and hardness (see Water Table 8). Further downstream at Station A1.8 the high quality inflow from Gunning Creek (G1.2) caused a noticeable drop in specific conductance, total dissolved solids, sulfates, alkalinity, and hardness in Anderson Creek.

One can use portions of the data collected during the two-year monitoring program to determine the suitability of the various water sources for domestic supply. In Water Table 14, the minimum and maximum values for selected constituents appear for the five locations on Anderson and Gunning creeks, which would most likely reflect upstream activities on the Occidental leasehold. These data serve to illustrate the range of values found during the monitoring program. Water Table 9 summarizes the total number of samples analyzed for selected contaminants versus the number of those samples which exceeded the corresponding MCL. The generally good water quality is apparent from the available data. For the selected stations, the MCL for turbidity of one unit was exceeded in a large number of samples due to runoff during the rainy season. The secondary MCL for iron was exceeded in 5 out of 50 samples taken in the Anderson Creek watershed.

The California Department of Health Services monitored the water quality of the Anderson Springs Water Company distribution system in April and May of 1979 for some of the parameters required by California Domestic Water Quality Monitoring Regulations, Title 22 of the California Administrative Code. Water Table 15 presents selected data from this survey. None of the values exceeded the applicable MCLs.

On April 22, 1980, Edwin E. Crawford of the Central Valley Regional Water Quality Control Board³⁰ conducted a sanitary survey of Anderson Creek. Fecal

coliform levels ranged from 2 to 14 organisms per 100 milliliters (ml). Although he found no visible evidence of raw sewage or septic tank effluent, Mr. Crawford concluded that the fecal coliform levels were evidence of sewage contribution from homes in the area. According to Standard Methods for the Examination of Water and Wastewater, the fecal coliform test, if positive, identifies the presence of coliforms from the intestines of warm-blooded animals, not necessarily humans.

Special Water Quality Monitoring

In order to assess local water quality adequately in relation to Title 22 water quality standards, Brown and Caldwell personnel gathered two samples from Anderson and Gunning creeks at the locations shown on Water Figure 3 and analyzed these for the required water quality constituents. These data appear in Water Table 10. Comparing the data to the drinking water standards in Water Table 12, it is evident that the water quality at both stations is excellent, with most measured values well below the MCLs listed for treated waters. Coliform bacteria counts, which exceeded 16 per 100 ml, were the exception. Standard disinfection kills coliform organisms. Therefore, coliform counts do not indicate a significant water quality problem for raw water.

In February of 1981, Brown and Caldwell collected samples at the same stations for radiological analyses. The results were as follows:

<u>Constituent</u>	<u>Gunning Creek</u>	<u>Anderson Creek</u>
Gross alpha	0.04 + 0.81	0.4 + 0.7
Gross beta	1.6 + 2.2	0.1 + 5.6

Note: All data in picoCuries per liter.

These concentrations are well below the MCLs in Table 12 and are at or below typical background levels.

To determine the impacts of storm runoff on the upper reaches of Gunning Creek, an Occidental Geothermal employee gathered additional grab samples for suspended solids analysis at the Ford Flat Road crossing and from an intermittent tributary to Gunning Creek about 100 meters north of the Aminoil PDC-1 drill pad site. The employee collected approximately 40 samples between December 12, 1980, and March 1, 1981, during or immediately following rainstorms. Water Table 7 summarizes the resulting data and also presents rainfall data for the same dates taken at PGandE power plant 13, located about 2,300 meters south of the sampling stations.

Suspended solids data indicate little, if any, extraneous disturbance of the Gunning Creek watershed. Undisturbed watersheds have yielded more than the seven or eight milligrams per liter transported by Gunning Creek and its tributary.³¹ Suspended solid concentrations less than 20 mg/l could be caused by such internal events as swimmers or a deer crossing the stream. Storm runoff from watersheds disturbed by logging or construction activities would be expected to result in suspended solid concentrations greater than 20 mg/l. The rainfall events which produced 8.2 mg/l were neither the first

heavy rainfall of the season nor the heaviest that could be expected. In contrast, the first major rainstorm of the 1980-81 record period dropped more than 13 inches at Power Plant 13 in 48 hours. Much higher (i.e., > 20 mg/l) suspended solids concentrations should be expected from storms dropping 13 inches in 48 hours.

EVALUATION OF WATER QUALITY

Review of historical water quality data indicates that surface water courses within the Anderson Creek drainage are generally of high quality but do exhibit some seasonal fluctuations. The data for the Anderson and Gunning creeks watersheds which supply recreational and/or potable water for Anderson Springs are discussed individually, followed by an overall evaluation.

Gunning Creek

The waters of Gunning Creek are generally of higher quality than water from other sources in the study area. Samplings by Brown and Caldwell, in 1976 and 1977 did show the MCL for manganese was exceeded slightly on two occasions. Tables 9 and 14 also show two cases when the MCL for iron was exceeded and four cases where the turbidity MCL was exceeded. The high turbidity value was only 2.4 units (0.4 of a unit over the MCL), however, and the iron levels were only slightly above the MCL. Gunning Creek water quality was marginally better for samples taken at locations further upstream. The data in Water Table 10 confirms the generally high quality of water from upper Gunning Creek and indicates that conditions in November 1980 were not substantially different from those during previous sampling.

Anderson Creek

Water samples from Anderson Creek generally decrease in quality the closer they get to Anderson Creek's confluence with Putah Creek. The change is probably most dependent on the water quality of tributary streams. Data for 1975 and 1976 show some high turbidity and manganese values. Water Tables 9 and 14 show a number of high turbidity and iron values, especially in the reach below Socrates Mine Road (Stations A0.5, A1.3, A1.8, and A2.7). Sampling by the Central Valley Regional Water Quality Control Board also showed increases in fecal coliform in Anderson Creek within the community of Anderson Springs. The water quality of Anderson Creek appears to be especially susceptible to degradation due to the removal of native vegetation and the attendant soil erosion. Most of the recent vegetation removal and soil erosion comes as a result of road and geothermal resources development in the Anderson Creek watershed, although mining, timber removal, and recreational activity have also contributed to soil and vegetation loss as observed by CEC staff and indicated by U.S. Geological Survey Quadrangle sheets.

WATER USE

People use water from Anderson and Gunning creeks for domestic consumption and recreation, and to a lesser extent for industrial and agricultural purposes. Gunning Creek supplies more than half of the potable water for the approximate 700 residents of the Anderson Springs community.³² Summer consumption has

been restricted to household use because of reduced streamflow. High suspended sediment loads in Gunning Creek during storms forces closure of the system, at which time the residents depend on numerous springs in the area for their domestic supply. People use the water in Anderson Creek primarily for recreation; however, three to five residences depend on it for their domestic supply.

IMPACTS

POWER PLANT SITE

Surface Water

Removal of vegetation and disturbance of the soils on the 16.7 acre plant site will increase the potential for erosion and sediment deposition in an intermittent tributary of Anderson Creek. Depending on weather conditions and the mitigation measures proposed by Oxy, erosion should decrease with time as cut and fill slopes stabilize. CEC staff used regional flood frequency equations developed by Waanen and Crippen³³ to estimate peak runoff for a 1:100 frequency storm from the 18 acre plant site to be 28 cubic feet per second.

The potential for high erosion rates will exist until Oxy revegetates all disturbed areas and stabilizes the soil. During power plant operation, drainage from disturbed areas will collect in lined ditches and flow to the natural channel via a network of surface and underground drains (see Water Figure 4). The force and velocity of the discharged water will be removed by energy dissipators at the end of the master drains.

Storm water falling on the site within the fence line will be impounded and pumped to the cooling tower basins. During intense rainfall, the capacity of the injection system may be exceeded. Storm water collected from those areas of the site not curbed for chemical spill protection would then be discharged to Anderson Creek. However, the initial accumulation of storm water from these areas, which will contain most of the dust and salts deposited on the site during dry periods, will be contained and pumped to the cooling tower basins for injection and evaporation. Runoff collected later during the storm may be similar in composition to natural storm water runoff from nearby areas and will be routed via the natural drainage into Anderson Creek.

The Geysers KGRA has a long history of pollution incidents attributed to geothermal development.³⁴ Forty out of 68 incidents recorded since 1965 were directly attributable to power plants. The preponderance (29) involved the discharge of steam condensate into local streams. The causes of condensate discharge in order of frequency were pipeline failures (10), mechanical breakdown of valves and control devices (10), and human error (3). The remaining incidents involved improper waste handling and disposal (3), settling pond overflow (2), landslides attributable to poor foundation conditions (1), and a spill caused by a vehicle accident (1). The combination of mechanical failure and human error indicates the continued potential for adverse impact to local water resources during the construction and operation of the Occidental Geothermal Power Plant No. 1.

OXY GEOTHERMAL #1

Source: Oxy #1 AFC, 1981

CUT

FILL

COLLECTOR SYSTEM

FIGURE 4: WATER-Cut and Fill Drainage Plan

During 1980 and 1981 four major geothermal spills (10,000 gallons or more) occurred in The Geysers KGRA. Two resulted in settling pond spillage at PGandE's Unit 17. The other two involved pipeline failures after the settling pond at PE&E Units 7 and 11. The most recent spillage happened on May 6, 1981.

Placement of berms around the newer plants, e.g., Occidental's, should reduce the frequency and severity of future spills. However, those spills which may occur outside of bermed areas on access roads, along steam pipelines, or because of sump overflow remain a possible source of surface water pollution.

Groundwater

The Oxy AFC indicates, and CEC staff concurs that accelerated erosion due to construction activities could have significant effects on the numerous perennial springs and seeps in Anderson Creek and on the unnamed tributary below the power plant site. These water sources provide valuable drinking water for wildlife and habitat for aquatic biota. Excessive siltation in the creek could eliminate the amphibian population in the upper reaches of Anderson Creek.

TRANSMISSION LINE

The preferred and alternative transmission alignments (see Water Figure 6) will disturb approximately one acre inclusive of necessary access roads. Most of the disturbance will be within the Big Sulphur Creek watershed, which is already impacted by the construction of 13 power plants and development of approximately 40 well pads. Although the amount of vegetation removed and soil disturbed will be small, it will add incrementally to erosion and surface water degradation in the watershed.

MITIGATION MEASURES

POWER PLANT SITE

Occidental's overall mitigation plan³⁵ will consist of (1) erosion, sediment and spill control; (2) revegetation of cut and fill slopes of the plant site and plant access road; and (3) habitat enhancement programs.

Erosion control measures, discussed in the soils section, will be implemented by Occidental to reduce sediment loads in storm runoff from cut and fill slopes. A comprehensive storm drainage system (See Water Figures 4 and 5) will be provided to accommodate 100-year storm precipitation. The facilities will include catch basins, culverts, ditches, berms, catch dams, riprap, energy dissipators, and straw bales at the toe of fill slopes.

The amount of sediment eroded from the 18 acre plant site has been variously estimated from 55 (Occidental estimate) to 250 tons (CEC staff estimate) per acre per year from bare slopes. As a consequence, from 990 to 4,500 tons of sediment could be washed into the Anderson Creek tributary during the first year of construction. This scenario assumes intense rainfall on nonvegetated

OXY GEOTHERMAL #1

Source: Oxy #1 AFC

FIGURE 5: WATER-Site Drainage Plan

OXY GEOTHERMAL #1

Source: Oxy #1 AFC, 1981

LEGEND

- OXY SITE
- × PROPOSED OXY TOWER SITES
- ▲ PG&E UNITS
- △ EXISTING PG&E TOWERS
- SMUDGE#1
- PROPOSED SMUD TOWERS
- EXISTING ROADS AND TRAILS
- - - PROPOSED TRANSMISSION ACCESS ROADS

FIGURE 6: WATER-Proposed and Alternate Transmission Route

slopes. Assuming, as did Oxy, a loss of 4.2 tons per acre per year after vegetation covers the slopes, the sediment yield from the 18 acre plant site could be reduced to 76 tons per year.

To prevent accidental spills and contaminated storm water from entering Anderson Creek, Oxy will construct a 0.5 foot high berm around the entire site, which will drain to catch basins. Oxy will pump storm water which falls inside the paved bermed area to the cooling tower basin.

The purpose of the berm is to contain spills from the cooling water system. Available storage within the berm is approximately 107,000 cubic feet. According to Oxy, this storage volume exceeds any potential spill anticipated from the cooling tower basins or circulating water system, assuming a four foot drawdown in the basins before the circulating water pumps trip.

Oxy will pave and curb other areas which contain chemicals, such as chemical storage, chemical processing, transformers, and fuel oil storage. The power plant design will direct spills and storm water from these areas to the plant treatment system, treat it for oil removal, and pump it to the cooling tower basins for evaporation or reinjection.

Annunciator systems on the cooling tower basin, Stretford unit, lube oil system, and chemical storage tanks will warn plant operators of abnormal operation.

Drift eliminators on the cooling tower will reduce drift to 0.001 percent of the circulating water flow.

Licensed carriers will haul chemicals and wastes in containers which conform to applicable sections of the Code of Federal Regulations (CFR), Title 49.

In the event of an uncontained spill or leak causing pollution of local waters, Occidental will retain a qualified spill cleanup contractor as needed to assist in the cleanup.

CUMULATIVE IMPACTS--WATER QUALITY

SETTING

Staff of the United States Geological Survey introduced "Environmental Assessment 131-81"^{36*} for Occidental Drill Pad B with the following analysis:

"Although the impacts of each of the undivided (geothermal) projects in The Geysers thus far have been considered insignificant in the sense of the National Environmental Protection Act (NEPA), the cumulative impact of development in the Geysers has affected, or may be expected to affect, air and water quality; and soil; the infrastructure of surrounding counties, especially Lake County; wildlife habitat; the steam reservoir; the aesthetic quality of the landscape; and the quality of life for people living in or near the developed portions of the steamfield.

The cumulative effects of development cannot be adequately assessed through case by case Environmental Assessments such as this one. Development has changed the character of the landscape, once relatively wild and roadless. Vegetation has been cleared from roughly 1500 acres or 20 percent of the field. The resulting small (generally 2 to 3 acre) patches and connecting ribbons of barren ground are dispersed over an area ten times as large. Both the United States Fish and Wildlife Service and the California Department of Fish and Game are concerned over the ecological impacts of disturbing habitat over so large an area.

Water quality may be affected by increased erosion caused by loss of vegetation; roadway, drill pad, and sump construction and use; alteration of natural drainages by cut and fill operation's and an increase in heavy equipment traffic, especially those carrying toxic materials which might spill (there have been spills in the past). Even with the diligent use of erosion control, revegetation and careful engineering, sedimentation rates increase with the addition of each cleared roadway or drill pad. Roads can be upgraded as use increases, to accommodate heavier and more frequent traffic. The soils at The Geysers are highly erosive (sic), even under natural conditions.

The erosion rates during construction and before revegetation may be twenty times the natural rate. Loss of soil makes revegetation much more difficult to accomplish, increases siltation into streams, and may result in landsliding and slumping."

IMPACTS

The Anderson Springs community water supply is particularly vulnerable to degradation by geothermal resource development in the Anderson and Gunning creeks watersheds. Because there is a need to protect the quality of life of

*All footnotes in this section are keyed to Water Resource References at the end of this section.

Anderson Springs residents, there is a unique concern for development within the Occidental leasehold. Previously proposed power plants within The Geysers KGRA have not had the potential to directly impact a public water supply. Although Occidental has implemented extraordinary mitigation measures on the fill slope facing Gunning Creek, the protection afforded will depend on how well the measures function during the first heavy storms of the 1981-82 water year. If the fill slope survives the first winter and a good grass cover is established, the soil losses and sediment deposition in Gunning Creek will probably be negligible from that time forward.

The Gunning Creek watershed, from which more than half of the Anderson Springs water supply is derived, is relatively undegraded by geothermal development. Portions of Anderson Creek show clear evidence of sediment degradation due primarily to access road and geothermal development. Presently, Aminoil has developed two exploratory drill pad sites in the Gunning Creek watershed. Full leasehold development of the Gunning Creek watershed has a potential to seriously degrade the municipal water supply of Anderson Springs.

In the Occidental leasehold development, economic and practical considerations have resulted in decisions by federal and local agencies to allow encroachment on both Anderson and Gunning creeks by a road and drill pad which seemingly override technical and environmental precautions. Federal, state, and local agencies have recommended that drill pads not be sited closer to live streams than 250 to 700 feet.³⁷ Drill Pad B is located within 158 feet³⁸ of a perennial tributary to Gunning Creek. The Bureau of Land Management in the Five Tracts EAR³⁹ established a 400 foot riparian protection zone adjacent to Anderson Creek (map 24 in the EAR) in which no construction should be allowed. The proposed access road from drill site C to drill site B goes through this zone.

BLM established riparian nonencroachment zones with good reason. Increased sedimentation of streams attributable to road location and construction methods was clearly evident in a recent study of deposition in reservoirs in 48 Northern California watersheds.⁴⁰ Streamside roads produced twice as much sediment as roads located on ridges or slopes. The greatest sediment producers were improved secondary (gravel surface) roads located at streamside. Deposition increased 6.9 times for each mile of road per square mile of watershed above a reservoir (Anderson 1974). Road location is especially important in steep watersheds (Anderson 1976).⁴¹ The Bureau of Land Management's permit requirement that Occidental chip seal the surface of the access road from Drill Pad C to B and place crushed rock in the side drainage ditches will greatly decrease but not eliminate entirely the erosion hazard.

Investigators estimate that during construction, exposed soils erode 20 times faster than vegetated ones (NCPA-1979). According to the USGS⁴² the highest sediment rates occur during the first year after construction and decline rapidly during the following three or four years. Thereafter, rates decline slowly and remain above preconstruction level for several decades.

No attempt has been made to predict rates of gully erosion. However, a large gully exists along the south side of the old logging road from Aminoil's PDC

No. 1 steam well to Drill Pad B. Federal and local permits require Oxy to rehabilitate the gully, restore the old logging road, and direct future runoff away from the gullied area.

SUSPENDED SEDIMENT TRANSPORT AND TURBIDITY

Various investigators (Fowler and Heady, 1981, and Robinson, 1971)^{43,44} characterize in-stream suspended sediment and bedload materials as the largest single polluting agent, by volume, in the United States. In their recent paper, Fowler and Heady concluded that suspended sediment loads are highest in the northwestern (which includes The Geysers KGRA) and southeastern regions of the United States. They further stated that these higher rates (greater than 0.25 tons per acre per year) relate to the steeper slopes, parent soil material, and the high rainfall and/or runoff prevalent in these regions. The rates suggest the need to exercise additional care during operations which disturb existing vegetation, soils, and terrain in these regions. Although they generally regard turbidity and suspended sediment as pollutants, investigators do not agree on the levels at which suspended sediment becomes detrimental. To limit turbidity in drinking water supplies, the State of California adopted a monthly average upper limit of one turbidity unit (NTU). For surface waters not exposed to significant sewage hazards or recreational uses, no consecutive two-day average may exceed five units.⁴⁵ These standards apply to water delivered to users, not raw water drawn from a well or surface stream. Appropriate treatment can bring raw water into compliance with these standards.

Currently, neither the Central Valley Regional Water Quality Control Board nor the California Department of Health Services has established absolute standards for settleable and/or suspended materials in naturally occurring surface or groundwaters of the state. As a result of their studies in California, Cordone and Kelley⁴⁶ characterized water containing 27 ppm suspended solids as "non-drinkable." Bean (1961)⁴⁷ proposed that for drinking water of ideal quality suspended matter should be limited to 0.1 ppm or less. A literature search by CEC did not reveal specific limits or threshold concentrations of settleable solids permitted in natural waters.

Various suspended solid thresholds have been determined for fish populations. Cordone and Kelley⁴⁸ found that in water containing 27 ppm sediment, the catch of fish dropped to one-half of normal, and the production dropped less than 10 percent although there was no increased mortality. Tests on the survival of rainbow trout in suspensions of inert solids (kaolin and diatomaceous earth) showed that concentrations of 30 ppm had no observable effect; a few fish died at 90 ppm, while at 270 ppm more than half of the fish died in 2 to 12 weeks.^{49,50}

The European Inland Fisheries Advisory Commission, Food and Agricultural Organization of the United Nations, prepared water quality criteria on finely divided solids.⁵¹ With respect to chemically inert solids and to waters that are otherwise satisfactory for the maintenance of freshwater fish, they made the following conclusions:

- "(a) There is no evidence that concentrations of suspended solids less than 25 ppm have any harmful effects on fisheries.

- (b) It should usually be possible to maintain good or moderate fisheries in waters which normally contain 25 to 80 ppm suspended solids. Other factors being equal, however, the yield of fish from such waters might be somewhat lower than those in category (a).
- (c) Waters normally containing from 80 to 400 ppm suspended solids are unlikely to support good freshwater fisheries, although fisheries may sometimes be found at the lower concentrations within this range."

Based on these and similar findings, fishery biologists have concluded that concentrations of suspended sediment less than 50 to 60 ppm will have little impact on fish and wildlife.

LEASEHOLD MITIGATION MEASURES

Federal, state, and local agencies require mitigation of impacts on water resources due to the development of roads, drill pads, and steam wells. When Oxy implements the mitigation measures, the potential for impact to local water resources should be lessened.

USGS MITIGATION REQUIREMENTS

Under authority granted them by the Geothermal Steam Act of 1970, the United States Geological Survey requires the following mitigation under terms of the federal lease granted to Occidental:

1. There shall be no construction or surface disturbance during the period from November 1 to March 1.
2. Any water needed for construction or maintenance of Site B and its road should be from a source authorized by the USGS and Bureau of Land Management (BLM), other than Anderson of Gunning Creeks.
3. The Anderson Creek crossing by the road from Drill Pad C to B shall be constructed according to California Department of Fish and Game recommendations.
4. No drill pad or sump runoff shall be discharged directly into Anderson or Gunning Creeks. Berms shall be constructed around the edges of pads to direct runoff into the sumps. Before sumps become full, excess water shall be pumped into tanker trucks and disposed of in an acceptable disposal area.
5. Subsurface groundwaters will be protected by casing and connecting procedures proposed in the Application to Drill (Form 9-331C) and approved by Office of Geothermal Supervisor, Menlo Park.

CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL BOARD MITIGATION REQUIREMENTS

The Central Valley Regional Water Quality Control Board requires the following mitigation of impacts by Occidental under terms of Board Order No. 79-228 and its accessory Monitoring and Reporting Program:

1. Waste sumps shall be lined with at least 2 feet (0.6 m) of compacted clay or soil cement having a permeability of 1×10^{-6} cm/sec or less.
2. A minimum freeboard of three feet (one m) shall be maintained in the waste sumps.
3. Wastes produced during the drill site preparation, road construction, and road maintenance shall be placed where they cannot be carried into the waters of Anderson Creek, Gunning Creek, or their tributaries.
4. The disposal sumps shall be protected from any washout or erosion of waste or covering material and from inundation, which could occur as a result of floods having a predicted frequency of once in 100 years.

LAKE COUNTY MITIGATION REQUIREMENTS

Lake County under their permit authority requires the following mitigation:

1. Subdrains shall be provided under all fills where natural drainage courses and seepage are evident.
2. Berms should be constructed around drill pads, and all run-off from the pad surface should be directed into the sump.
3. Buffer zones of undisturbed vegetation shall (ordinarily) be maintained 500 feet on either side of streams. No geothermal related construction shall take place within this buffer zone without specific approval.
4. A retaining levee of not less than eighteen (18) inches in height and three (3) feet in base thickness shall be placed on the perimeter of all fill areas, including access road fills, pad site, and reserve pit sites, to prevent storm runoff accumulation from random discharge.
5. No water for construction purposes at Site B shall be removed from Anderson or Gunning Creeks, their tributaries, or springs in the area without first obtaining approval from the Anderson Springs Water Master and the USGS in consultation with the BLM and Lake County Planning Department.
6. Roads bridging or fording any water course or stream shall be surfaced at least 250 feet on either side of such crossing.

CEC MITIGATION/MONITORING REQUIREMENTS

CEC staff concurs with the USGS and Lake County restrictions on Occidental's use of water from the Anderson and Gunning creeks drainages for construction purposes. The clear intent of these provisions is to minimize the impact of geothermal diversions on existing water uses.

As geothermal development increases in the two drainage basins the competition between geothermal and existing water users will heighten. Therefore, neither Occidental nor agents acting on their behalf should be allowed to procure construction water from Anderson or Gunning creeks, their tributaries,

springs, observation wells, or exploratory drill holes in the area unless such water can be obtained without adversely impacting the biota or other beneficial uses. Sources in the Anderson and Gunning creeks drainage basins should not be used without first obtaining approval from the manager of the Anderson Springs Water Company, CEC, plus the USGS DCM for Geothermal in consultation with the Bureau of Land Management and Lake County Planning Department.

In spite of Occidental's proposal to implement extensive erosion control measures, there is yet the possibility that soils may erode from the leasehold and deposit in both Anderson Creek and, to a greatly lessened extent, Gunning Creek. Deposition of sediment in local creeks could physically and chemically degrade both the recreational and domestic water for the following uses:

1. On Anderson Creek: Mostly for recreational purposes and for domestic supply for three to five intermittent users.
2. On Gunning Creek: Over half of the domestic water supply for the community of Anderson Springs plus other upstream domestic, recreational, and agricultural uses.

Historically, steam field developers and regulatory agencies have relied on empirical estimates for the determination of soil losses due to erosion, e.g., Universal Soil Loss Equation. Unfortunately, there is a paucity of actual data to verify the validity/credibility of such estimates.

Because of the lack of specific data for individual leaseholds it is difficult to determine whether an adverse impact has occurred, the magnitude of the impact, and its cause. To remedy this situation the Central Valley Regional Water Quality Control Board is requiring Occidental and other steamfield developers to conduct special water monitoring.

In compliance with requirements of the Central Valley Regional Water Quality Control Board, Occidental is required to collect water quality samples when a toxic spill is suspected, as reflected by an increase in turbidity above 25 nephelometric turbidity units and on stable water level in the creek.

Occidental has agreed to also monitor actual streamflow and collect water samples for sediment analysis during periods of high flow. Occidental's monitoring, coupled with monitoring required of other steam field developers at various sites in the watershed, will help establish the frequency and extent of degradation and spills attributable to geothermal development. (See Water Quality Figure 1, Cumulative Analysis, for location of required monitoring stations.)

The monitoring proposed by the Central Valley Board will help define the water quality in Anderson Creek. It will not, however, rectify any degradation of the water which might occur.

Ordinarily, on-site mitigation such as that proposed by Occidental would be considered adequate for most geothermal projects. However, the project's

location in the Anderson and Gunning creeks drainages dictates off-site mitigation beyond state-of-the-art.

CEC staff envisions three alternative means of off-site mitigation with varying ability to protect the citizens of Anderson Springs from pollution in Gunning Creek due to geothermal development. In order of preference, solutions to the problem would be:

1. Permanently enclose the headwater springs on Anderson and/or Gunning creeks and pipe the water to Anderson Springs.
2. An off-stream storage system capable of diverting and impounding a supply of unpolluted water from Gunning Creek. Storage should be adequate to meet the needs of the Anderson Springs residents for a period of three days at minimum.
3. A temporary supply of bottled water for the citizens of Anderson Springs in case a spill or high sediment episode occurs. For this to be an effective means of mitigation, the burden of procurement and distribution should be shouldered by the geothermal developer and not by local residents.

Bottled water and the off-stream storage system are measures designed to assure the residents of Anderson Springs a temporary clean, healthful supply of drinking water in the event of a spill or sediment episode. Permanently enclosing the headwater spring(s) would provide the citizens of Anderson Springs a groundwater source not subject to degradation by existing and proposed geothermal development in the Gunning Creek drainage basin.

OXY has agreed to fund safeguards to the domestic water supply in accordance with solution number 2 listed above. OXY will do this in a manner which would permit their contribution to be applied toward solution number 1 if funding for the rest of the system cost becomes available from other sources.

JURISDICTION OVER WATER QUALITY CONTROL ISSUES

The California Water Code, Section 13,000 et seq., establishes a statewide program for water quality control that is administered regionally by nine regional boards, each within a defined area of jurisdiction. Water quality issues resulting from the Occidental project fall within the jurisdiction of the Central Valley Regional Water Quality Control Board.

Section 13241 of the Water Code requires the regional board to establish "such water quality objectives in water quality control plans as in its judgement will ensure the reasonable protection of beneficial uses and the prevention of nuisance." For the Oxy project, the Sacramento River Basin Plan 5A applies. In addition to formulating appropriate water quality objectives for a regional water quality control plan, the regional board has the statutory obligation to prescribe requirements as to any proposed or existing discharge requirements; the regional board is required to consider a number of factors, including:

- (a) Past, present, and probable future beneficial uses of water,
- (b) Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area, and
- (c) Economic considerations. (See Water Code, Sections 13241 and 13263.)

An important aspect of the regional board's authority is described in Section 13267, which provides that a regional board, "in establishing or reviewing any water quality control plan or waste discharge requirements, or in connection with any action relating thereto or authorized by this division, may investigate the quality of any waters of the state within its region." This provision permits the regional board to conduct appropriate monitoring of an area's waters. In addition, Section 13267 authorizes the regional board to "require that any person discharging or proposing to discharge waste within its region...shall furnish, under penalty of perjury, such technical or monitoring program reports as the board may specify; provided that the burden, including costs, of such reports shall bear a reasonable relationship to the need for the report and the benefits to be obtained therefrom."

Under this provision, the regional board has the authority to specify a monitoring program by the kind of technical report required of one responsible for a discharge. At the same time, however, the board has the responsibility of showing a reasonable relationship between the need for the report and the benefits to be obtained from it.

Because development of the steam field for the Occidental project is on a federal leasehold, that aspect is subject to the provisions of the federal Geothermal Steam Act of 1970 and federal regulations on the leasing of geothermal resources. With respect to water quality issues, the federal provisions complement state provisions in that a federal lessee is required to comply with "all federal and state standards and all applicable local

standards with respect to the control of all forms of...water...pollution, including, but not limited to, the control of erosion and the disposal of liquid, solid, and gaseous wastes." Moreover, the regulations adopted pursuant to the Geothermal Steam Act permit the Supervisor (who is under the direction of the United States Geological Survey) at his discretion, to "establish additional and more stringent standards." [See Title 43, Code of Federal Regulations, Section 3204.1(c)].

With respect to water pollution problems, the federal regulations specifically require a lessee to "conduct lease operations and maintenance in accordance with Federal and State water quality standards and public health and safety standards."

Accordingly, the applicant, although a federal lessee with respect to the steam field, is nevertheless subject to all applicable state laws concerning water quality control. Given the statutory authority of the Central Valley Regional Water Quality Control Board, the applicant is also subject to the discharge requirements, including an appropriate monitoring program, that the regional board shall in its analysis of existing and potential problems see fit to impose.

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BIOLOGICAL RESOURCES

SETTING

The Oxy AFC describes the Occidental Geothermal leasehold biological setting (Occidental Geothermal, Inc., 1981). The following paragraphs summarize the information contained in this document with additional information incorporated where necessary. CEC staff verified the information through examination of the site, review of available pertinent information, and discussions with appropriate individuals and agencies.

VEGETATION

The project site consists of the 11 identifiable vegetation habitat types which generally follow those described by Cheatham and Haller (1975). Vegetation types are listed along with approximate area of coverage in Biology Table 1 and are described below. The distribution of vegetation was mapped based on recent aerial photography and is presented in Biology Figure 1. Some of these plant communities (e.g., serpentine chaparral, riparian woodland, and rock outcrop vegetation) are highly distinct with relatively well-established boundaries which can be closely correlated to soil and/or moisture conditions. Others (e.g., mixed chaparral, scrub oak chaparral, and yellow pine forests) are more successional in nature and tend to be less distinct, often integrating in a continuum.

The vegetation on the site has been strongly influenced by the area's history. A large wildfire burned through the site approximately 20 years ago, killing many large conifers and establishing conditions which have encouraged formation of the large chaparral areas present today. Many large "snags" remain from this prefire forest and now serve as important wildlife habitat.

BIOLOGY TABLE 1

VEGETATION TYPES ON THE OXY LEASEHOLD

<u>Plant Community</u>	<u>Approximate Area of Coverage</u>	
	<u>Acres</u>	<u>Hectares</u>
Mixed Californian Chaparral	192.8	77.9
Chamise Chaparral	30.5	12.3
Serpentine Chaparral	9.0	3.6
Ponderosa Pine Forest	161.6	65.3
Mixed Evergreen Forest	26.7	10.8
Canyon Live Oak Forest	24.1	9.7
Knobcone Pine Forest	24.3	9.8
Riparian Strip	3.9	1.6
Annual Grassland	5.7	2.3
Rock Outcrops	15.6	6.3
Seeps and Springs	—	—
Disturbed Areas	25.8	10.4

OXY GEOTHERMAL #1

VEGETATION TYPES

MXC — Mixed Californian Chaparral	KPF — Knobcone Pine Forest
CHC — Chamise Chaparral	RS — Riparian Strip
SCH — Serpentine Chaparral	ANG — Annual Grassland
PPF — Ponderosa Pine Forest	RO — Rock Out Crops
MEF — Mixed Evergreen Forest	D — Disturbed Areas
CLO — Canyon Live Oak Forest	OW — Northern Oak Woodland

FIGURE 1: BIOLOGY-Occidental Biology

The leasehold contains a complex arrangement of plant communities, with chaparral and yellow pine forest communities covering well over half of the leasehold area. Cheatham and Haller (1975) divide the chaparral vegetation on the leasehold into several distinct plant communities, including mixed Californian chaparral, chamise chaparral, and serpentine chaparral.

Mixed Californian chaparral (scrub oak chaparral and manzanita chaparral) (Hanes, 1977) covers approximately 192.8 acres, constituting the most common vegetation type on the project site. Mixed chaparral is characterized by tall (2 - 4 m) shrubs, forming nearly impenetrable vegetation with heavy litter accumulation (Cheatham and Haller, 1975). Manzanita, scrub oak, and buck brush are typically dominant, but species composition does vary from one area to another. Other shrubs, including toyon, coffeberry, silk tassel bush, California bay, and chaparral pea can be locally abundant.

Chamise chaparral is characterized by lower (1 - 3 m) shrubs which are more sparsely spaced, often with bare soil between shrubs and very little litter accumulation. Chamise chaparral typically occurs on dry rocky slopes with southern exposures. Species diversity is very low, with chamise comprising about 90 percent of the species present. Randomly scattered buck brush and manzanita are also occasionally present.

Serpentine chaparral also exists on the leasehold and is a locally important vegetation type which supports numerous endemic species. These include jepson's ceanothus, leather oak, and stanford's manzanita, which are often codominant. Occasionally there are large patches of bare soil between the shrubs. Herbaceous species are often present and are well represented by species restricted to this soil condition. Several of the rare plants in The Geysers KGRA are serpentine endemics. Disturbance of these sites must be preceded by careful study for sensitive species to avoid inadvertent loss of these species.

Ponderosa pine forest covers approximately 161.6 acres and makes up the second most common vegetation type in the Occidental Leasehold. Tall ponderosa pines and black oak with a well-developed shrub understory comprised of dear brush, manzanita, bracken fern, iris, and occasionally squaw carpet generally characterize the ponderosa pine forest on the site. Portions of this plant community have been affected by wildfire and logging which occurred approximately 20 years ago on the southeast side of Cobb Mountain. These areas are currently in an earlier stage characterized by lower, denser individuals.

Mixed evergreen forest exists primarily on the moist slopes within the leasehold. Dominant species include douglas fir, madrone, California bay, and canyon live oak. These form a dense canopy under which few other species grow. However, a few scattered shrubs (including poison oak) and herbaceous species do occur.

Another forest type on the leasehold is the canyon live oak forest. This vegetation type is characterized by the presence of canyon live oak, interior live oak, black oak, and California bay. It typically forms a forest of tall trees (up to 50.8 cm in diameter) on north-facing slopes and in canyon or dense chaparral-like cover on south-facing slopes.

Knobcone pine forest is also found on the leasehold. These areas are characterized by an upper canopy up to 10 m high comprised almost solely of knobcone pine, with a dense shrub understory of manzanita and a few other shrubs. Vogel et al. (1977) provides an excellent composition and ecology review of this plant community.

Riparian vegetation occurs as a narrow strip lining the banks of Anderson and Gunning creeks. Woody species include white alder, willow, spice bush, and big-leaf maple. Sedges and chainfern are among the herbaceous species present.

A small area of annual grassland exists on the east side of the leasehold. Species present include a variety of introduced annual grasses with a few native wildflowers.

Other important plant habitats include rock outcrops and seeps and springs. Rock outcrops are common on the Occidental leasehold and provide habitat for a number of perennial herbs. Seeps and springs are important for the herbaceous species they support and as watering sources for wildlife. Small intermittent springs are located in many locations on the leasehold. One larger perennial spring is located below the power plant site and is important in that it supports a number of uncommon species.

Rare and Endangered Plants

The Geysers region is noted for its complex arrangement of vegetation, soils, and topography. As a result, this region also supports a relatively large number of endemic plant species which are rare or endangered. Biology Table 2 lists the status of rare plants which are known or suspected to occur in The Geysers KGRA (Smith et al., 1980). This table separates species which have been identified as rare and endangered (CNPS List 2) from those which are recognized as rare but not endangered (CNPS List 3). Rare and endangered species are those which require a high level of protection in most instances. Species which are rare but not endangered may be indicators of special biological areas and may also require preservation under specific circumstances. At present, no rare plants are known to occur on the project leasehold.

WILDLIFE

The Occidental leasehold provides important habitat for wildlife species. The combination of varied vegetation (for food and shelter), ample water supplies, and the presence of special habitat features (e.g., rock outcrops, snags, and aquatic habitat) provide the habitat necessary to support a wide variety of wildlife species. In addition, the lack of continuous historic disturbance on the southeast side of Cobb Mountain also positively contributes to the wildlife values of the site.

Mammals are probably well represented on the project site, although no comprehensive studies have been conducted to confirm this. A number of large carnivores, including black bear, mountain lion, and bobcat, have been reported on or immediately adjacent to the leasehold. Other species which are likely to occur on the site include spotted skunk, striped skunk, long-tailed weasel, raccoon, and ringtail. In addition, a large number of small mammals are known or expected to occur on the site and are listed in Appendix E of the AFC.

Aquatic habitat exists within the leasehold on both Anderson and Gunning creeks. According to studies cited in the AFC, there is a rainbow trout fishery in Anderson Creek within the leasehold. Price et al. (1980) found several other fish species occurred downstream from the Occidental site. These include California roach, Sacramento sucker, and riffle sculpin. Similar studies conducted on Gunning Creek indicate that the upper boundary where rainbow trout are no longer found is immediately to the east of the Occidental leasehold (Price et al., 1980). Both the fisheries of Anderson Creek and Gunning Creek are so close to the Occidental leasehold development activity that they are susceptible to major changes in water quality, should such changes occur as a result of this project.

Amphibians and reptiles are probably well represented on the Occidental leasehold. Species which are known to occur in the area include western fence lizard, western rattlesnake, ringneck snake, northern alligator lizard, Pacific giant salamander, insatina salamander, red-bellied newt, and rough-skinned newt.

Numerous bird species are reported to be known or suspected to occur on the Occidental leasehold. These birds generally represent species which are typically found in The Geysers KGRA either as permanent or seasonal residents, or as migratory visitors. A discussion of several bird species appears in the AFC text, and a list of species is available in Appendix E of that document.

Endangered and Fully Protected Species

Only one endangered wildlife species, the peregrine falcon, is known to occur in the KGRA. The peregrine falcon is listed as an endangered species by both the United States Fish and Wildlife Service in 1977 (U.S. Fish and Wildlife Service, 1980) and the California Department of Fish and Game (1978). The legal status and ecological considerations of the peregrine have recently been summarized by the United States Fish and Wildlife Service (1980) and the Pacific Coast American Peregrine Falcon Recovery Team (1980).

Peregrines are known to nest in the Palisades and on Mt. Saint Helena 10 miles south-southeast of the Occidental leasehold. Peregrines have been sighted many times over The Geysers area.

A peregrine eyrie has been reported on Cobb Mountain. However, while several recent peregrine sightings have been reported, studies conducted between 1975 and 1977 which included the Cobb Mountain area found no evidence of nesting (Leitner, 1978). Leitner (1978) indicates that the cliffs on Cobb Mountain are apparently marginal for peregrine nesting. While Occidental leasehold

contains potential foraging areas, the approximate 10-mile distance from the nearest known eyrie makes regular use by those peregrines unlikely.

The golden eagle has been designated as a fully protected bird by the California Fish and Game Commission (1979). Golden eagles have been observed flying over the KGRA, but no eyries are currently known to exist in The Geysers region. It is unlikely that golden eagles would occur on the Occidental leasehold.

Ringtails are also fully protected in California (California Fish and Game Commission, 1979) and are known to occur in The Geysers KGRA. The closest known location to the Occidental leasehold where ringtails have been trapped is just two miles away (Koch and Brody, 1981). Presently, no studies have been conducted on the Occidental leasehold to provide any indication of the ringtail's possible occurrence. Studies on ringtail conducted in The Geysers indicate that this species occurs near riparian zones, often denning in rock outcrops, old stumps, large snags, and living trees. Ringtail may use several dens and have a home range of 400 to 500 acres (1 - 1.5 km²). Individuals may tolerate geothermal development and occur near some developments in The Geysers (Koch and Brody, 1981). The Occidental leasehold includes excellent ringtail habitat, so there is a substantial likelihood that ringtail occur on the site.

Recreational Species

Game species which occur in The Geysers KGRA include mountain quail, valley quail, mourning dove, band-tailed pigeon, western gray squirrel, jackrabbit, brush rabbit, Columbian black-tailed deer, black bear, and rainbow trout. Hunting is a popular sport among the residents in the region, both in season and out of season. Poaching of some species (particularly Columbian black-tailed deer) has been identified as a problem by Energy Commission biologists and the Department of Fish and Game.

Another important recreational aspect of wildlife is the aesthetic value of viewing wildlife in natural settings. The potential for observing wildlife in The Geysers is relatively high when one considers the variety of species which reside in the area. However, due to the limited public access into the area, recreational experiences with wildlife species in The Geysers will undoubtedly continue at extremely low levels.

Species of Special Concern

Species of special concern include candidate rare or endangered species that may need protection from potential adverse effects. Several such species are known or suspected to occur within The Geysers, including the merlin, prairie falcon, Cooper's hawk, sharp-shinned hawk, and long-eared owl. These bird species are discussed in the AFC and by Remson (1978).

While not presently considered rare or endangered, mountain lions are known to occur within The Geysers region. A statewide moratorium on taking mountain lions is currently in effect while the Fish and Game Commission considers various management strategies and future regulations.

IMPACTS

VEGETATION

Impacts to the vegetation resulting from the proposed project will include (1) direct loss of vegetation from construction of the power plant and accessory facilities and (2) vegetation injury and ultimate loss through exposure to cooling tower drift during power plant operation. The increase in human activity associated with construction and operation of the power plant will also result in an increase in fire hazard within the leasehold and to surrounding areas. These impacts are of concern both in terms of the direct loss and cumulative impacts over time within the entire KGRA.

Construction of the power plant, access road, and transmission lines will require the removal of approximately 19 acres of native vegetation (Occidental Response to Interrogatories of March 20, 1981). Vegetation loss will be limited to mixed chaparral, chamise chaparral, and serpentine chaparral. These vegetation types are relatively abundant in the region, and their loss presents no major impact in and of itself. Still, staff considers the loss of vegetation to be potentially significant as it relates to wildlife, erosion, and rare plant habitat.

The loss of chaparral represents a direct habitat loss for a number of wild-life species. These impacts are described in the section on wildlife.

The power plant construction will result in removal of vegetation from steep slopes on soils known to have high erosion potential. The region's high winter rainfall in combination with these other factors leads CEC staff to believe that there is a high likelihood of losing a relatively large quantity of sediments into the Anderson Creek drainage (see Hydrology section). The effect of erosion resulting from vegetation loss will include potential degradation of water quality (see Water Quality section) and contributes to impacts on aquatic organisms, including the recreational fishery of Anderson Creek from the point of disturbance to some potentially great distance downstream (see Wildlife section).

The loss of serpentine chaparral is potentially significant due to the relatively large number of rare plant species which are associated with only this soil/vegetation type. Serpentine chaparral in The Geysers region must be considered to be potentially important rare plant habitat. Staff believes that disturbance of this vegetation type must be kept to an absolute minimum.

Based on past experience in The Geysers steam resource area, operation of the power plant can be expected to result in moderate to severe vegetation stress and injury. Vegetation injury which is attributable to cooling tower drift is visible at virtually every operating power plant and a number of steam wells within The Geysers KGRA. Operating power plants emit a variety of substances from the cooling tower which are potentially toxic to surrounding vegetation. These substances include arsenic, boron, hydrogen sulfide, and mercury. Of these, boron has been identified as the most likely substance responsible for the injured vegetation surrounding power plants and steam wells (Malloch et al., 1979). The observed symptoms on injured vegetation surrounding power plants are nearly identical to those which are generally considered typical for boron toxicity and serve as strong evidence of the cause of injury.

The effects of boron on vegetation include both direct toxic effects and indirect effects which occur as a result of the stress. Direct effects include visible leaf injury and decreased plant vigor. Secondary effects include an increase in the incidence and severity of plant disease due to the weakened state of the plant. The net result can be vegetation injury and loss over an area which far exceeds the area disturbed during the power plant construction. Predicting the amount of area which will be impacted by cooling tower drift is extremely difficult. Such calculations require data on the boron content of the cooling tower drift, the meteorological conditions of the site, and the susceptibility of the vegetation on which the drift is desposited. These data are not currently available in quantifiable terms.

Loss of vegetation from cooling tower drift could result in increased impacts to wildlife habitat, and cooling tower drift would be especially threatening to any rare plant species occurring within the drift zone. However, no rare plants are known to occur near to the power plants, and the potential for significant effects on rare plants appears remote.

Construction of the power plant, access road, and transmission line will not directly impact any legally protected species, species of special concern, or species of commercial importance. Other impacts described previously would not be considered significant if proposed mitigation measures are successfully implemented.

WILDLIFE

Impacts to wildlife will result from construction-related disturbance, vegetation loss, and the release of toxic substances. Loss of terrestrial species will be most closely correlated with the amount of vegetation lost, while loss of aquatic species is directly related to the types and amounts of materials entering water courses. The significance of these impacts depends upon the species using the area, the amount of habitat lost, and the value or quality of that habitat. No estimates of current wildlife populations are available; thus, impacts cannot be quantified at this time.

Development at the power plant site will eliminate approximately 21 acres of chaparral. Wildlife species which will be most impacted include the smaller, more sedentary species such as snakes, fence lizards, and salamanders, small birds such as wrentits and rufous-sided-towhees, and small rodents. The loss of these species is not viewed as significant due to their relatively common occurrence in the area and the small number of individuals which are anticipated to be lost. The loss of chaparral has the potential for reducing the number of deer in the area by approximately 8 to 15 individuals (assuming .4 to .7 deer per acre).

Disturbance to wildlife will also result from direct human activity and noise in the area. Noise will be increased at the power plant, along access roads, and along transmission corridors. The extent of impact is uncertain but probably depends on the species which occur in the area. Some species appear to be relatively tolerant of noise and human activity in The Geysers. Other species (including gray fox, bobcat, and mountain lion) may avoid the area entirely.

Aquatic ecosystems are likely to be affected by soil erosion and possible accidental spills and other releases of toxic materials from the proposed project. Sedimentation of Anderson Creek will occur as a result of soil erosion from slopes which have had vegetation removed. Sedimentation can directly impact fish and other aquatic organisms by reducing respiratory function and indirectly by reducing reproductivity. Steel (1977) conducted fishery studies in the KGRA and found significantly higher sediment levels in areas of geothermal development. Trout populations in areas high in sediment were found to be both smaller and in poorer condition. The effect of erosion on aquatic organisms resulting from this project cannot be predicted in quantitative terms at this time.

Accidental spills or other release of materials into streams have occurred repeatedly in The Geysers (CEC staff report in preparation). The results of such spills include large fish kills and impacts to other aquatic organisms. The impact of a toxic spill is determined by the species composition in the stream at the time of the spill, the type of material spilled, and the flow, chemical, and physical composition of the stream. The release of materials can be very detrimental to aquatic species. Since release of toxic materials is not planned (or legally allowed), no estimate of the impact of this plant can be ascertained at this time. However, past experiences with other operators in The Geysers would indicate a strong possibility of toxic spill sometime during the life of this power plant.

The project is not expected to impact either peregrine falcon (endangered) or golden eagles (fully protected). These species are not anticipated to occur on the project site. No disturbance to hunting activities is anticipated as a result of this project.

Use of the leasehold by ringtail is considered likely. Vegetation loss from operation could affect potential breeding and feeding areas near the power plant. Because no estimates of ringtail populations on the leasehold are currently available, impacts on this fully protected species cannot be determined at this time. Due to the likelihood of ringtail occurring on the Occidental site, it is important to monitor the effects of this development on their well-being.

Recreational species will also be affected by vegetation loss from the power plant construction and operation. The loss of chaparral has the potential to reduce the populations of deer, quail, mourning doves, brush rabbit, and black-tailed hare.

While no single impact of significance has been identified, the total impact of the project on wildlife will be significant unless the impacts caused by the construction and operation of the power plant are mitigated.

MITIGATION MEASURES

VEGETATION

The applicant will revegetate all areas disturbed by the construction of the power plant and access road (Occidental Geothermal, Inc., 1981; Response to

Data Request dated March 20, 1981). Revegetation will be used in conjunction with the physical erosion control measures described in the erosion control plan (Response to Biology Workshop of May 7, 1981). Revegetation with native woody species has been incorporated into this plan, and if successfully implemented will help to reduce the loss of native plant communities and at the same time reduce the potential for soil erosion.

The effects of cooling tower drift on vegetation are difficult to mitigate, since the extent and severity of injury cannot be predicted. One method of mitigating the effects of cooling tower drift on vegetation is to reduce the amount of drift leaving the cooling tower. Drift eliminators will be incorporated into the power plant design and should reduce drift to the lowest possible levels. There is still a substantial probability of vegetation loss even at these reduced drift levels. There is still a substantial probability of vegetation loss even at these reduced drift levels. In order to quantify the effects of vegetation injury, the applicant shall monitor and report to CEC on the incidence and severity of pollution damage surrounding the power plant. This shall include large-scale color infrared aerial photography coordinated with visual ground inspection of permanent study plots. Specifics of the monitoring program will be described in detail in a separate document.

Impacts on native plant communities will also be lessened through a program of habitat management and enhancement. This will include a regular prescriptive burning program which will maintain a mosaic of vegetation types on the leasehold, reduce the threat of loss from wild fire, and ensure the continued existence and development of native plant communities on the leasehold.

WILDLIFE

The following mitigation measures are proposed to reduce the impact of habitat loss on wildlife species. Where impacts are suspected but unquantifiable, monitoring studies are proposed. In the event severe losses are identified at a later date, mitigation measures are recommended for future implementation if necessary.

Provided the surface owner agrees to such measures, Oxy will mitigate the loss of wildlife habitat through enhancement of existing vegetation and revegetation at disturbed areas with native species valuable to wildlife. Habitat enhancement procedures will include a conversion of old-stand chaparral through the use of prescribed burns on a rotating annual basis for the life of the project. This program will be described in the habitat enhancement plan submitted by Occidental. In addition to burning, Oxy will provide protection of existing snags from fire.

In the event on-site mitigation cannot be implemented, a fee equal to the cost of the full mitigation measure will be paid by Occidental. This money will be used in a manner designated by CEC biology staff for off-site mitigation measures. These could include purchase of unique biological areas, enhancement of wildlife species, preservation of habitat for endangered species, or other steps which will reduce the impact of geothermal development on the region.

The use of native shrubs and trees in revegetation of disturbed areas will also help wildlife by recreating food and cover. Species selected for

revegetation will include those which are valuable to wildlife and for erosion control.

Oxy will monitor impacts on aquatic resources on both Anderson Creek and Gunning Creek through their participation in the Aquatic Resource Monitoring program (ARM).

Occidental will implement a study plan to evaluate the effectiveness of the mitigation measures. Reports will be issued to the CEC annually beginning one year after initiation of the mitigation and monitoring plan. Reports on short-lived items (e.g., aquatic monitoring for the first three years) will cease one year after completion. Reports will be supplied annually for the life of the project on those items which last that long (e.g., prescribed burns, revegetation, etc.).

CEC staff recommends that Oxy shall avoid adversely impacting the ringtail by:

- A. Allowing no further disturbance of riparian areas.
- B. Locating and protecting as many ringtail as possible during construction (using trapping and radio telemetry to locate the animals).
- C. Starting vegetation clearing either before the birthing period (approximately late April) so that the pregnant ringtail are able to escape from the immediate construction zone or by waiting until after July 1. Furthermore, Oxy will attempt to determine the size of the ringtail population (by trapping) and determine the home range and denning sites of all captured animals (with radio telemetry). If ringtails are located on the leasehold, the following mitigation measures shall be implemented:
 1. Construction of artificial den sites.
 2. Establishment of food plants on fill slopes near Anderson Creek.
 3. Other methods as agreed to by both CEC and Oxy.

Oxy will then continue the trapping and telemetry efforts for a period of one year after the implementation to document the use of of the den sites by ringtail and the need to maintain these structures for longer periods.

CUMULATIVE IMPACTS—BIOLOGICAL RESOURCES

SETTING

Earlier sections of this report describe the leasehold and Geysers KGRA (see Biology and Cumulative Environmental Analysis).

IMPACTS

THE OCCIDENTAL LEASEHOLD

Impacts on the Occidental leasehold are of a similar nature to those associated with construction of the power plant. Leasehold development will require approximately 59 acres of land now covered by native vegetation. The land requirements of well pads, steam lines, access roads, and transmission lines are compared with the power plant and its access road in Biology Table 3 (based on data supplied by Occidental Geothermal, Inc.). The vegetation types to be lost in this development are more diverse than that lost in the power plant itself.

CUMULATIVE ANALYSIS BIOLOGY TABLE 1

AREAS OF DISTURBANCE ASSOCIATED WITH STEAM FIELD DEVELOPMENT

<u>Item</u>	<u>Total Area (Acres)</u>
<u>Well Pads</u>	<u>20.1</u>
<u>Internal Access Roads</u>	<u>11.7</u>
<u>Power Plant Site</u>	<u>18.0</u>
<u>Transmission Line—On Site</u>	<u>0.5</u>
<u>Transmission Line—Off Site</u>	<u>0.5</u>
<u>Total Lease</u>	<u>50.3</u>
<u>Total Project</u>	<u>50.8</u>

CEC staff does not expect any legally protected plants, species of special concern, or species of commercial importance to be impacted by the development of the steam field.

As with the power plant, concern for the loss of vegetation pertains mostly to impacts associated with soil erosion and wildlife populations. Losses will mostly be attributable to construction; however, small losses can be expected around venting steam wells due to release of phytotoxic substances. One access road (to Well Pad B) is being built on a relatively steep slope and crosses Anderson Creek. In addition, the northern most well pad (Well Pad B) is being constructed relatively close (within 160 feet) to Gunning Creek. Construction of these facilities, in addition to the power plant, steam lines, and other facilities on the leasehold, may impact the Anderson Creek watershed

Creek watershed (including Gunning Creek) through erosion of soil from denuded slopes. As described previously, sedimentation of these streams will likely result in impacts to aquatic biota (see Project-Specific Impacts) and to the Anderson Springs domestic water source, 50 - 70 percent of which is currently supplied by Gunning Creek (see Water Quality section).

Removal of vegetation will also have direct effect upon terrestrial wildlife through direct loss of habitat. Access roads and well pads have been constructed in areas which are distant from current development and which probably support substantial wildlife populations. The access road to Well Pad B has removed an area of riparian vegetation where it crosses Anderson Creek. Riparian vegetation is one of the most important wildlife habitat types on the leasehold due to the availability of water and numerous plant species which are valuable as food to wildlife. The U.S. Bureau of Land Management has recommended that riparian protection zones be established along both Anderson Creek and Gunning Creek and that no construction be allowed in these zones (BLM, 1978). The building of Well Pad B and its access road occur within this zone and is therefore in conflict with sound biological resource planning. Construction of this well pad facility presents a threat of impacts to wildlife both on and off the leasehold (see U.S. Geological Survey, 1980, for comments for agency biologists concerning Well Pad B and its access road).

The loss of vegetation from steam field development is not expected to significantly impact either the endangered peregrine falcon or the fully protected golden eagle. Impacts on the fully protected ringtail are currently undefinable, since adequate data are currently unavailable concerning this species on the leasehold. It should be noted, however, that riparian habitat, which this species prefers, is present and that the occurrence of ringtail on the leasehold seems very likely. It may be assumed that construction of these facilities will result in some currently undefined impact to the ringtail if it exists in this area.

Loss of recreational and other wildlife species can also be expected from development of the Occidental leasehold due to direct loss of habitat. However, if mitigated, these impacts should not be significant.

GEYSERS KGRA

CEC staff has examined cumulative impacts to terrestrial and aquatic biological resources in the steam dominated area of The Geysers KGRA (report in preparation). This report assesses biological impacts of three alternative development scenarios. The major findings of this report are summarized as follows.

Estimates of vegetation loss for existing power plants range from 500 acres to 1,607 acres. Depending on the ultimate development within the KGRA, total losses could vary from 1,860 acres to 3,720 acres over the next 20 years. As of 1979, about 247 acres of vegetation have been stressed and damaged due to cooling tower drift.

Vegetation loss eliminates habitat and food sources for wildlife. Wildlife studies conducted by PGandE (1977) indicate that there has been a shift in

species composition in developed areas when compared with some undeveloped areas within the KGRA. The effects of increase in human activity in The Geysers has not been ascertained, nor have potentially beneficial effects of increased edge and vegetation patchiness.

Vegetation removal and construction activities have destabilized soil surfaces, accelerated erosion, and increased sedimentation of some KGRA streams. As mentioned earlier, studies in the KGRA have indicated that sedimentation has adversely affected trout populations.

MITIGATION MEASURES

Mitigation measures proposed for impacts to wildlife and aquatic biota are as follows:

- o Revegetation of disturbed surfaces with native species to encourage wildlife and species with good soil holding capability to discourage soil erosion.
- o Enhance wildlife habitat through vegetation management, including prescribed burns where necessary.
- o Monitoring of aquatic biological resources shall be conducted on Anderson Creek and Gunning Creek. Occidental will participate in the Aquatic Resource Monitoring program.
- o Monitoring of ringtail populations on the leasehold commencing as soon as possible to establish a population base line to be compared with data collected during operations.

AIR QUALITY

SETTING

The most difficult environmental effects to analyze and evaluate are the impacts of power plant emissions on ambient air quality and the effects that deterioration of air quality has on surrounding plant, animal, and human populations. Several factors account for this difficulty. Some of the most pronounced are:

- a. Reliable up-to-date information on the existing ambient air quality is not always available for the specific plant site;
- b. Prediction of the expected ambient air quality when the project commences operation is difficult and involves many uncertainties;
- c. The current state-of-the-art for predicting the incremental impacts of a project (tracer tests and modeling studies), are not precise, primarily because of the complex terrain and meteorology of The Geysers KGRA; and
- d. Emissions from the power plant are uncertain because the exact composition and concentration of chemicals in the incoming steam are not known.

This section examines available information on ambient air quality at the proposed site, the climatic conditions affecting air quality, available information on steam content, and ambient air quality conditions. The purpose of the discussion is to provide baseline information against which one can measure and evaluate the effects of the proposed project's emissions and their impact on ambient air quality.

CLIMATE

Preproject Meteorological Conditions

Weather conditions in the general vicinity of the site have been monitored at various times for several years. Air quality and meteorological monitoring stations established by the Stanford Research Institute (SRI) are located near enough to the proposed Oxy site so that CEC staff can use data collected there to determine ambient and meteorological conditions at the plant site.*

Station SRI-2 is located on Anderson Ridge (on the same general ridgeline of the Mayacmas Mountains as the plant site), about one mile (1.6 kilometers) southeast of the plant site. Station SRI-6 is located about 3.2 miles (5.1 k) to the east-southeast, near the eastern end of Anderson Springs. Between 1976 and 1978 these stations monitored ambient concentrations of hydrogen sulfide

*The data and results from all eight of SRI's meteorological stations are contained in a report prepared in November 1979; see Ronald E. Ruff, Leonard A. Cavanaugh, Janet D. Carr, "1978 Executive Summary Specialized Monitoring Services," (SRI International, 1979), hereafter cited as Ruff, Cavanaugh, and Carr.

(H₂S) and meteorological conditions such as temperature, wind speed, and direction.

Air Quality Figure 1 shows other monitoring stations. The stations were established by SMUD, the California Department of Water Resources, PGandE, Occidental Geothermal, Inc., LCAPCD, and Lawrence Livermore National Laboratory (ASCOT) to provide a more complete and current data base of ambient H₂S concentrations at the KGRA.

Meteorological conditions at the proposed plant site are typical of the climate in the region. Wet winters and dry summers characterize the regional climate. The Pacific High, a semipermanent high pressure system off the Pacific Coast, which influences air flow and precipitation over the entire state, affects the general climate. This high pressure area causes prevailing northwest winds over the KGRA region and the persistent subsidence inversion which extends over much of the state during the summer months.

Ambient Air and Dew Point Temperatures

The complex terrain of the KGRA region is a major factor which affects local climate. The Mayacmas ridge deflects incoming marine air, moderating temperatures within the region. Even so, monthly temperatures at the site can range from 20°F (-6.6°C) in January to over 100°F (37.8°C) in August. Air Quality Table 1 shows monthly average ambient temperatures measured at SRI-2, the NCPA-2 station, and the SMUDGE0 #1 site. CEC staff believes that these values represent the temperatures at the Oxy #1 site.

Hot summer temperatures contribute to inversion conditions, or "limited mixing," which can "trap" pollutants between the inversion and the ground and intensify concentrations. Limited mixing conditions concentrate pollutants which are released under the stable layer (inversion). The limited mixing condition frequently includes winds which transport the pollutants over the Mayacmas Ridge towards populated areas such as Anderson Springs and Whispering Pines.

The relationships between dew point temperatures and cooling tower plume rise also affect air quality. In general, if the dew point temperature is low, the water vapor or steam in the cooling tower plume will condense at a slower rate. Heat energy is released in the condensation process, since condensation is slower, the heat release to the plume is slower, and the buoyancy of the plume is less. The plume will not rise as high, and the pollutant will not be dispersed over a wide area. Conversely, when dew point temperature is higher, the water vapor or steam tends to condense more rapidly. Heat energy is gained, the resulting plume rise is higher, and generally dispersion is more extensive.

The effects of dew point temperature on plume rise are not as strong as the effects of wind speed. In fact, mean dew point temperatures recorded at PGandE Geysers Unit 13 (PGandE Unit 18 AFC, 1979) during 1977-78 have a fairly narrow range of 34°F (November) to 43°F (August). Although a wider range could be expected at the Oxy #1 ridgetop site (Geysers 13 is at a lower, or more sheltered, location), CEC staff does not believe this difference would make dew point the predominant factor in determining plume rise or a major determinant of "worst-case" meteorological conditions for air quality analysis purposes.

OXY GEOTHERMAL #1

Source: Oxy #1 AFC

LEGEND

- H₂S SAMPLER AND MECHANICAL WEATHER STATION
- * H₂S SAMPLER ONLY
- MECHANICAL WEATHER STATION ONLY
- ⊖ MECHANICAL WEATHER STATION AND ACOUSTIC SOUNDER

FIGURE 1: AIR QUALITY-Air Quality and Meteorological Monitoring Stations

Air Quality

Table 1

MONTHLY AVERAGE AMBIENT TEMPERATURES IN PROJECT AREA

Location		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Anderson Ridge	⁰ C	7 ⁰	7 ⁰	5.5 ⁰	10 ⁰	18 ⁰	20 ⁰	21 ⁰	22 ⁰	16 ⁰	14 ⁰	10 ⁰	7 ⁰
SRI-21	⁰ F	45 ⁰	45 ⁰	42 ⁰	50 ⁰	64 ⁰	68 ⁰	70 ⁰	72 ⁰	61 ⁰	57 ⁰	50 ⁰	45 ⁰
NCPA-22	⁰ C	-1 ⁰	-1.6 ⁰	2.6 ⁰	4.3 ⁰	11.7 ⁰	13 ⁰	19.3 ⁰	18.4 ⁰	14.9 ⁰	13.6 ⁰	3.4 ⁰	1 ⁰
	⁰ F	30 ⁰	2.9 ⁰	37 ⁰	40 ⁰	53 ⁰	55 ⁰	67 ⁰	65 ⁰	59 ⁰	56 ⁰	38 ⁰	34 ⁰
SMUDGE0 #13	⁰ C	7 ⁰	5.4 ⁰	5.5 ⁰	10.3 ⁰	12.9 ⁰	14.9 ⁰	22.7 ⁰	22.3 ⁰	19.7 ⁰	13.1 ⁰	8.3 ⁰	8.5 ⁰
	⁰ F	45 ⁰	42 ⁰	42 ⁰	51 ⁰	55 ⁰	59 ⁰	73 ⁰	72 ⁰	67 ⁰	56 ⁰	47 ⁰	49 ⁰

1. Ruff, Cavanaugh and Carr, 1977. Data shown were measured from February 1976 through September 1977.
2. Environmental Systems and Service (contractor for the NCPA-2 met station). Data shown were measured from April 1978 thorough March 1979.
3. SMUDGE0 #1 AFC, 1980. Data shown were measured from October 1979 through September 1980.

Precipitation

In general, the amount of precipitation can affect the ambient air concentrations of total suspended particulates (TSP). Heavy rains and snow "scrub" or "wash" these particles from the air. Precipitation also helps dissolve certain water soluble gases or particulates emitted from geothermal plants, such as hydrogen sulfide, ammonia, and boron.

Average annual precipitation at the proposed plant site is approximately 80 inches (see Hydrology/Water Quality sections for additional discussion). Winter precipitation often occurs as snow above 2,000 feet (610m) and averages about 20 inches annually. Average relative humidity near The Geysers ranges from about 30 percent during the driest months to near 80 percent in the winter.

The high levels of precipitation during winter months partly account for the fact that the ambient air concentrations of H_2S measured at the SRI stations were generally lower in the winter than in the summer.

Wind Speed and Direction

Wind speed in the project area generally increases with elevation. The proposed project site is at about 3,600 feet elevation. Measurements taken at the meteorological station at the nearby SMUDGE0 #1 site indicate average wind speeds of approximately 15 mph. SRI data indicate that the frequency of calms (winds less than 1 or 2 mph) is significantly less than 10 percent at exposed elevated peaks. At lower elevations (1,400 to 2,600 feet, elevation of receptors), directional patterns bear little similarity to patterns found at high elevations. Local terrain becomes increasingly important in determining directional distribution. As indicated by the wind rose pattern for SRI-6 (Anderson Springs), there is no dominant wind direction, and this lower elevation exhibits a high frequency of calms, although 1976-78 data would indicate a westerly component.

The directional frequency distribution of local wind flow is more complex. At elevations above 2,000 feet (900m), the predominant wind is either from the NE +45° or the SW +45°. This distribution pattern occurs during all seasons. The likelihood of westerly and southwesterly winds is particularly important, since they can carry emissions from the plant toward Anderson Springs (3.2 miles to the east), Whispering Pines (2.3 miles to the northeast), or down into the Collayomi Valley toward Middletown.

Directional frequency of wind flows at the SRI-2 meteorological station, located on the ridge southeast of the proposed project site, exhibits the typical NE/SW high elevation pattern. Air Quality Figure 2 presents "wind rose" patterns for the SRI-2 site for the years of 1976 and 1977. Air Quality Figure 3 presents wind rose patterns for the SRI-6 (Anderson Springs) site for the period from October 1979 to July 1980. Air Quality Figure 4 also shows wind rose patterns for the SMUDGE0 #1 site, located northwest of the SRI-2 site on the ridge. Air Quality Table 2 shows the wind speed and direction for ASCOT Station 6 located north of the proposed project site for the year 1979. Comparison of these sets of wind data illustrates the effect of local terrain upon wind direction distribution and frequency.

OXY GEOTHERMAL #1

Source: SMUDGE #1 AFC

FIGURE 2: AIR QUALITY-Wind Rose,SRI-2 Period of Record 2/1/76 to 12/31/77

OXY GEOTHERMAL #1

METERS PER SECOND

Source: SMUDGE #1 AFC

FIGURE 3: AIR QUALITY-Wind Rose, Anderson Springs (SRI-6)
Period of Record 10/4/79 to 7/15/80

OXY GEOTHERMAL #1

FIGURE 4: AIR QUALITY-Wind Rose, SMUD-1 Period of Record 9/26/79 to 11/30/79

Air Quality

Table 2

ASCOT STATION 6 WIND DIRECTION AND SPEED FREQUENCY DISTRIBUTION (PERCENT) AND AVERAGE WIND SPEED (MPH) AUGUST 1979 THROUGH NOVEMBER 1979

Wind Direction	Percent of Time Wind Speed is Between						Avg. Wind Speed
	<u>1-3</u>	<u>4-7</u>	<u>8-12</u>	<u>13-18</u>	<u>19-</u>	<u>Total</u>	
NNE	0.8	1.8	0.3	0.0	0.0	2.9	5.0
NE	1.6	2.7	1.3	0.1	0.1	5.8	6.2
ENE	1.7	1.5	1.0	0.0	0.0	4.2	5.0
E	3.9	9.5	2.4	0.0	0.0	15.8	5.4
ESE	2.3	6.0	2.1	0.2	0.0	10.6	5.6
SE	1.4	0.4	0.0	0.0	0.0	1.8	2.9
SSE	0.7	0.3	0.0	0.0	0.0	1.0	3.2
S	1.1	0.0	0.0	0.0	0.0	1.1	2.0
SSW	0.5	0.0	0.0	0.0	0.0	0.5	1.8
SW	1.0	1.5	0.2	0.0	0.0	2.7	4.7
WSW	1.8	2.1	0.6	0.0	0.0	4.5	4.7
W	2.0	6.1	0.7	0.0	0.0	8.8	5.1
WNW	3.5	13.4	8.2	2.6	0.0	27.7	7.1
NW	1.8	2.9	2.2	0.5	0.0	7.4	6.5
NNW	0.9	1.0	0.7	0.0	0.0	2.6	5.1
N	1.0	1.5	0.1	0.0	0.0	2.6	5.1
	—	—	—	—	—		
Total	26.0	50.7	19.9	3.4	0.1		

4 month average wind speed = 4.7 mph

Source: Lawrence Livermore Laboratory, 1980.

Topographic features may cause channeling of moderate or strong flows within valleys and around obstacles. Heating and cooling of slopes tend to create upslope flows over sun-heated surfaces and downslope flows at night. Downslope drainage flows are mostly developed in winter and upslope flows are strongest and most frequent in summer.

Concern over characterizing wind flow into and out of the Anderson basin at the proposed plant site resulted in the installation of bi-elevated meteorological monitoring equipment at the plant site. Data gathered included temperature, relative humidity, wind direction, and speed at 33 feet and 100 feet AGL.* Tabulation of the data is provided in Stone & Webster's submittal to LCAPCO, Bob Reynolds, dated May 5, 1981. Tabulation of the data is also summarized in the Determination of Compliance (DOC) Attachments 1 and 2. Comparison of the Oxy and SRI #2 wind data readily shows the effects of obstacle flow around Cobb Mountain. Winds at the site will tend to be from the northwest, and will be lighter than those at the SRI #2 site. Generally, nocturnal easterly winds at Oxy are more southeasterly and only slightly lighter. Thus while downwash conditions under a west wind may occur at the SRI #2 location, the probability is significantly less that they will occur at the Oxy site. Also, the monitoring reveals that the winds 33 feet and 100 feet, measured at AGL under downwash and limited mixing could commonly have significant differences in direction and speed. This latter observation once again points out the caution that one must use when performing tracer tests or attempting to model in complex terrain. This was the case for the limited mixing tracer test conducted for the Oxy project.

The proposed plant site is located on the lee side of the Anderson Ridge (i.e., the site is located down wind of the ridge). Wind blowing across the ridge may result in an eddy on the down wind side of the ridge. This eddy may at times encompass the plume from the facility and cause it to disperse over a wider area or possibly impinge on the ground in the area near the facility.

Worst-Case Meteorological Conditions

Several studies were conducted for other CEC regulatory cases to determine worst-case meteorological conditions. SRI's study established a data base for determining the predominant meteorological conditions at several points in the KGRA, including ridgetop and valley locations. An objective of this project was to provide data to help clarify correlations between specific conditions, such as temperature and wind speed/direction, and the high H₂S concentrations which have been recorded.

This data base, subsequent analyses, and field tracer tests did not result in definitive relationships between particular sources (power plants) and the receptors which they affect. Therefore, Occidental conducted tracer tests for the limited mixing and downwash regimes (see Impacts and Mitigation Measures). The purpose of tracer tests is to determine transport and dispersion of a plume under the conditions recorded on that test day. However, those conditions may not result in worst-case impacts. Therefore, Occidental used a

*AGL = above ground level.

model simulation to extrapolate tracer test meteorology to worst-case conditions (by changing some parameters) to estimate expected worst-case air quality impacts at receptors.

The Oxy Geothermal Plant #1 could affect receptor areas under the following meteorological conditions (see Impact section for discussion of potential impacts):

- a. Limited Vertical Mixing: a layer of stable air above the Mayacmas Ridge (which reduces the total volume of air for dispersion and concentrates the pollutant) coincident with cross ridge winds, which transport the plume into Lake County receptor areas.
- b. Downwash: high speed ridge winds deflect the plume downward by mechanical fluid motion into an adjacent valley (either Alexander Valley or the Anderson Springs/Whispering Pines area).
- c. Drainage: surface cooling and light winds aloft can carry the plume over the ridge into Big Sulfur Creek or down into Lake County around daybreak.
- d. Fumigation: transportation of plumes via a neutral or stable layer to Alexander Valley, where drainage winds and subsequent convective mixing at sunrise carry pollutants to the ground. Fumigation may also occur in the afternoon because of valley shadowing causing indirect circulation.

Air Quality

Geothermal steam emissions predominantly influence ambient air quality in the region. Water vapor constitutes about 99.5 percent of these emissions; condensible gases (other than water vapor), noncondensable gases, and solids comprise the remaining .5 percent.

Characteristics of Steam Content as They Relate to Air Quality

Composition of the steam varies according to the location of the source within the KGRA. Air Quality Table 3 presents a comparison of the composition of geothermal steam produced from wells supplying earlier PGandE units and one which will supply the Oxy #1 power plant. The figures in this table identified as The Geysers represent averages based on the range of values measured for several producing steam wells in the KGRA.

As the table demonstrates, the concentration of regulated pollutants in the steam from the Occidental well is generally much lower than the average concentrations from other geothermal projects. Two wells have been drilled and tested at this time. Operation of the plant will require a total of 7 - 12 wells. Thus, the CEC staff can reach no firm conclusion about ultimate concentrations of these pollutants. However, information from wells drilled for nearby units (PGandE Units 9 and 10, 13, 16, and 18, and SMUDGE0) suggests that the concentrations of pollutants in the southern part of the KGRA will be less than that seen in most other developed areas of the KGRA. These facts imply a greater likelihood of the Oxy #1 project meeting air quality standards as well as a greater likelihood of avoiding adverse environmental impacts than units located in other parts of the KGRA.

Air Quality

Table 3

NONCONDENSIBLE GASES AND SOLIDS IN STEAM (AVERAGED) FROM WELLS SUPPLYING GEOTHERMAL POWER PLANTS

<u>Noncondensible Gases</u>	Parts Per Million	
	<u>The Geysers*</u>	<u>Oxy #1**</u>
Carbon Dioxide	3260	5000
Hydrogen Sulfide	222	90 + 30
Methane	194	390
Ammonia	194	33
Nitrogen	52	210
Hydrogen	56	34
Ethane	Neg1	Neg1
<hr/>		
Total Noncondensibles	0.398	0.5757
 <u>Solids</u>		
Arsenic	0.019	0.004
Boron	16.0	1.0
Mercury	0.005	0.0077
Silica (SiO ₂)	No Data	0.07

* Overall average from 61 producing wells supplying The Geysers Power Plant, measured in 1972 - 1974 (NSCAPCD, 1974). Characteristic of wells change with time, validity of 1972 - 1974 data may be questionable.

** Based on two wells proposed to supply Oxy #1; measured by Occidental Geothermal Inc.

Characteristics of Existing Ambient Air Quality

As geothermal development in the KGRA increases, observation of ambient air quality and meteorological conditions at key locations becomes more critical to ensure attainment and maintenance of the ambient air quality standards.

In 1975, the California Air Resources Board measured seven major air quality contaminants at two sites in southern Lake County. The two sites were Kelseyville, about 10 miles northwest of the site, and Middletown, about 5 miles to the west. The ARB monitored ozone, carbon dioxide, sulfates, total hydrocarbons, methane, nonmethane hydrocarbons, and coefficient of haze (reduced visibility). According to the ARB, the California Ambient Air Quality Standards (CAAQS) for each of these parameters were not exceeded during the monitoring period of April 14 through May 12, 1975. No similar or more recent monitoring for the parameters has been undertaken, despite the increase in geothermal development since 1975.

A significant effort was made by the ARB and LCAPCD to establish existing levels of criteria pollutants in the Lake County Air Basin during the past 1-1/2 years. A year's worth of data was collected at the city of Clearlake, and monitoring continues at Lakeport for O₃, Vis, and COH. At Clearlake NO_x, COH, CO, O₃, and Vis were measured. Particulate (total/Hi-Vol) continues to be measured at Upperlake, Lakeport, and Kelseyville.

Pollutants associated with development of geothermal resources which are of concern in maintaining ambient air quality include suspended particulate matter, hydrogen sulfide, sulfur dioxide, and radon. Other pollutants of concern are arsenic and mercury. Visibility is also a concern. The following discussion describes ambient air conditions for each of these pollutants.

Total Suspended Particulate Matter (TSP)

Lake and Northern Sonoma County Air Pollution Control Districts conducted a six-month program to monitor suspended particulate matter in the region. During the period of February through August 1977, suspended particulate matter concentrations averaged over 24 hours ranged from 1.74 ug/m³ on Socrates Mine Road (March 14, 1977) to 76.05 ug/m³ in Middletown (August 11, 1977). Since 1977 the Socrates Mine Road has greatly deteriorated. Occasionally people complain about dust on the road. A serious dust problem exists on this road, as well as on many other dirt roads within the KGRA. (See Transportation section of EIR regarding plans to upgrade Socrates Mine Road.) The higher values observed in Middletown probably reflect the contributions from nongeothermal sources in Middletown, such as vehicular traffic, construction activities, and agricultural activities.

All reported concentrations are below the California Ambient Air Quality Standard for TSP of 100 ug/m³, averaged over 24 hours.

Hydrogen Sulfide (H₂S)

As part of its study, SRI measured ambient concentrations of H₂S at eight locations in the region from 1976 to 1978. SRI then derived hourly averaged

concentrations of H₂S. Air Quality Figures 5 and 6 and Table 4 present the distribution and frequency of times when the state ambient H₂S standard (.03 ppm) was equalled or exceeded* at each monitoring point during 1976-77 and during 1978. Indicated violations by today's interpretation of the standard may be underestimated; e.g., the ARB has determined that concentrations which equal or exceed 25 ppb constitute violations (ARB Letter, Thomas Austin to Michael Tolmasoff, dated April 2, 1980).

The SRI data near the proposed site indicate that the H₂S levels at Geysers Rock (SRI-1) and on the ridge crest above Anderson Springs (SRI-2) are somewhat higher than those of other monitored areas. Both sites are near producing geothermal fields. SRI-2 is the monitoring station nearest the proposed project site (1.0 mile to the southeast). The data indicate that 1976 H₂S levels at this site exceeded the state standard approximately 10 percent of the time (640 hours from a total of 7,325 hours monitored). During 1977, the 30 ppb standard was exceeded approximately 5 percent of the time (360 hours from a total of 8,372 hours monitored).

SRI-2 generally records high H₂S levels when the winds are from the southwest. The distribution of H₂S concentrations versus time of day also peak during the night or early morning hours. Probably natural fumarole activity, coupled with emissions from geothermal development activities (operating PGandE units and wells) to the southwest of Cobb Mountain, is the primary contributor to H₂S concentrations recorded at SRI-2 during west or southwest winds.

Data from SRI-6 for 1977, located below the ridge in Anderson Springs, indicates that the state standard was exceeded about .3 percent of the time (25 out of 8,201 hours monitored). Most of the violations in 1977 occurred during evening hours with low southwesterly winds. For SRI-2 and SRI-6, Air Quality Figures 7, 8, and 9 provide H₂S data for each major wind direction, indicating the percentage of time various wind speeds occurred and the percent of time various levels of H₂S occur.

Air Quality Table 5 shows the results of the SMUD-DWR monitoring program conducted in 1979 and 1980. The data for Anderson Springs indicate relatively low H₂S concentrations. This may be due to unusual meteorology during 1980 or the fact that the monitor was removed in June 1980, before that time of the year in which excessive H₂S concentrations historically occur. The LCAPCD Anderson Springs H₂S monitor measured one H₂S standard violation (one of 36 ppb and one of 33 ppb) during the period from October 1979 to present.

PGandE indicated in their Quarterly Progress Report for Geysers Unit 17 (79-AFC-1) August 1, 1980, through October 31, 1980, that Environmental Systems and Services (ESandS) is operating (under contract with NSCAPCD) the ambient air quality monitoring station at the SRI-4 site. ESandS indicates that except for one reading of 28 ppb on July 30, 1980, at 2200 hours, all recorded H₂S concentrations at the SRI-4 site during 1980 were less than 20 ppb as of October 31, 1980. If the July 30, 1980, reading of 28 ppb were rounded per

*A violation of a state ambient standard occurs if the measured ambient concentration of a pollutant equals or exceeds that standard.

OXY GEOTHERMAL #1

Source: Oxy #1 AFC

FIGURE 5: AIR QUALITY-Distribution of H₂S Hourly Average at or Above 30 ppb

OXY GEOTHERMAL #1

Source: Oxy #1 AFC

FIGURE 6: AIR QUALITY—Distribution of H₂S Hourly Average at or Above 30 ppb (Concluded)

OXY GEOTHERMAL #1

POLLUTANT : H2S
STATION CODE : SRI 2
SAMPLING PERIOD : 76-32 TB 77-366

SHADE CONCENTRATION (PPB) NO. OF SAMPLES

ABOVE 25.0	1284
BETWEEN 10.0 AND 25.0	2737
BELOW 10.0	10482
ALL	14503

Source: SAI (Oct. 1980)

FIGURE 7: AIR QUALITY-Historical H₂S Levels at SRI-2 (1976-1977)

OXY GEOTHERMAL #1

POLLUTANT : H₂S
STATION CODE : ANDERSON SPRINGS
SAMPLING PERIOD : 76-32 TO 78-366

SHADE CONCENTRATION (PPB) NO. OF SAMPLES

	ABOVE 25.0	62
	BETWEEN 10.0 AND 25.0	806
	BELOW 10.0	20874
	ALL	21742

Source: SAI (Oct. 1980)

FIGURE 8: AIR QUALITY-Historical H₂S Levels at Anderson Springs (1976-1978)

OXY GEOTHERMAL #1

POLLUTANT : H2S
STATION CODE : ANDERSON SPRING
SAMPLING PERIOD : 79-278 TO 80-167

SHADE	CONCENTRATION (PPB)	NO. OF SAMPLES
	ABOVE 25.0	0
	BETWEEN 10.0 AND 25.0	9
	BELOW 10.0	4486
	ALL	4495

Source: SAI (Oct. 1980)

FIGURE 9: AIR QUALITY-Historical H₂S Levels at Anderson Spring (1979-1980)

Air Quality
Table 4

DISTRIBUTION OF H₂S HOURLY AVERAGES (30 ppb): 1978

Station		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Percent
1 Geyser Rock	≥30 ^a	5	2	1	14	1	23	56	28	7	23	12	16	188	2
	Days ^b	1	2	1	7	1	9	18	11	5	9	7	8	79	22
	Counts ^c	597	602	719	675	691	590	723	687	612	724	558	657	7835	89
2 Anderson Ridge	≥30 ^a	3	1	2	1	13	84	62	22	33	23	10	46	300	4
	Days ^b	2	1	2	1	6	18	14	7	14	13	6	16	100	27
	Counts ^c	600	539	712	679	676	575	591	481	497	596	659	711	7316	84
3 Kahm Ranch	≥30 ^a	0	0	0	0	0	0	0	1	0	1	0	0	2	0.03
	Days ^b	0	0	0	0	0	0	0	1	0	1	0	0	2	0.5
	Counts ^c	470	605	727	673	694	645	719	710	700	682	372	578	7575	86
4 Pine Summit	≥30 ^a	0	0	0	0	0	3	18	18	10	14	0	0	63	0.9
	Days ^b	0	0	0	0	0	1	7	8	6	5	0	0	27	8
	Counts ^c	607	595	611	692	335	646	714	728	712	547	242	553	6982	80
5 Whispering Pine	≥30 ^a	0	1	7	2	0	0	3	0	3	6	3	0	25	0.3
	Days ^b	0	1	5	1	0	0	2	0	2	4	3	0	18	5
	Counts ^c	562	571	687	683	698	634	723	716	666	648	537	420	7545	86
6 Anderson Springs	≥30 ^a	0	0	0	0	0	2	0	2	0	0	0	0	4	0.05
	Days ^b	0	0	0	0	0	1	0	2	0	0	0	0	3	0.8
	Counts ^c	587	601	609	689	705	645	726	719	690	687	697	742	8097	92
7 Sawmill Flats	≥30 ^a	0	0	0	0	0	1	3	0	0	4	0	0	8	0.1
	Days ^b	0	0	0	0	0	1	2	0	0	2	0	0	5	1.4
	Counts ^c	605	613	734	655	696	646	725	719	710	331	380	725	7539	86
8 Aidlin Ranch	≥30 ^a	12	9	0	0	0	0	66	41	7	94	62	9	300	6
	Days ^b	9	6	0	0	0	0	16	10	3	17	10	6	77	21
	Counts ^c	552	358	0	0	0	0	673	689	677	592	501	716	4758	54
Monthly totals:	≥30	20	13	10	17	14	113	208	112	60	165	87	71	890	
	≥30	12	10	8	9	7	30	59	39	30	51	26	30	311	

a ≥30 ppb = number of H₂S hourly averages at or above 30 ppb. (The actual measurement per hour must have averaged 29.5 or more.)

b Days = number of days with at least one hour reading at or above 30 ppb.

c Counts = number of valid hourly averages (percent counts correspond to valid data capture for 1 January through 31 December).

Source: Ruff and Cavanaugh (1979)

Air Quality

Table 5

SMUD/DWR MONITORING DATA

Monitor	Period of Record (Julian Date)	H ₂ S Concentration (ppb)		
		Highest	Second Highest	Number of Exceedances
Anderson Springs	4 October 1979- 26 June 1980	14	11	None
Geysers Rock	8 August 1979- 16 August 1980	90	88	59
Pine Summit	11 August 1979- 16 August 1980	33	28	2
Jimtown	10 October 1979- 15 July 1980	18	12	None
Geyserville	14 August 1979- 23 August 1980	93	82	30
Hobergs	21 November 1979- 1 July 1980	29	25	2
Big Sulphur Creek	13 August 1979- 8 August 1980	210	170	92

Source: SAI Report, "Assesment of The Sacramento Municipal Utility District's Proposed Geothermal Power Plant -- Volume III. Final Worst-Case Air Quality Analysis", October 3, 1980.

the ARB criteria, this reading would constitute a violation of the ambient air quality standard for H₂S. PGandE, in their Quarterly Progress Report for February 1, 1981, through April 30, 1981, reported 1 violation of 50 ppb at SRI-4 (January 6, 1981, at 2000 hours). PGandE also reported that most of their units were either down for repairs or overhaul just prior to or during this period.

Data from the PGandE/ARB monitoring station at Whispering Pines showed no violations from August through September 1980 (Oxy AFC). The Oxy aerometric station at Starview, on Boggs Mountain above Whispering Pines, recorded no H₂S concentrations above 5 ppb from August 1980 through January 1981 (Oxy AFC).

It is extremely difficult to determine the exact sources of H₂S during periods when state standards are violated. The total existing Geysers geothermal development contributes to these violations. Winds west of the Mayacmas ridge carry H₂S emitted from the plants and steam fields over the ridge crest. Drainage flow downslope could subsequently dominate this wind flow and cause pollutants to move toward Anderson Springs.

Sulfur Dioxide (SO₂)

As part of its study, SRI measured SO₂ concentrations at Anderson Springs (SRI-6) and Pine Summit (SRI-4). They took over 7,000 measurements (hourly average) at each station between February and December 1976. At no time did SO₂ concentrations ever exceed the state standards for SO₂ (0.5 ppm hourly average or 0.05 ppm 24-hour average). In fact, only rarely (1.1 percent of the time) did the hourly average concentrations of SO₂ at Anderson Springs exceed .005 ppm.* Thus, SO₂ concentrations are not expected to approach or exceed ambient air quality standards.

*See Ruff, Cavanaugh, and Carr, page 6, Table 3, Distribution of SO₂ Hourly Averages, 1976.

AIR QUALITY

IMPACTS

CLIMATE

Persistent emissions of heated water vapor can affect several microclimate variables. Addition of this vapor to the atmosphere slightly increases ambient temperature and humidity and reduces insolation (incoming solar radiation). CEC staff does not expect emissions from the proposed project to significantly affect local humidity and temperature, due to the relatively low volume of emissions in relation to the absorption capacity of the overlying air mass.

During calm winter nights when drainage or downslope wind flows predominate, emissions of water vapor may slightly increase the frequency and duration of fog within one-half to one mile of the proposed project site.

AIR QUALITY

Legal Requirements

Lake County Air Pollution Control District (LCAPCD)

All Lake County APCD rules apply to operation and construction of the facility. The following are the rules of specific concern for permitting the facility:

Rules 602, 604 and 605 (New Source Review)

LCAPCD Rules 602 and 605 require that the Air Pollution Control Officer (APCO) perform an air quality analysis for any source which will emit more than 20 pounds per hour or 150 pounds per day of any pollutant, except CO, for which there is a local, state, or federal ambient air quality standard (AAQS). The APCO must deny an authority to construct for such a source unless he determines that emissions from the source may not be expected to result in the violation or measurable contribution to the continued violation of any AAQS and provided that BACT will be used on the contaminant-emitting equipment for any pollutants for which there is an AAQS. Further, Rule 604 allows the APCO to conduct an air quality analysis for a source which will emit less than 20 pounds per hour or 150 pounds per day of any pollutant for which there is an AAQS if the emissions from the source may be expected to result in the violation or measurable contribution to the continued violation of an AAQS.

If an analysis performed pursuant to LCAPCD Rule 605 indicates the source will result in the violation or measurable contribution to the continued violation of an AAQS, Rule 602-B provides that the APCO may still permit that source if emissions offsets, beyond those reductions required by existing control strategies, are obtained in such an amount that a "demonstrable basin-wide air quality benefit" will result.

Rule 608

Notwithstanding Rules 602, 604, and 605(c), Rule 608 allows the LCAPCD to permit a facility, provided the facility uses best available control technology (BACT) and meets the following prescriptive criteria:

- o Power plants and geothermal fluid transmission lines must limit on a continuous basis the hydrogen sulfide emission rate to no more than five pounds per hour (5 lbs/hr) per one million pounds per hour of steam flow received.
- o The proposed power plant must be located such that not more than one permitted geothermal power plant (within the district) is closer than 0.6 miles, within 1.0 miles of a populated area [as defined in Chapter 21 of the Lake County Code, Article XXV, Section 21-73.6a(1)].
- o Geothermal development wells must limit the hydrogen sulfide emission rate on a continuous basis during air drilling, cleanout, initial testing, and reworking to no more than five (5.0) pounds per hour (2.3 kilograms per hour).
- o Venting wells on standby shall be located no closer than 0.5 mile from a populated area [as defined in Chapter 21 of the Lake County Code, Article XXV, Section 21-73.6a(1)], and emissions shall be no greater than an average of one (1) pound per hour per well based on the number of completed wells for the associated power plant's steam field.
- o In the judgment of the APCO the facility must readily be able to show compliance with all other rules and regulations which limit emissions other than hydrogen sulfide.
- o No individual property owner or legal resident within a one-mile radius of the proposed power plant site or within 0.5 miles of a well pad makes a request for a New Source Review of the project. Permits issued after 30 days notice to affected parties pursuant to this rule shall be final.

Rule 421.2.A

LCAPCD Rule 421.2.A (as revised April 7, 1981) limits H₂S emissions from a geothermal power plant which receives an Authority to Construct on or after January 1, 1981, to not more than 50 grams per gross megawatt hour (g/GMWh). H₂S emissions from all geothermal power plants located in Lake County will be limited to 50 g/GMWh beginning January 1, 1990, subject to a public hearing in 1987.

Rule 411

LCAPCD Rule 411 limits emissions of particulate matter to whichever is the lesser of:

- a. 0.2 grains per standard cubic foot of gas, or
- b. 40 pounds per hour.

Rule 412

LCAPCD Rule 412 limits emissions from any sulfur recovery unit producing elemental sulfur to the following:

- a. 300 PPMV of sulfur compounds calculated as SO₂,

b. 10 ppm H₂S by volume, and

c. 100 pounds per hour of sulfur compounds calculated as SO₂. The APCO interprets Rule 412 as applying to Stretford and EIC units.

Rule 430

A general emissions limitation contained in LCAPCD's Rule 430 prohibits the discharge of any contaminant in an amount which causes injury, detriment, nuisance, or annoyance to any considerable number of persons or which causes injury or damage to business or property.

State

The state AAQS for H₂S is 0.03 ppm. The California Air Resources Board (ARB), which sets and enforces state AAQS, determined that ambient concentrations of H₂S which equal or exceed 25 ppb (0.025 ppm) constitute violations (ARB Letter, Thomas Austin to Michael Tolmasoff, dated April 2, 1980). The Public Health Section of this EIR identifies the state AAQS for other pollutants.

Federal

Prevention of Significant Deterioration (PSD) regulations apply to construction of new facilities in areas which currently meet air quality standards. PSD regulations establish the acceptable levels of deterioration in these areas based on the classification of the area. National Parks and Wilderness areas are Class I areas, where practically any deterioration is significant. PSD regulations allow some deterioration in Class II areas. The proposed project is located in an area presently designated as Class II. The nearest Class I area to the site is approximately 50 miles to the north. PSD regulations also can require the application of BACT, as defined by federal law, to sources of certain pollutants.

Emission Sources

A typical geothermal power project can emit air pollutants from two principal sources: (1) the power plant itself and (2) the steam wells and steam transmission lines. The first source produces emissions during routine operation of the steam turbine-generator, while the latter sources produce significant emissions only when the steam turbine-generator shuts down and steam vents (stacks) directly to the atmosphere. Emissions from the power plant are from two major points: (1) the noncondensable gas stream from the condenser and (2) the cooling tower.

The two most important air pollutants Oxy #1 will emit are hydrogen sulfide (H₂S) and particulates (total suspended particulates or TSP). Both pollutants are present in the incoming steam and must be controlled. Occidental proposes the Stretford process to control H₂S emissions from the noncondensable gas stream and the Hydrogen Peroxide (with or without catalyst) secondary abatement process to control the H₂S emissions from the cooling tower. Occidental is investigating alternative secondary controls. Oxy #1 will also use dual turbines and a turbine bypass mechanism which will significantly reduce stacking occurrences and corresponding emissions. SMUDGE0 #1 and DWR Bottle Rock are the only other new plants currently committed to use of the bypass mechanism.

In addition, the steam transmission line can emit small quantities of pollutants from well bleedlines, leaky gaskets, or the clean-out of particulate collectors. The estimated emission rates from these sources are shown in Air Quality Table 5.5. These emissions are continually released throughout the leasehold, but are so low that the regulatory agencies generally consider their impacts insignificant.

Particulate Sources and Quantities

The major sources of particulate emissions from the Oxy facility will be the geothermal steam and the H₂S abatement system's chemicals and reaction products. The geothermal steam, after passing through the turbine, will be condensed in the unit condenser. In the condenser, the particulates in the steam will be separated into the liquid and noncondensable gas streams. The liquid stream will be transported to the cooling tower with the circulating cooling water, where a portion of the particulates will be emitted to the atmosphere in the form of drift. The remainder will be reinjected with the blowdown from the cooling tower to the geothermal reservoir. The particulates in the noncondensable gas stream will be transported to the Stretford unit, where some of them will be scrubbed out by the Stretford solution. The Stretford chemicals, however, are an additional source of particulates. The noncondensable gas stream, after treatment by the Stretford unit, will carry these particulates to the main power plant cooling tower, where they will be emitted to the atmosphere. The secondary abatement process will use hydrogen peroxide, which, when combined with the H₂S and ammonia in the condensate, will form ammonium sulfate which can be emitted as a particulate. The chemical reaction may also form other solids.

Occidental estimated the Total Dissolved Solids (TDS) and the Total Suspended Solids (TSS) in the circulating water to be 300 ppmw and 100 ppmw respectively (this is based on a circulating cooling water concentration factor of 3.94; AFC Table 1.4-21 shows steam condensate constituents). Occidental also estimated the TDS contribution from the secondary Hydrogen Peroxide process to be 350 ppmw. Based on a drift rate of 0.001 percent, the assumption that both TDS and TSS including contributions from the hydrogen peroxide process will form particulate emissions and a circulating water flow rate of 80×10^6 lbs/hr, the circulating water contribution of particulates is 0.6 lbs/hr.

Occidental estimated that mist eliminators on the Stretford process will reduce the carry-over of Stretford chemicals to approximately 0.002 percent of the solution flow rate or approximately 22.6 pounds per hour of liquid (7.5 lbs/hr from the Stretford absorber and 15.1 lbs/hr from the Stretford oxidizer). The Stretford solution may contain up to 30 percent dissolved solids. Therefore, the Stretford process absorber will contribute approximately 2.3 lbs/hr particulates in the noncondensable gas stream. Occidental also indicated that if an oxidizer and evaporator (Stretford cooling tower) are used, the Stretford process will emit an additional 4.7 pounds per hour.

The total particulate emission rate from the proposed facility, assuming an evaporative cooler, is 7.6 pounds per hour or 0.00003 grains per standard cubic foot, (based on a air flow rate through the cooling tower of 53.2×10^6 pounds per hour). This emission rate would comply with LCAPCD Rule 411.

Air Quality

Table 5.5

STEAMFIELD EMISSION POINT DATA

Point Identification	Outlet Height Above Ground	Size & Shape	Flow Rate Gas	Quantity of H ₂ S Emitted
wellhead rock muffler for dirty wells estimated 2 required	approx. 10'	rock filled chamber 8' X 10' area approx.	100,000 lb/hr approx. 2 times per year 6-8 hour duration each time	96 lb/8 hour period
orifice plate bleeds (pressure measurements) 30 required	approx. 5'	1/4" nozzle	.5lb/hr intermittent on a continuous basis	0.001 lb/24 hours
wellhead bleeds temp. and press. 30 required H ₂ S .001	approx. 2' (inside well cellar)	1/4 nozzle	.5lb/hr intermittent on a continuous basis	0.001 lb/24 hours

Air Quality

Table 5.5 Continuation

wellhead separator blow off 30 required	approx. 4'	2" pipe	5000 lb/hr approx. 2 times per month 10 minutes duration each time	0.10 lb/10 minutes
wellhead rock catcher blow off 4 required	approx. 4'	2" pipe	5000 lb/hr approx. 2 times per month 10 minutes duration each time	0.10 lb/10 minutes
drip legs 33 required	approx. 2'	1" pipe	2000 lb/hr approx. 2 times per year 2-3 hour duration each time	0.7 lb/3 hr
Final rock muffler at plant site 1 required	approx. 16'	60 X 30' area approx.	1,500,000 lb/hr approx. 2 times per year one hour duration	180 lb/1 hr

Hydrogen Sulfide Sources and Quantities

The H_2S in the steam supply, after it is exhausted by the turbine, separates (partitions) into both the noncondensable gas stream and the liquid stream. The proposed power plant will emit H_2S in the noncondensable gas stream and from the cooling tower. H_2S entrained in the liquid condensate will then enter the atmosphere. If these emissions were left untreated, they would contribute significantly to violations of applicable standards for H_2S . For this project (as in other recently proposed projects), Occidental proposes the Stretford process to abate H_2S in the noncondensable gas stream and the Hydrogen Peroxide process to abate the H_2S entrained in the liquid condensate. CEC staff expects the Stretford process to have a control efficiency of approximately 99 percent of the H_2S it receives. The Ralph M. Parsons Corporation, manufacturer of the Stretford units for PGandE's Geysers Units 15, 17, and 18, now offers guarantees that the treated gas stream leaving its Stretford unit contains no more than 10 ppmv H_2S . The Hydrogen Peroxide process is capable of control efficiencies in the range of 95 percent to 98 percent of the H_2S it receives.

The success of the H_2S abatement systems depends in part on the partitioning efficiency achieved in the surface condenser. The partitioning efficiency obtained at PGandE Unit 15 was approximately 65 percent. The partitioning efficiencies obtained at PGandE Units 13 and 14 were in the range of 80 percent to 90 percent. PGandE presently claims partitioning in excess of 90 percent is achieved on Units 13 and 14. Partitioning efficiency depends to a large extent on the incoming steam constituents and the condenser design. The boric acid and ammonia content of the steam may play a big part in partitioning. Leakage in the condenser and the design of the gas ejector systems may also play a big part in the partitioning achieved. Many factors potentially affect partitioning. Lawrence Berkeley Laboratory is currently developing a computer program which may help significantly in predicting partitioning. Since Oxy #1 is located in the same general area as Units 13 and 14, it might be expected that the steam constituents and the partitioning efficiency would be similar. However, for the purposes of a worst case assumption, the CEC staff will assume the partitioning efficiency is 65 percent.

Based on the limited data from the initial Occidental steam well, the range of H_2S concentrations in the incoming steam is 90+30 ppmw (Oxy AFC Table 1.2-3). The total amount of H_2S entering the plant, based on an expected incoming steam flow of 1.6×10^6 pounds per hour, would range from approximately 96 to 192 pounds per hour.

Occidental initially proposed a 9.7 pounds per hour (50 g/GMWh) H_2S emission rate for their project. Since the initial AFC filing, LCAPCD adopted Rule 608, which limits H_2S emissions to 5 lbs/hr per million pounds steam input. Occidental applied for a permit under Rule 608 (letter, June 26, 1981, Bob Ward to Bob Reynolds, LCAPCD, Application under Rule 608 for Authority to Construct; and the revision to the AFC submitted July 2, 1981.) For the Oxy #1 project, Rule 608 limits the H_2S emissions rate to 8.0 pounds per hour, based on 1.6×10^6 pounds per hour steam input.

Based upon the above Stretford (99 percent) and Hydrogen Peroxide (95 percent) control team efficiencies and the worst-case assumed partition efficiency (65 percent), the proposed control would be capable of abating H_2S emission to 4.6 pounds per hour (based on the highest input rate of H_2S of 192 pounds per hour). Thus, the proposed controls would be capable of meeting LCAPCD Rules 608 and 421.2.A.

Occidental is currently investigating alternative secondary abatement systems. These systems are Condensate Stripping and Condensate pH Control. Condensate Stripping and Condensate pH Control would increase the partitioning efficiency obtained in the surface condenser. Application of these controls would send the additional H_2S to the Stretford unit for abatement.

The Condensate Stripping process uses an inert gas to drive H_2S from the condensate. The stripping gases move up a vertical column (stripping tower) while the condensate flows down through the column. The stripper gas contains carbon dioxide which reacts with the ammonium and hydrogen sulfide in the condensate and results in hydrogen sulfide gas formation. The Stretford unit will then oxidize the hydrogen sulfide gas. Condensate pH control (Ammonia Fixation) increases partitioning in the condenser by affecting the chemical balance during condensation. This control manufactures carbonic acid from the noncondensable gas leaving the Stretford unit. The carbonic acid is injected into the condenser where it reacts with the ammonia in the steam and reduces the amount of hydrogen sulfide in the condensate. Preliminary technical and economic analyses of the condensate stripping and condensate pH control techniques encouraged Occidental to further investigate these methods under bench scale testing. Occidental agreed to use hydrogen peroxide with ferrous sulfate and hydroxyacetic acid for condensate treatment. If tests of alternatives are positive, Occidental may modify the design with LCAPCD and Commission approval. However, currently, there is insufficient data to approve either alternative control.

Sulfur Compound Sources and Quantities

The Stretford unit will emit the byproducts sodium sulfates and thiosulfates as entrained aerosols and small amounts of H_2S in the treated gas stream. Up to 28 percent of the Stretford solution may be sodium sulfate and thiosulfate. Sodium sulfate and thiosulfate emissions as aerosols will be approximately 4.0 pounds per hour, calculated as sulfate, SO_4^{2-} .

The treated gas stream from the Stretford unit will contain 0.1 percent of the inlet H_2S . Occidental will require in bid specification for the Stretford Unit that H_2S in the tail gas will not exceed 10 ppmv. Assuming 65 percent partitioning and 120 ppmw H_2S in the steam, the effluent H_2S would be 0.12 lb/hr. The total sulfur compound emissions from the Stretford unit, calculated as SO_2 , would be 2.9 lb/hr. This latter figure is well below the limit of 100 pounds per hour set by Rule 412C.

Stretford sulfur compound emissions from the cooling tower would be about 0.018 ppmv, calculated as SO_2 . Sulfur compound emissions from the Stretford oxidizer and evaporator, if one is used, would be about 21 ppmv. Both emissions are well below the standard of 300 ppmv set by Rule 412A.

Stretford H_2S emissions of 0.0022 ppmv from the cooling tower are far below the standard of 10 ppmv set by Rule 412B.

Ambient Air Quality Impact

Systems Applications, Incorporated (SAI), investigated air quality impacts at nearby receptor areas due to the projected emissions from Oxy #1. SAI's impact assessment integrated field tracer tests with computer modeling. The

objective of this approach was to incorporate real-world information from the tracer studies into a mathematical computer simulation. Also, the results of the tracer studies provided a baseline against which the modeling results could be compared. After making these comparisons to improve model performance, SAI expected the model to be capable of predicting ambient air quality at The Geysers when Oxy #1 begins operation in 1984.

There are four components of the SAI Geysers Hybrid Model. Those components are the Cooling-Tower Plume Rise Model, the Gaussian Puff Model, the Airshed Grid Model, and the Complex Terrain Wind Model. The Plume Rise Model is important because the height which the plume rises from the cooling tower significantly affects where ground level pollution concentrations will occur and the magnitude of these concentrations. From several equations describing the plume rise, SAI decided on the Winniarski and Frick (1978) equations.

Once the pollutants enter the atmosphere, numerous meteorological characteristics (wind speed and direction at various altitudes, air and ground temperatures, etc.) affect the plume in which the pollutants travel. The Puff Model was required so that the travel and dispersion of gases could be more accurately characterized as the cooling tower plume begins to disperse. Once these puffs grow sufficiently large, the gridded Airshed Model predicts the transport and dispersion of the pollutants. The Wind Model is used to develop the wind fields, based on known measurements, to be used in predicting the transport and dispersion of the pollutants.

The grid cell size of the Airshed Model is limited by the assumption used to develop the model's transport and dispersion equations. Because the grid cells are relatively large in comparison to the transport distances, they have a tendency to average or flatten the predicted concentrations. The size of the grid cells is the primary reason for the use of the Puff Model, which will better characterize the dispersion of the plume in the dimensions less than the grid cell size. The Plume Rise Model use in this modeling study has not been verified for the cooling towers in The Geysers. The wind fields have been developed with a minimum of actual wind observations. Despite these flaws in the model, the model has been relatively accurate in replicating the tracer test results.

Four components were used to predict the incremental impacts from Oxy #1:

1. Tracer Tests--Gases were released under two candidate worst-case weather conditions (i.e., limited mixing and downwash) under which Oxy #1 would most likely affect receptor areas. Detectors in these areas indicated cumulative hourly concentrations of tracer gases.
2. SAI Model Simulation--The SAI Geysers Hybrid Model was used to simulate the Oxy #1 limited mixing tracer test. This enabled SAI to calibrate the model so it would provide results similar to values measured in the tracer test. The input parameters were then varied in order to examine possible worst-case impacts.
3. Comparison with SMUDGE #1 Incremental Impacts--The CEC staff examined the SMUDGE #1 tracer test results and modeling studies, because the SMUDGE #1 facility is relatively close to the Oxy site.

4. SAI Simulation of the July 28, 1976 Worst-Case Day--Meteorological data from July 28, 1976, were used to simulate the incremental impact from Oxy #1.

Limited Mixing Incremental Impact

Based on a worst-case emission rate of 9.7 pounds H₂S per hour, SAI* determined peak H₂S concentrations (summarized in Air Quality Table 6). Air Quality Table 6 shows SMUDGE #1 peak H₂S concentrations. Air Quality Figures 10 - 14 illustrate predicted impacts during limited mixing conditions. The lines on these figures, called "isopleths," indicate places where ambient H₂S concentrations are equivalent. Figures 10 and 12 present the concentrations which resulted when a tracer gas was released at 820 feet (SF₆) and at 320 feet (CBrF₃) above the ground, respectively. The 820-foot release should represent the expected plume height under normal operating conditions while the 320-foot release should simulate the expected plume height during stacking. Air Quality Figures 11 and 13 present the results of the Hybrid Model simulation, plume motion, and diffusion under tracer test conditions.

The equivalent worst-case H₂S impact observed during the tracer test (from SF₆, the higher release height) was approximately 0.7 ppb** at Whispering Pines. Involved parties assume that worst-case concentrations occurring within two or three grid cells of receptor areas represent worst-case predicted model impacts. This is based on the observation that modeling results tend not to be exactly on target. Using pertinent data describing the meteorology which occurred during the tracer test day, the Hybrid Model simulated plume transport and diffusion. The model predicted a peak concentration of approximately 1.1 and 1.17 ppb (upper and lower release heights respectively) at the same general geographic location as observed during the tracer test.

The mountainous or "complex" terrain at The Geysers makes it extremely difficult to simulate plume motion in the atmosphere. Complexity notwithstanding, comparing the tracer test results with those of the modeling shows a promising degree of correlation.

Hybrid model simulations of other tracer tests resulted in predicted peak concentrations that differ from observed values by a factor of 1.5 to 3. Applying this to the peak value of 1.1 ppb (Air Quality Figure 11) results in a range of 1.6 ppb to 3.3 ppb.

In the SMUDGE #1 case, SMUD, SAI (the applicant's air quality consultant), and the CEC staff agreed that a reasonable estimate of the incremental impact from the SMUDGE #1 project in the Anderson Springs area was 2 ppb. The LCAPCO and NSCAPCO disagreed and concluded that it was likely that model results were underestimated. Based on a ratio of the SMUDGE #1 (8 pounds per hour) and Oxy #1 (9.7 pounds per hour) emission rates and air estimated

*T.W. Tesche et al., Air Quality Analysis of the Proposed Occidental Geothermal Power Plant, Final Report, (SAI), March 31, 1981.

**The peak value on Air Quality Figure 10 is 0.071 ppb per pound H₂S emitted. Based on a 9.7 pounds H₂S/hour emission rate, the predicted H₂S impact is 0.69 ppb (9.7 lbs H₂S/hr x 0.071 ppb/lbs H₂S) of H₂S.

Air Quality
Table 6
PEAK CONCENTRATIONS DUE TO OXY #1

Meteorological Condition	Receptor Areas	Tracer		1984 ^{3/}
		Test	Simulation	Simulation
Oxy #1 Impacts ^{1/}				
Limited Mixing	Anderson Springs, Whispering Pines, Collayomi Valley	0.69 ppb	1.1 ppb	1.8 ppb
Downwash	Lake County Anderson Springs	0.18 ppb	--	--
SMUDGE #1 Impacts ^{2/}				
Limited Mixing	Anderson Springs, Whispering Pines, Collayomi Valley	0.9 ppb	0.6 ppb	0.8 ppb

1/ Based on a 9.7 lbs/hr H₂S emission rate.

2/ Based on a 8.0 lbs/hr H₂S emission rate.

3/ Impacts only under limited mixing conditions were simulated for 1984 emissions at The Geysers.

OXY GEOTHERMAL #1

THE GEYSERS GEOTHERMAL AREA
JULY, 1977

SCALE 1:20000

Equivalent H₂S Isopleth (ppb)
Bagger Site $\left(\frac{\text{Max. H}_2\text{S Eqv.}}{\text{Time Recorded}} \right)$

Source: Oxy #1 AFC

FIGURE 10: AIR QUALITY-Isopleths of Maximum Equivalent H₂S Based on Occidental Test 1 Limited Mixing (SF₆ Results)

OXY GEOTHERMAL #1

1600 to 1700 hours

Source: Oxy #1 AFC

FIGURE 11: AIR QUALITY-Equivalent H_2S Isopleths for Limited Mixing-820 feet (SF_6) Model Simulation (ppt)

OXY GEOTHERMAL #1

Source: Oxy #1 AFC

FIGURE 12: AIR QUALITY—Isopleths of Maximum Equivalent H₂S at 1 lb/hr from CBrF₃

OXY GEOTHERMAL #1

FIGURE 13: AIR QUALITY—Equivalent H_2S Isopleths for Limited Mixing—320 feet($CBrF_3$) Model Simulation (ppt)

OXY GEOTHERMAL #1

(p) Between the Hours of 2000 and 2100

Source: Oxy #1 AFC

FIGURE 14: AIR QUALITY—Predicted 1984 Worst-Case H₂S Concentrations Due to OXY#1 Emissions (ppt)

SMUDGE0 #1 incremental impact of 2 ppb, the Oxy #1 incremental impact is 2.4 ppb ($9.7/8.0 \times 2.0 = 2.4$) in the Anderson Springs area. This assumes data obtained from the SMUDGE0 #1 analysis is also applicable to the Oxy #1 project.

In addition to the tracer tests and modeling studies, the parties selected an historical day from the SRI data base, during which elevated H₂S readings occurred in receptor areas. The parties selected July 28, 1976, and pertinent meteorological data from this day were input to the model. Air Quality Figure 14 illustrates the impacts predicted for emissions of 9.7 pounds per hour of H₂S from Oxy #1. The peak value predicted is 1.8 ppb H₂S in the Ford Flat/Anderson Springs area.

Considering the uncertainties involved with the approaches (established tracer test methodology and state-of-the-art modeling) used in these analyses, a reasonable estimate of the worst-case impact from Oxy #1 H₂S emissions (9.7 pounds per hour) is 2 to 3 ppb H₂S at sensitive receptor areas under limited mixing conditions. A conservative estimate in light of the uncertainties would be less than 5 ppb. The incremental impacts would be proportionally less for a lower emission rate. It should be noted that the tracer tests conducted marginally fitted the criteria for limited mixing and downwash.

This contribution, in and of itself, will not constitute a violation of the state ambient air quality standard for H₂S. However, the background or "cumulative" concentration from existing plants must be added to Oxy's incremental impact to determine if there will be violations of the standard in populated areas when Oxy #1 begins operation (see Cumulative Impacts--Air Quality for this analysis).

Downwash Incremental Impact

The results of the Oxy downwash tracer test are provided in the ES&S Report "Tracer Dispersion Test, Data and Analyses, Occidental 75 MW Geothermal Project, Lake County, California," May 15, 1981. The results indicate that the maximum incremental impact under downwash conditions would be at Lincoln Rock (see Air Quality Figure 15) and would be approximately 0.56 ppb H₂S (based on a 9.7 pounds per hour H₂S emission rate). The downwash impact from the Oxy #1 project at Anderson Springs would be 0.18 ppb H₂S. Consequently, the impacts from the Oxy #1 project could be considered negligible under downwash.

MITIGATION MEASURES

As previously indicated, Occidental agreed to use the Stretford and Hydrogen Peroxide (with or without catalyst) processes to abate H₂S in the incoming stream. It can reasonably be expected that these controls could abate H₂S to the required levels. Based on recent cases before the CEC, it is also likely that the permitting authority would consider these controls in combination to be BACT.

Occidental also committed to use dual turbines and a turbine bypass system to mitigate stacking events. The turbine bypass system will route steam around

Source: E.S. & S. (May 1981)

FIGURE 15: AIR QUALITY—Isopleths of Maximum Equivalent H₂S at 1 lb/hr

the turbine(s) to the downstream abatement systems during unit outages. If only one turbine is out of operation, the remaining turbine could use the excess steam from the other turbine for power production. This dual turbine/turbine bypass design will significantly reduce stacking and provide greater operational flexibility. This design warrants consideration by other developers in the KGRA.

Reliability of the proposed abatement systems is critical to maintaining the required emission rate and to successful operation of the stacking controls. The CEC staff expects the turbine bypass mechanism to operate reliably. Reliability of the downstream controls, however, is critical to the operation of the bypass system.

PGandE, at a recent workshop on NSCAPCD-proposed rule changes, indicated that they are experiencing corrosion effects on stainless steel screens located downstream of the Hydrogen Peroxide process on Unit 15. LCAPCD indicates this may also be a problem on PGandE Unit 13. The extent and cause of the corrosion are not certain at this time, although PGandE attributes the corrosion to the chelating agent. Chemical mismanagement can worsen the corrosion problem. Use of proper management techniques or selection of compatible material will help avoid this problem. If the problem proves to be significant, a possible solution could be to reduce the amount of chelating agent and ferrous catalyst being injected and increase the reaction time by increasing the length of piping or by installing a holding tank in the stream.

Other than the corrosion problems discussed above, there appears to be little that can go wrong with the Hydrogen Peroxide process that cannot be mitigated. The major components of the process are pumps, valves, pipes, and storage tanks. If the design provides for sufficient redundancy and capacity for the critical components (i.e., pumps and valves), the availability of the Hydrogen Peroxide process should be high.

Control of the input rate of hydrogen peroxide is critical to maintaining the control efficiency, because the inlet H_2S concentration can vary over a wide range in a short time. Currently there are not adequate H_2S condensate monitoring devices to provide automatic control of the input rate of hydrogen peroxide. PGandE and other utilities are currently pursuing development of continuous H_2S condensate monitors, primarily for compliance purposes. However, when adequate monitors are developed, they can be used to provide the necessary feedback to control the hydrogen peroxide input rates, thus improving the reliability of the control process.

CEC staff expects the reliability of the Stretford process to be relatively good, based upon previous use of Stretford in the petroleum industry. PGandE indicated that they have experienced problems with sulfur clogging some lines. This problem can be overcome by redesigning the sulfur lines. If the design provides for sufficient redundancy and capacity for critical components, the Stretford process should obtain a high availability factor.

Drift eliminators will be installed on the cooling tower, which will limit the drift to 0.001 percent of the circulating water flow rate. This level of control is the current state-of-the-art. The use of this control measure will reduce particulates and some pollutants of concern to public health.

Specifications for the Stretford Unit will require that the unit control H₂S in the tail gas to 10 ppmv or less.

The Joint Findings and Conclusions in the air quality area and the DOC condition are attached in Appendix E.

CUMULATIVE IMPACTS--AIR QUALITY

SETTING

CLIMATE

Moist air plumes from cooling towers generally disperse rapidly in the atmosphere due to their buoyancy, air entrainment, and atmospheric turbulence. Beyond a radius of about one-third mile (about one-half kilometer) from a particular cooling tower structure, the combined contribution from all operating cooling towers affects the environment (see Air Quality, Setting section).

The cumulative contribution of water vapor to the atmosphere from all power plants presently operating in The Geysers KGRA, in the absence of an intense inversion, results in only minor changes to the area's climate.

AIR QUALITY

Comparisons between the tracer tests and the model simulations focused on the model's capability to predict future incremental air quality effects from Oxy #1. These results indicate relative precision and accuracy of the model in predicting H₂S concentrations, especially peak values at sensitive receptor areas, due to emissions from a single-point source.

Oxy #1 will begin operation in 1984, when it will be one of several units operating at The Geysers KGRA. Therefore, it is necessary to determine the background air quality (to which Oxy #1 will contribute) in order to evaluate the overall or cumulative impact. As with the incremental impacts simulation, the cumulative effects prediction requires some form of evaluation to establish credibility and to use as a "yardstick" to compare model simulations against observed real-world concentrations.

Model Evaluation

In order to predict the 1984 worst-case ambient H₂S levels, a day (July 28, 1976) was selected during which H₂S standard violations occurred at sensitive receptors. The meteorological parameters and estimated emissions (see Cumulative Air Quality Table 1) for that day were used in the model simulation. Cumulative Air Quality Tables 2 and 3 summarize the observed and predicted H₂S concentrations at several locations for July 28, 1976.

The model appears to be relatively accurate in predicting background in sensitive receptor areas. For Geysers Rock (SRI-1) and Kahn Ranch (SRI-3) stations, the model generally underpredicts, while at sensitive receptor sites, such as Whispering Pines (SRI-5), Anderson Springs (SRI-6), and Sawmill Flat (SRI-7), there is relative agreement between predicted and observed concentrations. This agreement is better if model result one grid cell away from the station are compared to the observed levels.

Predicted 1984 Ambient H₂S Levels

Predicting ambient air quality in 1984 required the use of the worst-case meteorology (the July 28, 1976, meteorology data) and the expected emission

CUMULATIVE ANALYSIS
AIR QUALITY TABLE 1

ESTIMATED H₂S COOLING-TOWER EMISSION RATES
ON JULY 28,1976

EMISSION SOURCE	AVERAGE HOURLY EMISSION RATES (lbs/hr)
PGandE UNIT #1	42
#2	44
#3	209
#4	192
#5	201
#6	315
#7	190
#8	119
#9	63
#10	63
#11	222
Wild Well	35
Total	1704 lbs/hr

Source: SAI 1981

CUMULATIVE ANALYSIS
AIR QUALITY TABLE 2
PEAK PREDICTED AND OBSERVED H₂S CONCENTRATIONS FOR SEVEN STATIONS*

Station Specific Values

Station	Maximum Hourly Equivalent H ₂ S Concentrations (ppb)		Average Error (percent)	Ratio of Predicted- to-Observed Maximum Concentrations
	Predicted	Observed		
Geyser Rock	49	120	-59%	0.41
Anderson Ridge	93	111	-16	0.84
Kahn Ranch	4	43	-91	0.09
Pine Summit	14	33	-58	0.42
Whispering Pines	35	41	-15	0.85
Anderson Springs	32	36	-11	0.89
Sawmill Flat	45	55	-18	0.82

* The average error value is defined as follows:

$$\text{error} = \left(\frac{P - O}{O} \right) \times 100\%$$

† P - O = Predicted minus observed concentrations.

Source; SAI 1981

CUMULATIVE ANALYSIS
AIR QUALITY TABLE 3
1 Cell Radius

Station	Maximum Hourly Equivalent H ₂ S Concentrations (ppb)		Average Error (percent)	Ratio of Predicted- to-Observed Maximum Concentrations
	Predicted	Observed		
Geyser Rock	80	120	-33%	0.666
Anderson Ridge	98	111	-12	0.883
Kahn Ranch	9	43	-90	0.209
Pine Summit	30	33	-9	0.909
Whispering Pines	35	41	-15	0.854
Anderson Springs	40	36	+11	1.111
Sawmill Flat	51	55	-7	0.927

* The average error value is defined as follows:

$$\text{error} = \left(\frac{P - O}{O} \right) \times 100\%$$

† P - O = Predicted minus observed concentrations.

Source; SAI 1981

rates for the Wild Well and for PGandE units, the Department of Water Resources (DWR) units, Northern California Power Agency (NCPA) units, and the SMUD unit. The Northern Sonoma County Air Pollution Control Officer (NSCAPCO), in the SMUDGE0 #1 case, provided his estimate of the expected 1984 emissions from existing and proposed facilities (699 lbs H₂S/hr total; see Cumulative Air Quality Table 4). Since the SMUDGE0 case the NSCAPCO has revised his estimate of the expected emission rates (485 lbs H₂S/hr total; see Cumulative Air Quality Table 5). The CEC staff believes that the NSCAPCO revised estimates are valid for the 1985 - 1986 time frame, when PGandE is expected to retrofit existing Units 1, 2, 7, 8, 9, and 10 in accordance with the NSCAPCD Variance for these units (based on a comparison of the variance schedule, the revised NSCAPCD rules and the estimated emission rates). Since the Draft EIR was prepared, the NSCAPCD revised the emission rates for these facilities. The SAI analysis of the revised emission rates showed approximately the same background as the revised rates for 1985 - 1986 discussed below. PGandE has recently applied for a change in the variance for Units 7 and 8. It should be noted that there are many uncertainties in these emission rates.

Cumulative Air Quality Figures 1 and 2 show the predicted worst-case background H₂S concentration in the vicinity of sensitive receptors for the July 28, 1976, worst-case meteorology and the expected 1984 emissions (based on emissions shown in Cumulative Air Quality Table 4). The SAI simulation shows approximately a 24 ppb contribution from the NCPA units and the PGandE units. The DWR units will contribute approximately 0.1 ppb, and SMUDGE0 will contribute approximately 1.25 ppb (based upon a 5 lbs/hr emission rate). The predicted background level in 1984 is sufficiently close to 25 ppb (the ARB's criteria for determining a violation; see Air Quality Impacts section) that it is likely that a violation will occur in 1984 when Oxy #1 becomes operational.

The SAI analysis of the revised NSCAPCD emission rates averaged the upper quartile of the model predicted concentrations surrounding sensitive receptor areas to develop an estimated background H₂S level. The CEC disagrees with this approach, and the following estimates are based on the maximum predicted concentrations reported.

Cumulative Air Quality Figure 3 shows the predicted worst-case background H₂S concentrations in the vicinity of sensitive receptors for the July 28, 1976, worst-case meteorology and the expected 1985 - 1986 emissions (based on emissions shown in Cumulative Air Quality Table 5). Results of this analysis would indicate that the background concentrations in 1985 - 1986 would be 10 to 15 ppb near Anderson Springs. These levels are sufficiently below 25 ppb that it is likely that a violation would not occur under normal operating conditions in 1985 - 1986 unless some unforeseen event occurs. The difference between the 1984 and the 1985 - 1986 background levels is due to the expected reduction in emissions from existing plants after 1984.

IMPACTS

CLIMATE

For the annual average wind speed of 15 miles per hour (SMUD meteorological station), the downwind contribution of water vapor is less than 0.1 gram per

CUMULATIVE ANALYSIS

AIR QUALITY TABLE 4

1984 EMISSION LEVELS USED IN THE COMBINED IMPACT AIR QUALITY SIMULATION*

Unit	H ₂ S Emission Rate (lb/hr)
PG&E 1	60
PG&E 2	49
PG&E 3	20
PG&E 4	5
PG&E 5	22
PG&E 6	32
PG&E 7	24
PG&E 8	127
PG&E 9	63
PG&E 10	63
PG&E 11	37
PG&E 12	27
PG&E 13	11
PG&E 14	23
PG&E 15	12
PG&E 16	7
PG&E 17	26
PG&E 18	12
NCPA 1	13
NCPA 2	13
SMUDGE0#1	8
DWR Bottle Rock	5
DWR South Geysers	5
Wild Well	<u>35</u>
Total	699

* Source: Estimates supplied by the Northern Sonoma
County Air Pollution Control District (July 1980).

CUMULATIVE ANALYSIS

AIR QUALITY TABLE 5

REFINED 1984 ^{**}HYDROGEN SULFIDE EMISSION ESTIMATES*

<u>Unit</u>	<u>Uncontrolled (lb/hr)</u>	<u>Controlled (lb/hr)</u>
PG&E 1	60	5
PG&E 2	50	6
PG&E 3	213	12
PG&E 4	161	12
PG&E 5	301	23
PG&E 6	426	23
PG&E 7	242	23
PG&E 8	126	63
PG&E 9	63	32
PG&E 10	63	32
PG&E 11	697	47
PG&E 12	204	47
PG&E 13	--	11
PG&E 14	85	23
PG&E 15	232	12
PG&E 16	--	5
PG&E 17	534	26
PG&E 18	202	12
SMUDGE#1--1	80	5
DWR Bottle Rock	280	5
NCPA 1	90	13
NCPA 2	90	13
Wild Well	<u>35</u>	<u>35</u>
Total	4234	485

* Source: Estimates supplied by the Northern Sonoma County Air Pollution Control District (January 1981).

** CEC Staff believes these levels are applicable in 1985-1986.

OXY GEOTHERMAL #1

Source: SAI (1980)

FIGURE 1: AIR QUALITY-Cumulative Analysis-Predicted 1984 Ground Level H₂S Concentrations Due to PG&E and NCPA-1 Emissions (ppb)

OXY GEOTHERMAL #1

Source: SAI (1980)

FIGURE 2: AIR QUALITY—Cumulative Analysis—Predicted 1984 Ground Level H_2S Concentration Due to DWR Bottlerock and South Geysers Emissions (ppt)

OXY GEOTHERMAL #1

Source: SAI (1980)

Between the hours of 1000 and 1100

**FIGURE 3: AIR QUALITY—Cumulative Analysis—Predicted 1985–1986
Ground H_2S Concentrations (ppb)**

cubic meter of air at a distance of 5 to 10 miles (8 to 15 kilometers) from the operating units at The Geysers. At the coldest temperatures expected in the area saturated air could contain at least three grams of water vapor per cubic meter. This addition of water vapor corresponds to a change of less than 1°F in wet-bulb temperature readings.

During the dry season of April through October, the capacity of the air for water vapor ranges from 6 to 40 grams per cubic meter, so the addition of cooling tower water vapor from all units during this period will not change the wet-bulb temperature more than 0.5°F. During this dry season, the area is generally in or above the inversion so that the relative humidity is low and the addition of cooling tower water vapor causes an insignificant change (CEC staff analysis, 1979).

However, one concern expressed by members of the scientific community is that even minor changes in temperature and humidity may impact sensitive plant species and their ability to survive (Neilson, 1975a; Ecoview 1975; Leitner, 1978). See Biological section of this EIR.

AIR QUALITY

Hydrogen Sulfide

The last step in determining compliance with ambient air quality standards is to add the worst-case predicted 1984 background H₂S concentrations at receptor areas and the incremental impacts of the Oxy #1 project. As described in the previous section, it is likely that a violation or near violation will occur in the Anderson Springs area when Oxy #1 comes on line. The incremental impact expected from Oxy #1 is between two and three ppb, in the same vicinity. Oxy #1's contribution, however, is not a measurable contribution as defined by the LCAPCD Rules.

By 1985 - 1986 the CEC staff expects the background levels in the receptor areas to be less (10 -15 ppb), provided PGandE meets the schedule of the NSCAPCO Variance. Under these conditions Oxy #1 will not cause the violation or contribute to a violation of the H₂S ambient air standard.

Particulates

Data collected regarding ambient TSP indicate no historical particulate ambient standard violations at sensitive receptors. Oxy #1, as proposed, is not a major source of TSP and is likely neither to contribute nor to cause a violation of the standard.

Assuming the TSP is transported to the same receptor areas as the H₂S emissions and assuming TSP impacts are proportional to their emission rate, an approximation of the expected ambient concentration is calculated below.

$$9.7 \text{ lbs H}_2\text{S/hr} = 2 \text{ ppb ambient concentration}$$

$$= 2.8 \text{ ug/m}^3 \text{ ambient concentration}$$

7.6 lbs TSP/hr = 78% H₂S ambient concentration

= 2.2 ug/m³ ambient concentration

The projected impact from Oxy #1 appears insignificant in comparison to the 100 ug/m³ (24-hour average) ambient air quality standard for TSP.

Compliance During Abnormal Conditions

Analysis of project impacts must consider both anticipated emissions during regular operation (9.7 lbs H₂S/hr emission rate) and during abnormal conditions. A geothermal power plant periodically ceases operations due to either scheduled routine maintenance or because of an unscheduled forced shutdown. When this occurs at most power plants at The Geysers, the steam supply is vented directly to the atmosphere (unabated), referred to as "stacking." If unabated, Oxy #1 would emit during stacking as much as 192 lbs H₂S/hr unabated (120 ppm H₂S x 1.6 x 10⁶ lbs steam/hr = 192 lbs H₂S/hr).

The results of modeling and tracer analyses indicate that Oxy #1 emissions will result in a two to three ppb concentration contribution at Anderson Springs during normal operation. During stacking this contribution would increase approximately 20 times (192 lbs/9.7 lbs = 19.8). If unabated, this would constitute a violation of the state AAQS for H₂S if stacking occurred during the worst-case meteorological conditions. Occidental proposed dual turbines and a turbine bypass system to mitigate this impact.

Prevention of Significant Deterioration (PSD)

Based on the SMUDGE0 #1 case, where the EPA determined a PSD permit was required, the Oxy #1 facility would require a PSD permit. (The EPA is currently reviewing the PSD permit requirements. The Oxy PSD permit requirements are pending the results of that review.) Under PSD regulations (see Impact section description of PSD regulations), the maximum permissible deterioration in ambient particulate levels in a Class II area is 37 ug/m³ (24-hour averaging time). Assuming the estimated particulate emission rate of approximately 8.0 lbs/hr, the expected maximum impacts from the project on ambient TSP are on the order of 2.2 ug/m³ (averaged over 1 hour) at sensitive receptor areas. This impact would be even less if averaged over 24 hours, as specified by the PSD Class II allowable deterioration increment. Consequently, the impact of the proposed Oxy #1 facility is far below the allowable Class II increment, and the facility is too far from the nearest Class I area to cause any significant air quality deterioration.

Based on previously approved PSD permits for geothermal power plants, the CEC staff expects the use of Stretford abatement supplemented by secondary condensate treatment to satisfy the federal BACT requirement.

MITIGATION MEASURES

The proposed mitigation measures for this project are identified in the Mitigation Measures section of the Air Quality Impact section. It is the CEC staff's opinion that no additional mitigation measures are required. However, the CEC staff emphasizes that the reliability of the proposed H₂S abatement

technologies is critical to attaining and maintaining the ambient air quality standards for H_2S . The two violations of the AAQS at SRI-4 during the last year appear to be caused by concurrent stacking events. Since the Oxy #1 project would result in a violation of the AAQS for H_2S if the facility stacked during worst-case meteorological conditions, reliability of the controls is important. Occidental should ensure that sufficient capacity and redundancy for critical components are incorporated in the proposed facility design. Occidental should also ensure that the previously discussed corrosion problem (see Air Quality Impacts section) is adequately compensated.

NOISE

SETTING

LEGAL REQUIREMENTS

Lake County

Lake County adopted a Noise Element to the County General Plan which establishes an acceptable ambient noise level for residential receptors of 55 dBA L_{dn} * from all sources. Lake County currently establishes noise limits by placing conditions in the use permit. The most recent permit (PGandE Unit 13) establishes a standard of 55 dBA L_{dn} at a residential receptor. A source standard is established in order to determine whether a violation of the use permit exists. At Unit 13, this source standard value was 75 dBA (L_{eq}) at 200 feet from the plant. The permit conditions exclude construction activities, such as the movement of heavy equipment. Well drilling and production testing are not exempt.

Lake County is currently considering a draft noise control ordinance. At this time, it is speculative as to when and in what final form Lake County might adopt the ordinance. The final noise ordinance is awaiting the adoption of a general plan by Lake County. However, the draft ordinance standards which would apply to this project are 55 dBA for daytime hours (7 a.m. - 10 p.m.) and 45 dBA for nighttime hours (10 p.m. - 7 a.m.) for residences and open space.

Sonoma County

Sonoma County adopted a Noise Element to the County General Plan which indicates that noise levels between 50 dBA and 60 dBA L_{dn} are acceptable for residential land uses; noise levels between 60 dBA and 70 dBA L_{dn} require noise mitigation for residential land uses; and noise levels greater than 70 dBA L_{dn} are unacceptable for residential land uses (Noise Element, Table 42). Although the noise element also states that the above standards should be used in evaluating all new land uses, Sonoma County currently sets noise levels for geothermal projects in the individual use permits. The most recent use permit (Geothermal Kinetics Resolution No. 58299) contains a standard for construction activities of 65 dBA day and 55 dBA night and for operation of 60 dBA day and 50 dBA night, as measured at a residence.

State

The applicable state regulations are the CAL/OSHA Occupational Noise Exposure Regulations, Title 8 CAC, Article 105, General Industrial Safety Orders, which apply primarily to on-site conditions. The Division of Occupational Safety and Health (DOSH) of the Department of Industrial Relations enforces the CAL/OSHA regulations. These regulations set a 90 dBA employee exposure limit for an 8-hour period and reduce the exposure time in half for each 5 dBA increase in the noise level above 90 dBA. There is no direct state regulation of off-site conditions.

*See glossary for definition of terms.

Federal

The EPA has identified an L_{dn} of 55 dBA as providing reasonable protection against community annoyance and activity interference due to noise (U.S. EPA, 1971). The Occupational Safety and Health Act of 1970 (29 CFR 1910 et seq.) establishes federal worker standards which are basically the same as the CAL/OSHA regulations identified above.

Environmental Description

The sensitive receptor nearest the proposed plant site is a residence off-road (survey point 5), approximately 9,130 feet west of the proposed site. See attached Noise Figure 1 for location of the proposed facility and sensitive receptor locations.

Ambient noise levels at the nearest residential receptor range between 70 dBA and 29 dBA.* Noise levels at other locations in the site vicinity were provided in PGandE Geysers Unit 18 AFC, Table 5.6-1 (see attached Noise Table 1; also see Noise Tables 2 and 3 for minimum levels measured at sensitive receptors). Noise levels in the site vicinity typically range between 25 dBA and 46 dBA with occasional peaks as high as 70 dBA. Noise sources in the site vicinity consist of the following: local and remote steam development activities, local traffic, wind, insect and wildlife activities, and human activities. Noise levels in the vicinity of a site are typical for a quiet rural environment (see attached Noise Table 4 from PGandE Geysers 16 NOI).

The nearest well pad to a sensitive receptor (i.e., Site 5, a single family residence) is approximately 1.5 miles away.

IMPACTS

The generally accepted criterion for determining the existence of a noise impact is audibility. To determine audibility, one must examine the background or ambient noise levels, the noise source's projected noise levels, and the tonal content of the noise. If a source's projected noise level is greater than or equal to the ambient noise level, it will probably be audible. A source whose tonal content is different than the existing ambient level will tend to be more audible than one whose content is similar to the existing ambient.

STEAM FIELD

Noise Table 5 shows the primary noise sources and levels associated with steam field development and operation. The noise levels shown include mitigation measures unless otherwise stated. Production testing, unmuffled well venting, and wellhead master valve changes are potentially significant noise sources in the vicinity of the well pad. These activities occur infrequently and can be conducted during daylight hours. Other sources will not be significant at the nearest receptor because of the remoteness of the site.

*These noise levels and other noise source and levels were provided in the AFC. These data were not independently varified by CEC staff. However, the methodology and equipment used and values obtained appear to be reasonable.

OXY GEOTHERMAL #1

Source: Oxy #1 AFC

LEGEND

- LEQ CONTOURS
- - - PORTION OF LEQ CONTOURS IN SHADOW ZONE
- ↑↑ SHADOW ZONE BOUNDARY; SHADOW ZONE IN DIRECTION OF ARROWS
- RADIALS CONNECTING SHADOW ZONE BOUNDARIES
- * RECEPTOR SITES

NOTE:

WORST CASE NOISE PREDICTION WHICH ASSUMES DIRECT LINE OF SIGHT AND ONLY HEMISPHERICAL SPREADING AND ATMOSPHERIC ABSORPTION. ACTUAL LEQ LEVELS WOULD BE LOWER THAN THOSE INDICATED BY THE CONTOURS.

FIGURE 1: NOISE-LEQ Contours for Construction Noise

Noise
Table 1

AMBIENT SOUND LEVELS IN dBA, RE. 20 MICROPASCAL, AT AND AROUND UNIT 18

Date	Time	Point	Inst.	Meas.	Sample Duration	Range	Sound Level, dBA, re 20 Micropascal						Comments
							L ₁	L ₁₀	L ₅₀	L ₉₀	L ₉₉	L _{eq}	
6/23/77	1400	1	A	Cont.	5 Min.	-	38.8	35.5	33.0	31.0	30.3	33.5	Natural Sounds, Fair Weather
10/25/77 to 10/26/77	1658 to 0758	2 (Site 18)	A	Cont.	15 Hrs.	-	43.3	36.8	31.8	29.8	28.8	34.4	Natural Sounds, Remote Steam Bleed to SE. Very calm - Quiet conditions, fair weather
10/26/77	0845 to 1345	2 (Site 18)	A	Cont.	5 Hrs.	-	46.3	38.0	33.0	27.3	25.8	37.7	Same as above
10/25/77	1705 to 1717	3 to 7	B	D.O.	-	32/40	-	-	-	-	-	-	Natural sounds, calm quiet conditions after working hours at Unit 13.

NOTES:

- Abbreviations: Inst. - Instrumentation; Meas. - Measurement, Cont. - Continuous; D.O. - Direct Observation
- Instrumentation (Inst.) Column

A (System A): 1" Electret-Condenser Microphone to Gen Rad 1558-BP Analyzer to Bruel & Kjaer 4426 Noise Level Analyzer.
Continuous Measurement System with Sample Rate of 1 Sample/Sec.

B (System B): 1" Electret-Condenser Microphone to Gen Rad 1933 Precision Sound Level Meter. Direct Observation
(D.O.) of Meter Scale Approximately 1 Min./Observation

Calibration of both Systems A & B above in Field with Gen Rad 1562-A Sound Level Calibrator

SOURCE: PG&E Unit 18 AFC

Noise
Table 2

EXISTING NOISE ENVIRONMENT DURING QUIET CONDITIONS

LOCATION 8 (dBA)

<u>Date & Time</u>	L_1	L_{10}	L_{50}	L_{90}	L_{99}	L_{eq}	<u>Comments</u>
Thursday	38	32	26	24	24	29	Noise
11/15/79							environment
2:40-2:45 pm							controlled by
							unidentifiable
							natural sounds
							and occasional
							jet and far-off
							aircraft

SOURCE: Oxy AFC

Noise
Table 3

ESTIMATED WORST CASE NOISE LEVELS
AND MINIMUM MEASURED BACKGROUND LEVELS

<u>Locations of Nearest Sensitive Receptors</u>		<u>Construction (Leq)</u>	<u>Operation (Leq)</u>	<u>Minimum Measured L99</u>
<u>Number</u>	<u>Description</u>			
1	Pine Grove, near Bottle Rock Road	22 dBA	10 dBA**	20 dBA
2	Hobergs, overlooking Bottle Rock Road	19 dBA	7 dBA**	27 dBA
3	Anderson Springs	24 dBA	14 dBA**	34 dBA
4	Whispering Pines	25 dBA	15 dBA**	32 dBA
5	Socrates Mine Road	32 dBA	24 dBA	38 dBA
6	Verdant Vales School, Castle Rock Springs	28 dBA	19 dBA	48 dBA*
7	Mercuryville	15 dBA**	3 dBA**	26 dBA
8	Pine Flat Road	27 dBA	18 dBA	24 dBA

* Dominated by grading activities at location of Unit 16 sites.

** These noise levels are theoretical predictions. Because the predicted values are extremely low they would not be measurable in the real world.

Noise

Table 4

A-WEIGHTED SOUND LEVELS, dBA, OF TYPICAL NOISES
IN VARIOUS ENVIRONMENTS*. REF. $2 \times 10^{-5} \text{ N/M}^2$

<u>Subjective Impression</u>	<u>dBA</u>	<u>Community** (Outdoor)</u>	<u>Home or Industry** (Indoor)</u>
	130	Military Jet Aircraft Take-Off from Aircraft Carrier @ 50'. (130)	Oxygen Torch (121)
Uncomfortably Loud	120	Turbo-Fan Aircraft Take-Off @ 200'. (118)	Rock-N-Roll Band (108-114)
	110	Jet Fly Over @ 100'. (103)	Riveting Machine (110)
Very Loud	100	Power Mower (96) Boeing 737, DC-9 @ 6080' before landing (97)	Electric Furnace Area (100) Newspaper Press (97)
	90	Motorcycle @ 25'. (90) Car Wash @ 20'. (89) Diesel Truck, 40 mph @ 50'. (84)	Food Blender (88)
	80	High Urban Ambient Sound (80) Passenger Car, 65 mph @ 25'. (77)	Garbage Disposal (80) Living Room Music (76)
Moderately Loud	70	Freeway @ 50' from edge (76±6) Urban Shopping Center (60-70)	TV-Audio, Vacuum Cleaner (70) Elec. Typewriter @ 10'. (64) Dishwasher (Rinse) @ 10'. (60)
	60	Daytime Urban Residential (50-60)	Conversation @ 3'-5'. (60) Large Store (60)
Quiet	50	Large Transformers @ 100' (50) Daytime Suburban Residential (40-50)	Average Daytime Residence (40-50)
	40	Lower Limit Urban Ambient Sound (40) Farm in Valley (30-40)	
	30		Studio Speech (30) Quiet Bedroom at Night (20-30)
	20	Daytime Grand Canyon (North Rim) (20)	
Just Audible	10		
Threshold of Hearing	0		Threshold of Hearing for Youths - 1000-4000 Hz

* The noise sources and typical levels were taken from the following sources:

- Peterson, A. P. G. & Gross, E. E. Jr., "Handbook of Noise Measurement", General Radio Company 7th Edition 1972.
- Schultz, T. J., Bolt Beranek & Newman Inc., "Noise Assessment Guideline, Technical Background" Report No. TE/NA 172 prepared for U. S. Department of Housing and Urban Development.
- Wyle Laboratories, "Community Noise", Report No. NTID 300.3 prepared for U. S. Environmental Protection Agency, December 31, 1971.

** Numbers in parenthesis are A-weighted sound levels.

Source: Geysers 16 NOI

Noise

Table 5

NOISE LEVELS DUE TO GEOTHERMAL DEVELOPMENT
AND OPERATION ACTIVITIES

Activity	Max. Noise Levels at (50') (15.2m) in dBA	Nearest Receptor ^a Projected Noise Levels at (9720') (2414m) in dBA
Construction of roads and drill pads	90 ^b	29-39 ^c
Construction of steam pipelines	90 ^b	29-39 ^c
Mud drilling	85 ^d	24-34 ^c
Air drilling (cyclonic muffler)	88 ^d	29-39 ^c
<u>Air drilling in steam</u> (cyclonic muffler)	90 ^d	29-39 ^c
Well clean-out (cyclonic muffler)	90 ^d	29-39 ^c
Production testing (cyclonic muffler (portable test muffler)	90 ^d 100 ^d	29-39 ^c 39-49 ^c
Shut-in well venting	75 ^d	24
Normal Field Operations	40-70 ^d	19
Steam venting at generating unit (rock-filled muffler)	70 ^e	19
Starting steam transmission thru pipelines (unmuffled well venting)	120 ^b	59-69 ^c
Changing wellhead master valves (unmuffled well venting)	110 ^b	49-59 ^c

a. Estimated projected levels made by CEC

b. Estimated from noise measurements.

c. Higher noise levels are based on worst case weather conditions; lower levels are based on normal attenuation of noise.

d. Based upon measurements by P. Leitner.

e. Based upon measurements by PGandE and Union Oil.

Source: Nielson, 1977; Castle Rock Springs Geothermal Steam Area EIR, 1975; Geothermal Pipeline System Unit 16 Castle Rock Springs Area EIR, 1979.

PLANT CONSTRUCTION

The highest construction noise levels range between 75 dBA and 95 dBA at 50 feet (see Noise Table 6). The higher noise levels can be attributed to large earth moving equipment and blasting. Measurements made at Geysers Unit 13, with 9 pieces of equipment operating, showed an average L_{eq} level of 76 dBA at about 360 feet from the center of the construction site (PGandE Geysers Unit 18, page 5-85). The CEC staff expects the noise levels during site preparation, projected to the nearest sensitive receptor (survey point 5) in Lake County, to range from 30 - 40 dBA L_{eq} (see Noise Figure 1 for estimated construction noise contours). Projected construction noise may occasionally be barely audible at the nearest receptor in Lake County when the construction noise level is in the high range and ambient levels are low. Since construction occurs only during daylight hours, barring unforeseen circumstances, the potential noise impact would be reduced. Construction noise levels would meet the standards of Lake and Sonoma counties; however, construction noise will impact the serenity of the area. Construction noise at the Tocher cabin will meet the Lake County standards provided construction is limited to daylight hours. However, the construction noise will be noticeable and will disturb the serenity of this remote area.

CONSTRUCTION TRAFFIC

Noise Table 7 shows the construction traffic noise estimates. Based on these levels, the CEC staff would expect communities or single residences along the access routes to be exposed to intermittent noise levels which would exceed the nighttime standard of the Lake County draft noise ordinance. Construction traffic should be limited to daylight hours, to the extent practicable.

PLANT OPERATION

Occidental estimated the operational noise levels projected to receptors in the vicinity of the site. These are shown in Noise Figure 2 and in Noise Table 3. The estimated noise level projected to the nearest receptor is 24 dBA L_{eq} . Actual projected noise levels may be less, due to ground effects and possible barrier effects. In any case, this noise level will comply with the existing and proposed Lake County standards. Operational noise will not be audible at the nearest receptor.

Operational noise at the Tocher cabin will meet the Lake County standards. However, because the tonal content of the noise is different than the ambient it might be audible at this receptor.

NOISE TONAL IMPACTS

In the PGandE Geysers Unit 17 AFC, PGandE provided (Appendix G, Figures 9.4-1 through 9.4-3) one-third octave band noise frequency spectra from operating Geysers units. Occidental agrees that these frequency spectra are representative of the noise expected from the proposed Oxy #1 facility. While certain tonalities would be discernable in the immediate vicinity of the site, it is the CEC staff's opinion that the tonalities would not be discernable at any of the receptors in the site vicinity due to the low projected noise levels to the receptor. This means that the noise resulting from Occidental geothermal development will not be noticeable at the nearest residence to the plant. The

Noise
Table 6

PROJECTED CONSTRUCTION EQUIPMENT USE

<u>Item</u>	<u>Number Used</u>	<u>Time Use Factor (%)</u>	<u>Range of Measured dBA Maximum (at 50 ft)</u>	<u>Base dBA Used for Estimating</u>
<u>SITE PREPARATION</u>				
Bulldozer	2	75	77-90	89
Dump Truck	2	50	84-87	86
Loader	1	75	77-90	89
Compactor	1	75	75-82	81
Water Truck	1	50	81-94	83
Scraper	2	75	88-91	90
<u>PLANT ERECTION</u>				
Lift Crane	2	70	80-85	84
Backhoe	1	75	86-90	89
Batch Plant	1	40	83	83
Transit Mixer	1	50	84-87	86
Concrete Pump	1	50	74-84	83
Welder	2	80	73	73
Air Compressor	2	75	76-89	86
Lowboy	1	10	84-87	86
Light and Medium Trucks	3	50	81-84	83
Water Truck	1	50	81-84	83
<u>TRANSMISSION LINE CONSTRUCTION</u>				
Crawler Tractor	2	75	85-90	89
Grader	1	75	86-89	88
Hauling Trucks	2	75	86-88	87
Mobile Crane	1	70	80-85	84
Air Compressor	1	75	76-89	88
Concrete Mixer Trucks	2	50	84-87	86
Light Trucks	2	50	81-84	83
Medium Trucks	2	50	84-87	86
Chain Saw	1	25	72-88	87

Noise
Table 7

ESTIMATED CONSTRUCTION TRAFFIC NOISE

<u>Assumed Condition</u>	<u>Distance (ft)</u>	<u>Leq (dBA)*</u>
50% of traffic in each direction (65 autos, 5 heavy trucks)	200	49
Same as above	2,000	35
90% of traffic using one access (117 autos, 9 heavy trucks)	200	51
Same as above	2,000	37
10% of traffic using one access (13 autos, 1 heavy truck)	200	42
Same as above	2,000	28

*Assumes a long, straight road on a 7 percent grade, the line of sight from vehicle to receiver, and "soft" ground between vehicle and receiver.

OXY GEOTHERMAL #1

Source: Oxy #1 AFC

NOTE:

WORST CASE NOISE PREDICTION WHICH ASSUMES DIRECT LINE OF SIGHT AND ONLY HEMISPHERICAL SPREADING AND ATMOSPHERIC ABSORPTION. ACTUAL LEG LEVELS WOULD BE LOWER THAN THOSE INDICATED BY THE CONTOURS.

LEGEND

- LEQ CONTOURS
- - - PORTION OF LEQ CONTOURS IN SHADOW ZONE
- ↑ ↑ SHADOW ZONE BOUNDARY: SHADOW ZONE IN DIRECTION OF ARROWS
- RADIALS CONNECTING SHADOW ZONE BOUNDARIES
- * RECEPTOR SITES

FIGURE 2: NOISE-LEG Contours for Operational Noise

construction and upset noise from the project will probably be audible in the receptor areas regardless of tonal content.

CAL/OSHA REQUIREMENTS

Occidental stated (AFC, pages 1-23 and 1-24) that they will take the following steps to ensure compliance with CAL/OSHA noise regulations:

1. Any unavoidably high noise areas will be posted with signs.
2. As necessary, personal hearing protectors will be supplied and their use enforced during both the construction and operational periods.
3. The hearing of employees routinely subjected to high noise levels will be periodically checked.

If these measures are implemented, the CEC staff will conclude that Occidental will adequately meet the hearing conservation requirements of CAL/OSHA.

MITIGATION MEASURES

Occidental identified (AFC, pages 1-23 and 1-24) the following noise mitigation measures to be applied to the proposed facility:

1. Mechanical equipment will be purchased on the basis of a procurement-specific action that will encourage manufacturers to supply reduced-noise motors, pumps, valves, and other components;
2. Noisy steam-handling equipment, steam piping, and steam ejector housings will be insulated with materials possessing good acoustic and thermal properties;
3. Waste steam will be routed when necessary through an effective muffling system;
4. A low-noise office enclosure for the operators will be provided inside the turbine building;
5. The turbine building walls and roof will reduce the propagation of noise to the outside environment; and
6. Any excessively noisy ancillary equipment will be silenced as feasible.

In addition, Occidental agrees to incorporate the following steps when implementing the above mitigation measures:

- a. Except for the turbine generator sets, which shall be specified for 90 dBA, require equipment manufacturers, where applicable, to supply equipment with a maximum sound level of 85 dBA at 3 feet. If the manufacturer cannot meet this specification, the Applicant shall undertake appropriate mitigation measures to conform with OSHA/DOSH standards,

- b. Route the steam drain lines from the turbine to the condenser so that steam will not be discharged into the atmosphere during unit start-ups, and
- c. Utilize to the maximum extent feasible a rock muffler or an equivalent noise reducer to mitigate noise during unit outages. The dual turbine, Turbine bypass design will greatly reduce the number of stacking events.

Occidental should also limit construction traffic to daytime hours.

The Joint Findings and Conclusions reached by CEC staff and Oxy during the CEC regulatory process for the noise and air quality areas are attached in Appendix E.

CUMULATIVE IMPACTS--NOISE

SETTING

Other projects in the area of the proposed Oxy #1 project are PGandE Geysers Units 9 and 10, Unit 18, Unit 13, Unit 16 and SMUDGE #1 (see Noise Figure 1). The proposed Oxy #1 project is remote from these units and potential noise sensitive receptors.

IMPACTS AND MITIGATION MEASURES

The other units in the Oxy #1 site area may raise the ambient noise level in receptor locations, such as Camp Verdant Vales and Anderson Springs. Because the Oxy #1 project is remote, it will not add to the impact of the other units. The effects of the well development and steam field operation noise levels generally exceed the noise levels for plant construction and operation. These cumulative activities, however, will not increase the impact on the receptors beyond that caused by well development and well operation (see Project-Specific Impacts section). Therefore, the CEC staff concludes that no significant noise impact will result from the combined activities, although ambient noise levels in the KGRA have risen as a result of geothermal development. No additional measures to mitigate cumulative impacts are needed (see Project-Specific Mitigation section).

Geothermal traffic on local roads will result in possibly the most significant noise impact. As development increases in the area, the problem will only get worse. The only possible mitigations are to limit traffic to daylight hours and/or to stop development in the area. The CEC staff proposed and Occidental agreed to limit construction traffic to daylight hours to the maximum extent possible.

WASTE MANAGEMENT

SETTING

Construction and operation of a geothermal power plant produces a number of potentially hazardous liquid and solid wastes. These wastes include contents of steam well drilling sumps, construction wastes, condensate from the spent geothermal steam, by-products from the H₂S abatement system(s), and sanitary wastes. Mitigation of potential health hazards from toxic waste disposal is assured through a series of health and safety oriented regulations developed by the California Department of Health, the Environmental Protection Agency, and the Water Quality Control Board.

Currently, PGandE operates all power plants at The Geysers. PGandE hauls all hazardous wastes produced by its operations to Geothermal, Inc.'s Class II-1 hazardous waste disposal site near Middletown in Lake County. Since Occidental Geothermal, Inc., proposes a similar operation, the CEC staff assumes that the impacts of their operation will be similar to PGandE's.

DRILLING WASTES

Drilling wastes consist of drilling mud used in developing the geothermal resource and the borings produced by such drilling. The drilling mud can contain chemicals added to improve drilling performance. Chromium compounds which are toxic to humans and are included in the California Department of Health Services list of hazardous wastes (DOHS, 1981) have been used in the past (Gennis, 1977).

CONSTRUCTION WASTES

Construction wastes will include cleared vegetation, miscellaneous debris, oily discharge and residues, unsalvageable wooden shipping crates and skids, cardboard boxes, lumber scraps, concrete wastes, paper, and plastic wrapping.

OPERATIONAL WASTES

Potentially toxic wastes from the geothermal power generation process include the excess condensate, water from the cooling tower basin, maintenance wastes such as used oil and cleaning fluids and fluid wastes from air pollution control equipment.

SANITARY WASTES

Sanitary wastes consist of those produced in sanitary facilities used by on-site workers. During normal operating conditions, a staff of two or three workers could produce 200 gallons of sewage daily.

POTENTIAL DISPOSAL SITES

Wastes produced by geothermal power plant operations must be disposed of at sites approved by the responsible regulatory agencies: the Regional Water Quality Control Board, the Department of Health Services, and the local agencies.

These agencies allow geothermal waste disposal at any Class I disposal site or Class II-1 disposal sites that have been approved specifically for geothermal wastes. For environmental protection, all official disposal sites are designed according to constraints established by the regulating agencies: the California Department of Health Services and the Regional Water Quality Control Board. Class I disposal sites are separated from usable groundwater by natural geologic formations and are not subject to flooding. Class II-1 disposal sites are separated from usable groundwater by artificial means, usually must be monitored, and are protected from flooding by a storm or flood having a predicted frequency of once in 100 years.

Geothermal, Inc., operates a Class II-1 disposal site near Middletown in Lake County, about six miles from the proposed project area. This operator has a permit to accept all wastes produced by the geothermal power plants in The Geysers KGRA (Central Valley RWQCB, 1979).

The IT Corporation operates a Class II-I disposal site near Kelseyville in Lake County, about 17 miles from the proposed project area. The site operator is fully licensed for disposal of all wastes produced by the existing power plants in the KGRA. Based upon the current rate of waste production from Geysers Units 1 - 12, the current site has a design life of 30 years. (Posson, 1981).

IT Corporation also operates a Class I disposal site near the City of Martinez in Contra Costa County, about 75 miles from the proposed project area. This site is licensed to accept wastes of the type produced in geothermal power plant operations.

IMPACTS

Hazardous wastes are of special concern because of their potential for causing significant adverse impacts on public health and the environment. The California Department of Health Services considers geothermal drilling wastes, cooling tower sludge, and the elemental sulfur produced as a by-product from the Stretford process, as hazardous wastes (DOHS, 1979). Other hazardous wastes include oils, thinners, and solvents.

DRILLING WASTES

See Public Health Impacts.

CONSTRUCTION WASTES

Although the total production of construction waste is not known, the Occidental project will produce 20 to 30 cubic yards of waste per week during times of peak construction activity. During a typical 32-month construction period, PGandE's projects have produced as much as 3,500 cubic yards of construction waste (Geysers Unit 18 Final EIR, Appendix C). If such wastes were stored on site, there would be significant potential aesthetic, biological, and water quality impacts; however, Occidental proposes to use drop boxes each with a 20 cubic yard capacity, which will be removed weekly.

OPERATIONAL WASTES

Occidental's proposed Stretford system would produce approximately 13 cubic yards of sulfur and used process solution per week. In addition, a secondary

H₂S abatement system will be required. This system will add a chelated iron catalyst and hydrogen peroxide to the steam condensate before it passes through the cooling tower. The hydrogen peroxide will oxidize the dissolved hydrogen sulfates to soluble sulfates. Side reactions with the catalyst may result in the production of elemental sulfur and iron sulfide precipitates. The elemental sulfur and iron sulfide solids from the secondary abatement system are expected to amount to less than 3.5 cubic yards of sludge per year. These wastes will accumulate in the cooling tower basins, along with sludge formed by particulates scrubbed from the atmosphere. Unless properly disposed of, these operational wastes might cause significant adverse environmental impacts on water quality, public health, and vegetation.

SANITARY WASTES

Exposure of people to sanitary wastes through inadequate disposal can result in nuisance odors and the spread of communicable diseases.

MITIGATION MEASURES

HAZARDOUS WASTES

There are a number of federal, state, and local laws which regulate the safe handling of toxic waste materials. Compliance with the following requirements will reduce the risk of impacts from hazardous wastes to an acceptable level.

Federal

- o Hazardous Materials Transportation Act, Public Law 93-633, 49 United States Code Section 1801 et seq.--The regulations adopted pursuant to this act are codified in Title 49 of the Code of Federal Regulations, Parts 100 through 199. These regulations provide authority to the Secretary of Transportation to guard against risks to life and property which are inherent in the transportation of hazardous materials.
- o Resource Conservation and Recovery Act of 1976 (RCRA), Public Law 94-580, 42 United States Code Section 6901 et seq.--The regulations adopted pursuant to this act are codified in Title 40 of the Code of Federal Regulations. Although not all final RCRA regulations have been promulgated, the Environmental Protection Agency has authorized California's hazardous waste management program to be operated in lieu of the RCRA program except for issuing new permits for new treatment, storage, and disposal facilities. Therefore, the California Health and Safety Code cited below regulates hazardous waste management practices in California. California's permit program is expected to receive authorization soon (Blais, 1981).

California

- o California Water Code, Division 7.5, "Transportation and Disposal of Waste"--Each Regional Water Quality Control Board (RWQCB) may approve sites suitable for the disposal of different kinds of wastes. Section 13360 allows the RWQCB to specify the design, location, or type of construction of evaporation ponds and solid waste disposal sites.

California Administrative Code, Title 23, Chapter 3, Subchapter 15, "Waste Disposal to Land," contains the regulations implementing these statutes.

- o California Health and Safety Code, Division 14, Chapter 6.5, "Hazardous Waste Control"--Allows the Department of Health Services to specify standards and procedures for determining the appropriate classification of wastes and, if hazardous, the proper disposal and transportation methods. California Administrative Code, Title 22, Division 4, Chapter 30, contains the regulations implementing those statutes.
- o California Governmental Code, Title 7.3, "Solid Waste Management and Resource Recovery"--Allows the Solid Waste Management Board to license disposal sites or to give the permitting authority to counties which have an approved program. California Administrative Code, Title 4, Division 7, Chapter 3, "Minimum Standards for Solid Waste Handling and Disposal," contains the regulations implementing these statutes.
- o "California Assessment Manual for Hazardous Wastes," published by the Department of Health Services--Gives DOHS guidelines for determining the classification of wastes.
- o "Waste Discharge Requirements for Non-Sewerable Waste Disposal to Land," published by the State Water Resources Control Board--Provides disposal site design and operational information.
- o California Vehicle Code, Sections 2402 and 34501 and the regulations adopted pursuant to it contained in Title 13 of the California Administrative Code, Article 1.3, "Hazardous Materials Definitions," and Article 1.5, "Hazardous Materials Transportation"--These regulations prescribe requirements for shipping hazardous materials by highway. They are enforced by the California Highway Patrol.

Local

- o Lake County Code, Chapter 9, "Health and Sanitation," Article I. This code prohibits unlawful waste disposal in Lake County.

Limited quantities of potentially toxic or hazardous wastes may be stored on site for a limited period of time. Storage facilities must be maintained in conformance with regulations of the California Department of Health Services and the Regional Water Quality Control Boards.

Transportation of these wastes is also regulated by the Department of Health Services, Hazardous Materials Management Section (DOHS). Hazardous wastes being removed from the site for disposal must be carried in trucks by registered haulers who must comply with applicable sections of the California Health and Safety Code and pursuant to DOHS regulations.

By law (California Health and Safety Code) the producer of hazardous wastes is responsible for their disposal even after they have been delivered to the hauler. In the event of a spill during handling or transport of these wastes, protective service agencies, such as the county sheriff, highway patrol, highway department, and fire department, generally respond to assist in needed

abatement, cleanup, or other protective measures. The Department of Health Services and Regional Water Quality Control Boards may provide consulting services if requested.

Hazardous wastes must be disposed at approved Class I or Class II-1 sites. Available sites are located in Martinez, Middletown, or Kelseyville. Occidental or its contractor(s) should determine whether the proposed disposal site(s) has adequate capacity for estimated wastes produced during the lifetime of the proposed project, and if not, Occidental should select an alternate disposal site. Occidental has not yet contracted with any waste disposal sites.

The California Department of Health Services considers elemental sulfur produced as a by-product of the Stretford process hazardous. As such, it is subject to the regulations shown above; however, as a nearly pure sulfur cake, this by-product is also saleable, and therefore, Occidental may opt to sell this waste to industry.

DRILLING WASTES

By order of the Regional Water Quality Control Boards (CVRWQCB Order No. 78-184 and NCRWQCB Order No. 78-17), after the liquid portion of the contents of drilling sumps evaporates, the well field operator should analyze the solid portion. If it is hazardous, it will be disposed of as described in the Mitigation Measures for Hazardous Wastes subsection above. If it is not, it will be covered with earth, and the surface will be revegetated. Compliance with these measures and those described in the Water Quality section of the EIR will render drilling waste impacts insignificant.

CONSTRUCTION WASTES

Geothermal operators may dispose of cleared vegetation and miscellaneous debris on site or at an approved disposal site. Unregistered haulers can transport wastes which are not hazardous and dispose of them in any site which has been approved by the Regional Water Quality Control Board and responsible local agencies. This procedure will render impacts of such wastes insignificant.

OPERATIONAL WASTES

Underground Injection

Other geothermal units dispose of potentially toxic wastes, including steam condensate and liquid abatement equipment wastes, by injecting them into the steam reservoir through nearby dry or under productive wells. Tests of the hydrogen sulfide abatement system(s) currently in progress at PGandE's Unit 15 also include an investigation into the toxicity of the wastes produced by the abatement system(s).

Although no studies have determined the effects of injection of any of these geothermal wastes, no adverse effects are anticipated by either RWQCB or CEC staff because the reservoir lies far beneath any groundwater aquifers where natural barriers (tight and clay-like soils) and deep well casings separate it from these aquifers (CEC-SRI, 1977; Holman, 1978).

SANITARY WASTES

Sanitary wastes at the Occidental site will be of limited volume, but they cannot be disposed of on site because the slope and soils of the proposed site do not allow for construction of an adequate leachfield disposal system.

The responsible regulatory agencies (Regional Water Quality Control Boards and Department of Health Services) indicate that injection of sanitary liquid wastes back into the steam reservoir is an acceptable practice (Ed Crawford, CVRWQCB, 1979). If injected into the steam reservoir, any pathogens in this waste would be killed by the intense heat and pressure of the steam reservoir. This mitigation will render this impact insignificant. Geothermal operators, however, must dispose of solids off site.

CUMULATIVE IMPACTS--WASTE

SETTING

Approximately 2,000 cubic yards of sludge per month are produced by existing power plants and are presently disposed of at a site near Middletown in Lake County. This sludge consists of waste from water processing systems at PGandE Geysers Units 3, 4, 5, 6, and 11 and waste from cooling tower basins at Units 1 - 11. Geothermal, Inc., owns this site, which they estimate to have a 50-year capacity to accept wastes at the current production rates. In addition, these wastes can be disposed of at IT Corporation's facilities (Kritikos, 1979; Simonsen, 1979; Central Valley RWQCB, 1979).

IMPACTS AND MITIGATION MEASURES

The Oxy Geothermal Plant No. 1's Stretford system will produce approximately 676 cubic yards of sulfur and used process solution per year; the H₂O₂ secondary abatement system may produce an additional 3.5 cubic yards of sludge per year. Disposing of these wastes will reduce the capacity of the waste disposal site, but if operators dispose of wastes properly, their adverse effects upon water quality and public health will be mitigated.

HEALTH

SETTING

Existing levels of air and water pollutants and the human population which could experience adverse health effects constitute the two aspects of the environmental setting for the proposed facility which relate to public health.

EXISTING POLLUTANT LEVELS--AIR

The Air Quality Setting section discusses existing ambient air concentrations of regulated pollutants, including hydrogen sulfide, total suspended particulates, sulfur dioxide, and sulfates, in the project site area.

Ambient air concentrations of nonregulated pollutants, including radon-222, mercury, arsenic, ammonia, boron, silica, benzene, anthraquinone disulfonic acid, asbestos, and silica, have not been recently measured in the immediate project vicinity or in areas which could be impacted by the plant. However, limited measurements in The Geysers KGRA and measurements in rural areas elsewhere in the country suggest concentrations expected in The Geysers KGRA (see Health Impacts, Table 4). The following paragraphs summarize available monitoring results from The Geysers KGRA.

Lawrence Livermore Laboratory measured radon-222 in the atmosphere at The Geysers KGRA for PGandE during 1975-77 when only 11 geothermal power plant units were operational (Anspaugh, 1978). The highest recorded radon-222 concentrations in air were 0.5 picocuries per liter (pCi/l)* at Units 1 and 2 and 1.4 pCi/l at the SRI Station 7 (Sawmill Flat). These peak values fall below the California and federal emission limitations for radon-222 of 3 pCi/l (annual average) above background in uncontrolled areas.

Ambient air concentrations of mercury have not been monitored in populated areas near The Geysers KGRA. Two studies of mercury concentrations in ambient air in unpopulated areas within The Geysers KGRA report concentrations ranging from less than 0.001 ug/m³ to 0.018 ug/m³ (Robertson, 1977) and from 0.005 ug/m³ to 0.400 ug/m³ (Jepsen, 1973). Mercury mining was very common in the area at one time; thus, abandoned mercury mines and tailings may contribute significant amounts of mercury to ambient air levels.

PGandE reports that in 1977 ambient air arsenic concentrations at Unit 11 ranged from less than 0.010 ug/m³ to 0.044 ug/m³ (PGandE, 1979). Ambient air concentrations of boron in the atmosphere have not been measured at this time.

Research reveals relatively little monitoring of ambient air concentrations of ammonia at The Geysers KGRA. Periodic monitoring during 1976 and 1977 at a number of locations in The Geysers KGRA recorded one hour average ammonia concentrations ranging from 0 to 0.263 parts per million (ppm) (DWR, 1978).

*Picocurie = 10⁻¹² curie. A curie is a unit of radioactivity.

Chrysotile asbestos concentrations in steam from one of Occidental's wells was reported to be 5×10^5 fibers per liter (Lake County APCD, personal communication October 19, 1981). Casings in the upper levels of geothermal wells minimize contact between steam and asbestos-containing serpentine rock formations. Ambient air concentrations of asbestos have not been measured in The Geysers KGRA (Robertson, 1980; Wesolowski, 1980; CEC, 1980a); however, they are probably too low to present a significant health hazard, due to typically small asbestos content (roughly 1 percent) in California serpentine rock.

Appendix B-1 describes the potential effects of geothermal air pollutants on human health.

EXISTING POLLUTANT LEVELS—WATER

The Water Quality Setting section of the EIR describes existing water quality and beneficial uses of surface water in the project area.

Week (1978) measured high concentrations of mercury in fish at Clear Lake, not far from The Geysers KGRA. Although the mercury content in most fish tested was below the recommended safe level of 1.0 ppm in edible fish flesh, a small number of the fish sampled exceeded this value. Such high levels are more likely caused by sources other than mercury emissions from geothermal power plants at The Geysers KGRA, such as abandoned mercury mines and tailings; yet, by inference, residents of this area may carry a significant burden of body mercury already. Any addition of mercury to the environment would increase this burden.

Appendix B-2 describes the potential effects of water pollutants on human health.

EXISTING HUMAN POPULATION IN THE VICINITY OF THE PROPOSED SITE

PGandE reported that in January 1977, 3,737 residents lived within 10 miles of Cobb Mountain, as shown in Table 1 (PGandE, 1978b). This figure includes residents of communities near the project site, but it does not include seasonal residents in the area, which may triple the population during summer months (Ecoview, 1978). Table 1 gives the approximate age distribution for these people. The Noise and Land Use Setting sections of the EIR discuss human receptor sites nearest the proposed site.

Data in Table 1 indicate that approximately 22 percent of the population in that area could be classified as sensitive to pollutants due to age (e.g., the very young and the elderly).

No reported studies describe existing public health status in The Geysers. No reported cases of adverse public health effects clearly link the cause to pollutants from The Geysers power plants, although some residents of Lake County report health effects which they attribute to emissions from geothermal operations (Grew, 1978; Madill, 1978). A survey of 142 Cobb Valley residents reported that 72 percent of the respondents disagreed with the statement that geothermal development would have no odor impacts (Vollintine and Weres, 1976).

TABLE 1

POPULATION DISTRIBUTION IN THE GEYSERS KGRA

Age Group*	Area		
	Within 7 Miles of Units 5 & 6	Within 10 Miles of Cobb Mountain	Within 30 Miles of Units 5 & 6
0-5	182 (10.5%)	322 (8.6%)	14,487 (8.6%)
6-17	439 (25.3%)	888 (23.8%)	36,342 (22.1%)
18-34	335 (19.3%)	685 (18.3%)	34,715 (21.1%)
35-64	586 (33.8%)	1,321 (35.3%)	53,999 (32.8%)
65+	194 (11.2%)	521 (13.9%)	25,188 (15.3%)
Total Population	1,735	3,737	164,731
Total Area	154 mi ²	314 mi ²	2,827 mi ²
Population density (persons/mi ²)	11.3	11.9	58.3

*January 1977 ages

Source: PGandE, 1978b.

IMPACTS

IMPACTS RELATED TO AIR POLLUTANTS

Introduction

The potential for health impacts from the project's air pollutant emissions depends on the concentrations of pollutants to which people would be exposed, the duration of exposure, and the toxicity of the pollutants. The project will add to existing ambient or background concentrations of hydrogen sulfide, radon-222, ammonia, suspended particulates, mercury, arsenic, boron, anthraquinone disulfonic acid, and vanadium in nearby areas. In addition, project emissions may increase airborne levels of sulfur dioxide, sulfates, asbestos, silica, and benzene.

The public health analyses and conclusions contained in this document are based on the air quality analyses conducted by Occidental Geothermal, Inc. (Oxy) and CEC staff, Oxy's responses to data requests from CEC staff, and independent CEC staff analysis. A list of assumptions used in this analysis is found in Appendix C.

Table 2 lists ambient air quality standards for regulated pollutants.

Tables 3A and B list values for assessing potential public health impacts from nonregulated pollutants in ambient air. Varying methodologies and criteria for determining these values result in divergent values (see Appendix C for a description of the types of values in Tables 3A and B). While neither CEC nor other state or federal agencies have adopted any of these suggested levels as standards, CEC staff includes these values, along with other values in Tables 3A and B, for use as a guide for determining which pollutants are not likely to pose a health hazard and which pollutants might require a more in-depth analysis and monitoring.

Appendix B-1 describes the potential effects of geothermal air pollutants on human health.

Regulated Pollutants

Hydrogen Sulfide (H₂S)

The California Ambient Air Quality Standard (CAAQS) for H₂S is 0.03 ppm (1 hour average). Although public health protection was considered, California Air Resources Board (CARB, 1970) based this value on the average H₂S odor threshold obtained in a study conducted by the California Department of Public Health. In that study, H₂S odor thresholds for 16 individuals ranged from 0.012 to 0.069 ppm; the geometric mean value was 0.029 ppm H₂S. A more recent report, prepared by Lawrence Berkeley Laboratories, states that if the standard is to be based on known odor threshold, "then the standard should be lowered by a factor of three to five to the more recently accepted value for the odor threshold" (Case, 1977). The California Department of Health Services (CDHS, 1981) recently reviewed the current standard for the Air Resources Board and recommended leaving the standard unchanged (Perry, 1980).

HEALTH TABLE 2
AMBIENT AIR QUALITY STANDARDS

<u>Pollutant</u>	<u>Averaging Time</u>	<u>California Standard</u>	<u>Primary Federal Standard</u>
Carbon Monoxide	12 hours	10 ppm (11 mg/m ³)	-
	8 hours	-	10 mg/m ³ (9 ppm)
	1 hour	40 ppm (46 mg/m ³)	40 mg/m ³ (35 ppm)
Hydrogen Sulfide	1 hour	0.03 ppm (4 mg/m ³)	-
Nonmethane Hydrocarbons	3 hours	-	160 ug/m ³ (0.240 ppm)
Lead	30 days	1.5 ug/m ³	-
Nitrogen Dioxide	Annual Average	-	100 ug/m ³ (0.0500 ppm)
	1 hour	0.25 ppm (2.47 mg/m ³)	-
Oxidant (Ozone)	1 hour	0.10 ppm (0.20 mg/m ³)	240 ug/m ³ (0.120 ppm)
Sulfur Dioxide	Annual Average	-	80 ug/m ³ (0.03 ppm)
	24 hours	0.05 ppm (131 ug/m ³)*	365 ug/m ³
	1 hour	0.5 ppm (1,310 ug/m ³)	-
Sulfates	24 hours	25 ug/m ³	-
Suspended Particulate Matter	Annual Geometric Mean	60 ug/m ³	75 ug/m ³
	24 hours	100 ug/m ³	160 ug/m ³
Radon-222	Annual Average	3 pCi/l**	3 pCi/l** ***

*When standards for total suspended particulates of oxidant are being exceeded.

**Above natural background, at point of release to the environment, in uncontrolled areas.

***Radon-222 in combination with its short-lived daughters.

HEALTH TABLE 3A

SUGGESTED LEVELS FOR NONREGULATED
POLLUTANTS IN AMBIENT AIR*

<u>Pollutant</u>	<u>Type of Value***</u>	<u>Source</u>	<u>Concentration</u>	<u>Averaging Time</u>
Ammonia	Suggested Ambient Level Goal	EPA, 1977	0.06 ppm	annual average**
	Foreign Ambient Air Quality Standards	Russia and East European Countries	0.14 - 0.71 ppm	24 hours
Arsenic	Presumed Safe Level	Wilcox, 1973	5.9 ug/m ³	24 hours
	Suggested Ambient Level Goal	EPA, 1977	0.005 ug/m ³	annual average**
Boron	Presumed Safe Level	Wilcox, 1973	50 ug/m ³	24 hours
	Suggested Ambient Level Goal	EPA, 1977	7.4 ug/m ³	annual average**
Mercury	Presumed Safe Level	Wilcox, 1973	0.8 ug/m ³	24 hours
	Suggested Ambient Level Goal (based on toxicity)	EPA, 1977	0.1 ug/m ³	annual average**
	Suggested Ambient Level Goal (based on carcinogenic potential)	EPA, 1977	0.01 ug/m ³	annual average**
Vanadium	Presumed Safe Level	Wilcox, 1973	6.8 ug/m ³	24 hours
	Suggested Ambient Level Goal	EPA, 1977	1.2 ug/m ³	annual average*
Anthraquinone disulfonic acid	Suggested Ambient Level Goal	EPA, 1977 Supplement 2	260 ug/m ³	annual average*
Hydrogen Peroxide	=	=	=	=
Iron	=	=	=	=

HEALTH TABLE 3A (continued)

<u>Pollutant</u>	<u>Type of Value***</u>	<u>Source</u>	<u>Concentration</u>	<u>Averaging Time</u>
Copper	Suggested Ambient Goal	EPA, 1977	0.5 ug/m ³	annual average*
Benzene	-	-	-	-
Silica	-	-	-	-

*See Appendix C for a discussion of the validity of these values.

**Although an averaging time for suggested ambient level goals is not stated within the document (EPA, 1977), the authors have indicated that these goals are most applicable to annual average concentrations.

***Abbreviations: EPA--U.S. Environmental Protection Agency.

HEALTH TABLE 3B

STANDARDS AND SUGGESTED LEVELS FOR
NONREGULATED POLLUTANTS IN OCCUPATIONAL SETTINGS

<u>Pollutant</u>	<u>Type of Value*</u>	<u>Source</u>	<u>Concentration</u>	<u>Averaging Time</u>
Ammonia	California Occupational Standard	CAL/OSHA	25 ppm	8 hours
Arsenic	Suggested Occupational Standard	NIOSH	2.0 ug/m ³	15 minutes
	Threshold Limit Value	ACGIH, 1980	50 ug/m ³	8 hours
Boron	California Occupational Standard	CAL/OSHA	10 mg/m ³ boron oxide	8 hours
Mercury	California Occupational Standard	CAL/OSHA	50 ug/m ³	8 hours
Vanadium	Threshold Limit Value	ACGIH, 1980	0.5 mg/m ³ (dust)	8 hours
			0.05 mg/m ³ (fume)	
	California Occupational Standard	CAL/OSHA	0.5 mg/m ³ (dust)	8 hours
			0.1 mg/m ³ (mist)	
Anthraquinone Disulfonic Acid	-	-	-	-
Hydrogen Peroxide	Threshold Limit Value	ACGIH, 1980	1 ppm	8 hours
	California Occupational Standard	CAL/OSHA	1 ppm	8 hours
Iron	Threshold Limit Value	ACGIH, 1980	10.0 mg/m ³ (iron oxide fumes)	8 hours
			1.0 mg/m ³ (iron salts)	
			0.08 mg/m ³ (iron penta-carbonyl)	

HEALTH TABLE 3B (Continued)

<u>Pollutant</u>	<u>Type of Value*</u>	<u>Source</u>	<u>Concentration</u>	<u>Averaging Time</u>
Iron (con't)	California Occupational Standard	CAL/OSHA	10.0 mg/m ³	8 hours
Copper	Threshold Limit Value	ACGIH, 1980	0.2 mg/m ³ (metallic copper fume)	8 hours
			1 mg/m ³ (dusts and mists)	
Benzene	Threshold Limit Value	ACGIH, 1980	30 mg/m ³ (10 ppm)	8 hours
	Emergency Temporary Occupational Standard	U.S. Labor Department (EPA, 1977)	3 mg/m ³ (1 ppm)	8 hours
	California Occupational Standard	CAL/OSHA	10 ppm	8 hours
Silica	California Occupational Standard	CAL/OSHA	10 mg/m ³ 1% SiO ₂ +2 (respirable)	8 hours
	Suggested Occupational Standard	NIOSH	50 ug/m ³	8 hours

*See Appendix C for a discussion of the validity of these values.

Abbreviations: CAL/OSHA--California Occupational Safety and Health Administration.
NIOSH--National Institute for Occupational Safety and Health.
ACGIH--American Conference of Governmental and Industrial Hygienists.

Compliance with the CAAQS of 0.03 ppm H₂S appears to protect public health in that adverse health effects have not been reported from exposure at or below this level (see Appendix B-1). However, even at this concentration, the nuisance odor of H₂S would be noticeable to at least some of the general public (Miner, 1969).

Oxy estimates the H₂S content in the untreated steam for this project to be 90 ppm $\pm$ 30 ppm, based upon test results from 2 wells (AFC, Table 1.2-3). Estimates based on a steam flow rate of 1.6 million lb/hr (AFC, Figure 1.4-21) indicate total unabated H₂S emissions at a maximum of 193 lbs/hr (AFC, p. 1-20).

CEC staff determined that with hydrogen sulfide abatement equipment the project will comply with emission regulations and limitations (see Air Quality Impacts section). However, violations of the CAAQS for H₂S already occur in The Geysers KGRA, and this project will increase the likelihood and magnitude of future violations. See Air Quality and Public Health sections on Cumulative Impacts and Mitigation Measures for further discussion of this issue.

Suspended Particulates, Sulfur Dioxide, Carbon Monoxide, Nitrogen Dioxide, Oxidant, Lead, Nonmethane Hydrocarbons, and Sulfates

CEC staff believes that if the ambient air quality standards are not violated, the project as proposed should not produce adverse health impacts associated with inhalation of these pollutants. From previous experience with geothermal power plant projects, CEC staff expects that these standards will not be violated, and potential public health impacts due to the project's emissions of these pollutants should be insignificant (CEC, 1980a and b).

Radon-222

Reports indicate the radon-222 concentration in the project steam supply to be 14.8 nCi/kg (AFC, Table 1.2-3). Radon-222 steam concentrations monitored by PG&E at Units 1 through 11 ranged from 5 to 30.5 nCi/l and averaged 16.2 nCi/l (Ansbaugh, 1978). Results of PG&E's monitoring program for Units 1 through 11 also indicate that radon-222 emissions from a geothermal power plant meet applicable standards and, therefore, should not cause an adverse public health impact.

The California Department of Health Services (CDHS), however, contends that there is sufficient uncertainty about the radon-222 emission levels from geothermal power plants and their cumulative downwind impact to justify radon-222 monitoring at geothermal power plants. To reduce this uncertainty, DHS has established minimum program requirements for monitoring radon-222 at geothermal power plants, including periodic steam sampling, to allow for continued impact assessment. The California Department of Health Services standard for radon-222 is 3 picocuries per liter in air (annual average) above background levels at the point of emission to uncontrolled areas. CDHS/RHS recommends Applicants notify CDHS/RHS immediately if radon-222 concentrations exceed 6 picocuries per liter in cooling tower exhaust. If the radon-222 concentration exceeds 3.0 picocuries per liter (pCi/l) in the cooling tower exhaust, Occidental will inform the CDHS/RHS with a written report within 30 days. If the radon-222 concentrations exceed 6.0 pCi/l in

the cooling tower exhaust, Occidental will notify the CDHS/RHS and the CEC by telegram or telephone upon confirmation of the sample result. Confirmation includes re-analyzing the sample by Occidental or another qualified laboratory. The confirmation procedures used will be the same as the routine analysis, but may include sending samples to CDHS/RHS or other qualified laboratories for analysis. Sample result confirmation will be accomplished in the quickest possible manner and should take less than five calendar days. Oxy agreed to include a radon-222 monitoring program as a condition of certification for the proposed project.*

Nonregulated Pollutants (Ammonia, Arsenic, Benzene, Boron, Mercury, ADA, Vanadium, Asbestos, and Silica)

The following analysis of impacts from nonregulated pollutants is based on steam composition data listed in Table 4 and limited ambient air quality monitoring data. Table 4 also shows the maximum expected emission rates and the maximum incremental impact on ambient air concentrations of nonregulated pollutants from the project's emissions. (The assumptions used in this analysis are found in Appendix C.) CEC staff estimated that an emission rate of 9.7 lbs/hr would increase ambient H₂S concentrations in Anderson Springs by between 2 ppb and 5 ppb (1 hour average) (see Air Quality Impacts section), or 0.3 ug/m³ to 0.75 ug/m³ (1 hour average) per pound H₂S emitted. For this analysis staff also assumed that an increase of 0.3 ug/m³ to 0.75 ug/m³ (1 hour average) would result for each pound of nonregulated pollutant emitted.

The estimates presented in Table 4 are tentative at best, because data on actual emission rates, environmental transport, and background ambient air concentrations of these nonregulated pollutants in The Geysers KGRA are either absent, of questionable validity, or not applicable in this analysis. Where numerous sources of uncertainty reduce the level of confidence in such analyses of significant effects, CEC staff attempted to reduce uncertainties by recommending pollutant source tests and environmental monitoring as a condition of power plant certification (see Mitigation Measures). In concurrence with this approach, the Lake County Air Pollution Control District included steam and ambient air monitoring of nonregulated pollutants as a condition of certification for similar projects (LCAPCD, 1980a and b).

Due to current limited use of H₂S abatement systems, it is likely that background air of The Geysers KGRA contains only negligible amounts of ADA. CEC staff concludes that resultant ambient concentrations of ADA, including contributions from the project, would be similar to the ADA concentrations presented in Table 4 and that they should not cause adverse health impacts.

The project's maximum contribution to the ambient boron concentration (annual average) is much less than the most stringent suggested ambient level, 7.4 ug/m³ (annual average). Based on available data, it appears to be highly improbable that the project's boron emissions would adversely impact public health.

*Letter from R.F. Ward, Vice President/Project Manager, Occidental Geothermal, Inc., to J.H. Wazlaw, CEC, June 8, 1981.

OXY GEOTHERMAL #1

	Concentration in Steam Supply (ppm) ^a	Maximum Possible Emission Rate (lb/hr) ^b	Impact on Ambient Concentration ^c (ug/m ³)	Background Ambient Concentration ^c (ug/m ³)	Maximum Resultant Ambient Concentration ^{c,d} (ug/m ³)	Ambient Level Goal-Air ^{c,e} (ug/m ³)
Ammonia (NH ₃)	33.1	53	15.9 - 39.75	1.4-7 ^f	47	43
Arsenic (As)	0.004	0.0064	0.0019 - 0.0048	0.001-0.0044 ^h	0.0092	0.005
Boron	1.0	1.6	0.48 - 1.2	- ^j	1.2 ^j	7.4
Benzene (C ₆ H ₆)	0.05	0.08	0.024 - 0.06	0.054	0.11	7.1 ^k
Mercury (Hg)	0.0077	0.012	0.0036 - 0.009	0.001-0.018 ^l 0.005-0.4 ^m	0.4	0.01 ⁿ - 0.1
Silica (SiO ₂)	0.07	0.112	0.034 - 0.084	- ^j	0.084 ^j	-
Anthraquinone- Disulfonic Acid (ADA)	-	0.077	0.0231 - 0.0578	- ^j	0.0578 ^j	260
Vanadium (V)	-	0.05	0.015 - 0.0375	0.005-0.024 ^l	0.0615	1.2

a. Based on analysis of two wells (AFC Table 1.2-3).

b. Based on incoming steam flow rate of 1,600,000 lb/hr (AFC Figure 1.4-21). Assumes the total quantity of pollutants entering the plant in steam are emitted from the cooling tower. ADA and Vanadium emission rates assume 0.002 percent loss of Stretford solution as drift.

c. Expressed as annual average; obtained by multiplying hourly average by 0.1 (see Appendix C). Based on air quality analysis showing that each pound of H₂S emitted from the proposed facility will add a maximum of 0.3 ug/m³-0.75 ug/m³ to ambient H₂S concentrations (see Air Quality Impacts section).

d. Summation of maximum background concentration and maximum impact on ambient concentration.

e. Estimated permissible concentration; toxicity based on health effects (EPA, 1977).

f. Measurements of urban air concentrations (Wagoner, 1976).

g. Monitoring in Geysers KGRA (DWR, 1978).

h. Measured near Unit 11 (PGandE, 1979).

i. Measurements of rural air concentrations (Wagoner, 1976).

j. No background data available.

k. Estimated permissible concentration; toxicity based on genotoxic effects would be no more than 0.7 ug/m³, in accordance with the NIOSH recommended occupational level of 1 ppm.

l. Particulate mercury measurements in Geysers KGRA (Robertson, 1977).

m. Vaporous mercury measurements in Geysers KGRA (Jepsen, 1973).

n. Estimated permissible concentration; toxicity of zero-threshold pollutants based on genotoxic effects (EPA, 1977).

**TABLE 4: HEALTH-Nonregulated Pollutant Impacts
From OXY Geothermal Plant No. 1**

CEC staff believes that the project's emissions of arsenic, ammonia, and mercury, especially in combination with contributions from other power plants, will probably result in ambient air concentrations exceeding the Multimedia Environmental Goals* (MEG) suggested ambient goals (see Health Cumulative Impacts section). The failure to meet these goals does not necessarily mean that adverse health impacts would occur.** Rather, these failures demonstrate the need to:

- o Better characterize and monitor nonregulated pollutant emissions and ambient air concentrations;***
- o Develop ambient air quality standards for these nonregulated pollutants based upon the protection of public health.****

Due to incomplete background data, CEC staff cannot meaningfully compare concentrations of boron and silica to the MEGs suggested ambient goals. Based on the large degree of uncertainty, CEC staff recommends that Oxy implement a monitoring program for ammonia, arsenic, asbestos, benzene, mercury, silica, and vanadium. Included in this program should be monitoring of ambient air concentrations in Anderson Springs and other affected population centers and steam concentrations, as described in the Compliance Monitoring Report. CEC staff and Occidental Geothermal, Inc., will jointly develop this report.

IMPACTS RELATED TO WATER POLLUTANTS

The Oxy Geothermal Power Plant No. 1 may contribute to degradation of water quality in local creeks (see Water Quality Impacts section and Health Cumulative Impacts section). Degradation of creeks which supply drinking water may adversely impact public health if contaminants are present in sufficient concentrations and duration. Appendix B-2 summarizes potential human health effects from consumption of water pollutants.

MITIGATION MEASURES

Oxy could achieve mitigation of potentially adverse health effects from exposure to geothermal pollutants by reducing air pollutant emissions where possible (methods of H₂S abatement are discussed in the Air Quality Impact Section). There are not demonstrated technologies for abating emissions of radon-222 or other nonregulated geothermal power plant pollutants specifically, although H₂S abatement systems, particularly upstream treatment, may

*See Appendix C for a description of the MEGs.

**For example, a recent study (Larson et al., 1978) reported mean concentrations of ammonia in human breath of 157 ug/m³ (0.23 ppm), which exceeds the MEG value by nearly a factor of 4. Therefore, the MEG value for ammonia appears to be unnecessarily stringent for public health protection.

***Within the statutory authority of the CEC.

****Within the statutory authority and responsibility of California Air Resources Board, CDHS, and U.S. Environmental Protection Agency.

scrub pollutants other than H₂S to some degree (Accurex, 1980). Incorporation of a turbine bypass to avoid steam stacking is expected to reduce emissions of condensable nonregulated pollutants.

The Water Quality section and Health Cumulative Impacts section address measures to mitigate impacts to drinking water quality. These mitigation measures should also reduce the potential for adverse health impacts related to drinking degraded water.

HEALTH RELATED MONITORING PROGRAMS

Monitoring alone does not mitigate any potential public health impacts; rather, it assists in determining the magnitude of project impacts, and those of geothermal development in general, on ambient pollutant concentrations and ultimately on public health.

CDHS, in cooperation with EPA, plans field and source sampling for radon-222 and its daughter products in The Geysers KGRA. These efforts represent an attempt to minimize uncertainty in anticipating the total impact on human radiation exposure associated with the operating Geysers units (Vold, 1980).

CEC staff is examining the feasibility of conducting a program for assessing the health status of Geysers KGRA residents.

CEC staff suggests that Oxy establish a baseline ambient air monitoring and incoming steam monitoring program for the following reasons:

- o Available data on background air concentrations of nonregulated pollutants are outdated and inadequate for use in determining resultant concentrations in populated areas.
- o Ongoing and future development will increase pollutant emissions at The Geysers during the operating lifetime of this project.

CEC staff further recommends that Oxy conduct the following monitoring programs:

- o Ambient monitoring for ammonia, arsenic, benzene, mercury, silica, and vanadium for one year prior to and one year after commencement of the project operation.
- o Incoming steam monitoring (operational) for ammonia, arsenic, benzene, mercury, silica, boron, and radon-222.
- o Mass balance measurements (operational) for mercury and arsenic if agreed to be warranted and methods are available that yield meaningful results.

The Lake County Air Pollution Control Officer has included the following monitoring requirements as conditions in his Determination of Compliance:

Condition 7

If a generic monitoring program for H₂S and/or other constituents of concerns is initiated in The Geysers KGRA by responsible agencies (NSCAPCD, ARB, CEC,

and LCAPCD), Occidental shall participate to the extent equitable with other parties in funding or causing to be performed such a program.

Condition 8

Occidental shall install and operate for one year in the Gunning Creek Drainage a wet/dry deposition sampler and analyze monthly composite of both wet and dry samples for soluble solids, boron, fluoride, arsenic, silica and mercury. The sampler utilized shall comply with or exceed the guidelines of the National Atmospheric Deposition Program.

Condition 9

Occidental shall perform biannual tests to determine the content of steam components as listed below upon written request of the LCAPCO and as required in the geothermal fluid transmission line permit. The continued need for such tests shall be reviewed after two years of operation. Copies of all tests shall be forwarded to the ARB and CEC. Such monitoring is not intended to be redundant.

STEAM CONDENSATE OR TOTAL STEAM

GAS PHASE

Ammonium (total)
Arsenic (total)
Asbestos (total)
Benzene
Boron (total)
Hydrogen sulfide (total)
Fluorides (total)
Mercury (total)
Carbon dioxide (total)
Total dissolved solids
Total suspended solids

Particulate mass in micrograms per kilograms of steam
Arsenic from particulates above
Lead from particulates above
Cadmium from particulates above
Sulfur from particulates above
Mercury vapor
Total methane and nonmethane hydrocarbons
Other nongases as indicated by condensate
NESHAP pollutants as requested

The Water Quality section addresses water quality monitoring in creeks which supply drinking and recreational waters. In addition, CEC staff recommends that during power plant operation, Oxy monitor potentially toxic constituents in Gunning Creek, which supplies drinking water for Anderson Springs.

Occidental has agreed to monitor quarterly for one year prior to and one year after commencement of power plant operation, in Gunning Creek downstream of the project area the constituents listed in the proposed Brown and Caldwell water quality monitoring program (May 1981), including aqueous pollutants in Table 2 of that report, plus benzene, vanadium, oil, and grease. The data from the first year's monitoring will be evaluated in relation to baseline data, and a decision will be made as to the necessity of continuing monitoring for some or all of the constituents. Oxy should not be required to conduct the monitoring if water quality protection measures, such as enclosing the Anderson Springs water supply, are undertaken.

These programs will be described in the Compliance Monitoring Report to be developed by CEC staff and Occidental Geothermal, Inc., during AFC proceedings for this project.

WORKER HEALTH

Operating geothermal power plants can pose risks to workers' health and safety. Those risks unique to geothermal plants primarily result from possible exposure to toxic and potentially carcinogenic chemical compounds associated with geothermal steam and H₂S abatement systems. Such exposures may occur during routine operation, accident or upset conditions, repair and maintenance activities, and process or system modification activities.

Workers may accidentally come into contact with many of the potentially toxic and potentially carcinogenic substances (e.g., H₂S, ammonia, radon-222 and its daughters, mercury, arsenic, and chemicals associated with H₂S abatement systems) in geothermal steam, waste streams, and when they handle chemicals used in abatement systems. Adverse effects of such exposures could include dermatitis, acute chemical poisoning, chronic illnesses, and cancers after some induction latency period (see Appendix B-1). To protect workers from possible exposure to arsenic, PGandE requires workers to wear protective equipment in some areas of the existing power plant units (McKenzie and Draeger, 1981).

General Industry Safety Order 3203 (Subchapter 7 of Chapter 4, California Administrative Code, Title 8) requires employers to have an accident prevention program to reduce or prevent occupational injuries and illnesses and to conduct periodic inspections to correct unsafe conditions. Employers must comply with California Administrative Code, Title 8, Chapter 4, Group 16 (Articles 107 - 112), which refers to control of hazardous substances. The California Division of Occupational Safety and Health (DOSH) enforces compliance with state occupational safety and health standards. DOSH must inspect the plant if there is a complaint from an employee. If working conditions are found to violate an occupational standard, DOSH will determine what corrective actions are required. There is generally no means for ensuring that an employer has an adequate accident prevention program until DOSH receives a worker complaint regarding worker health and safety.

In 1976, the National Institute for Occupational Safety and Health (NIOSH) received reports that Geysers Unit 11 workers, while performing maintenance of the H₂S abatement system, developed skin rashes (dermatitis) and sore throats (pharyngitis) (NIOSH, 1978). As a result, the process was automated. Unfortunately, incidents of skin rashes have not been completely eliminated (Hahn, 1981). Such incidents lead NIOSH to the conclusion that the medical problems may be associated with exposure to H₂S abatement system residues, but the precise causal agent has yet to be identified.

Oxy will request recommendations from the CAL/OSHA Consultation Service regarding the adequacy of Oxy's worker health and safety program during project construction and operation. Methods of verifying the program's adequacy will be described in the Compliance Monitoring Report.

For reference to potential worker safety issues which CEC staff considers insignificant, see Worker Safety section of Initial Environmental Impact Evaluation, Appendix A.

CUMULATIVE IMPACTS--HEALTH

SETTING

For discussion of overall setting, see introductory portion of Cumulative Environmental Analysis section.

Future development at The Geysers KGRA will increase the total quantity of pollutants emitted into the environment and will increase ambient pollutant concentrations locally and regionally. This project will contribute to the cumulative impacts of total geothermal development.

IMPACTS

REGULATED AIR POLLUTANTS

Hydrogen Sulfide

The Lake County APCD and Northern Sonoma County APCD have adopted regulations for retrofitting H₂S abatement at existing geothermal power plants which will reduce the potential cumulative impacts of H₂S emissions at The Geysers KGRA.

If the CAAQS for H₂S is enforced, the public should not be exposed to H₂S concentrations of 0.03 ppm or greater. However, existing hydrogen sulfide concentrations in populated areas near The Geysers KGRA occasionally exceed the standard with only 15 geothermal power plant units currently on line. Twenty units should be on line when the project begins operating. Unless compliance with the standard is enforced, even greater and more frequent violations could result from future development (see Air Quality Impacts section). Although experts do not know at this time if adverse health effects result from chronic exposure to low levels of H₂S, by inference, increasing H₂S concentrations will increase the possibility of adverse health impacts (see Appendix B-1).

Radon-222

If this project and future facilities comply with the California and federal radon-222 emission standards, the public should not be exposed to greater than a maximum 3 pCi/l of radon-222 and its daughter products above natural background radiation at the point of release. Oxy will monitor radon-222 concentrations in incoming steam to ensure compliance with these radon-222 standards.

A study conducted by Lawrence Livermore Laboratories (Anspaugh, 1978) concluded that the 11 units then operating at The Geysers power plant had "no discernible impact upon the radiological environment of the surrounding area. This is because the amount of radon-222 released by the operation of the power plant is small compared to the radon-222 exhaled from soil in the general area." Due to continued geothermal development since the Lawrence Livermore Laboratory study, CDHS Radiologic Health Section is beginning further cumulative impact studies of radon-222 emissions in The Geysers area.

NONREGULATED AIR POLLUTANTS (ammonia, arsenic, asbestos, benzene, silica, boron, mercury, ADA, and vanadium)

Operation of this project, existing and future power plant units at The Geysers KGRA will increase the concentrations of these pollutants in nearby populated areas. CEC staff can make crude estimates of potential cumulative impacts on ambient air concentrations of nonregulated pollutants at Anderson Springs, Whispering Pines, and other population centers from existing, CEC-approved, and currently proposed power plants, using results from H₂S studies. Table 1 lists the maximum predicted ambient air quality impacts of nonregulated pollutants from Oxy Geothermal Plant No. 1, SMUDGE #1, PGandE's Units 16 and 18, and NCPA #2. (No data are available for PGandE's Units 13 and 14.) The maximum cumulative impact is the sum of the maximum impacts from these facilities and background levels. Since the meteorological conditions producing the maximum impacts from each facility may not occur simultaneously, these values overestimate the cumulative impact.

Based on information in Cumulative Analysis--Health Table 1, ammonia, arsenic, and mercury concentrations might exceed the MEG ambient level goals. Even under worst-case conditions, available data indicates that ADA and vanadium would not exceed the MEGs. Due to incomplete data, cumulative concentrations of boron, benzene, asbestos, and silica cannot be meaningfully compared to the MEGs.

For the reasons stated in the Health Introduction and earlier in this section, predicted concentrations in excess of the MEGs or other suggested levels do not necessarily indicate that adverse health impacts will occur. CEC staff believes that monitoring of emissions and ambient air nonregulated pollutant concentrations is needed to determine steam concentrations and ambient levels of these pollutants.

PUBLIC HEALTH IMPACTS FROM DRINKING WATER SUPPLY CONTAMINATION

The Occidental leasehold is located in the Gunning Creek and Anderson Creek watersheds (AFC, Figure 5.2-2). Gunning Creek is the main domestic water source for Anderson Springs residents (Oxy Geothermal Plant No. 1 Draft EIR, Water Quality section). Anderson Creek is used as a domestic water supply for a few residents; it is used primarily for recreational purposes by Anderson Springs residents (see Water Quality section).

Geothermal development in The Geysers KGRA has caused numerous water pollution incidents in the past. Reports of these incidents are summarized both in Cumulative Analysis Health Table 2 and in the EIR Water Quality section. Materials spilled into local creeks include steam condensate (cooling tower waste water), drilling muds and wastes, hydrogen sulfide abatement system chemicals, petroleum products, and detergents. Increased levels of sediment and turbidity have also been reported. These accidental spills, resulting from mechanical failures and human error, have occurred at power plant sites and well pads and along materials transport routes.

Many of the materials spilled in The Geysers KGRA between 1965 and 1980 can be toxic to people if consumed in sufficient concentrations and duration. Appendix B-2 summarizes the health effects associated with these water pollutants.

CUMULATIVE ANALYSIS
HEALTH TABLE 1

CUMULATIVE IMPACTS OF NONREGULATED AIR POLLUTANT EMISSIONS

	Background Ambient Air Concentration ^a (ug/m ³)	Maximum Impact on Ambient Air Concentration ^a (ug/m ³)					Maximum Cumulative Impact ^g (ug/m ³)	Ambient Level Goal ^h (ug/m ³)
		Oxy Geothermal Plant No. 1 ^b	SMUDGE #1 ^c	PGandE Unit 16 ^d	PGandE Unit 18 ^e	NCPA #2 ^f		
Ammonia	1.4-7 ^k	15.9 - 39.75	4.8	247	30.0	0.008	328.6	43
Arsenic	0.001-0.0044 ^l	0.0019 - 0.0048	0.024	0.0024	0.000027	0.0005	0.034	0.005
Boron	_1	0.48 - 1.2	0.74	0.096	5.05	0.45	7.54 ^j	7.4
Benzene	0.054	0.024 - 0.06	0.024	_1	_1	_1	0.138 ^j	7.1 ^q
Mercury	0.001-0.018 ^m 0.005-0.4 ⁿ	0.0036 - 0.009	0.00012	0.033	0.0000072	0.0005	0.06- 0.44	0.1- 0.01 ^r
Silica	_1	0.034 - 0.084	0.6	31.38	_1	_1	32.06 ^j	-
Anthraquinone Disulfonic Acid	_1	0.0231 - 0.058	0.0006	0.003	0.0016	0.00015	0.062	260
Vanadium	0.005-0.024 ^p	0.015 - 0.0375	0.0012	0.006	0.0033	0.00029	0.071	1.2

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Footnotes and References for Cumulative Analysis--Health Table 1

- a. Expressed as annual average; obtained by multiplying hourly average by 0.1 (see Appendix C).
- b. Oxy Geothermal Plant No. 1 Draft EIR Impacts Section Table 4.
- c. SMUDGE0 #1 Final EIR, Table 21.
- d. PGandE Geysers Unit 16 Final EIR, Table 18.
- e. PGandE Geysers Unit 18 Final EIR, Table 13.
- f. NCPA No. 2 Final Joint Environmental Study, pages IV-58 to IV-61.
- g. These values are the sum of the maximum ambient air quality impacts calculated for Oxy Geothermal Plant No. 1, DWR South Geysers Power Plant, PGandE's Units 16 and 18, NCPA #2, and maximum background levels. Impacts from PGandE's units 13 and 14 are not included due to lack of data. It assumes that the maximum air quality impact from the five facilities could occur simultaneously at one location. The maximum ambient air quality impact from each facility occurs under different meteorological conditions, and are not expected to occur simultaneously. Therefore these values overestimate the cumulative impact.
- h. Estimated permissible concentration (annual average) in air; toxicity based on health effects (EPA, 1977).
- i. No data available.
- j. Based on incomplete data.
- k. Measurements of urban air concentrations (Wagoner, 1976).
- l. Measured near Unit 11 (PGandE, 1979).
- m. Particulate mercury measurements in Geysers KGRA (Robertson, 1977).
- n. Vaporous mercury measurements in Geysers KGRA (Jepsen, 1973).
- o. Measurements of rural air concentrations (Wagoner, 1976).
- p. Estimated permissible concentration (annual average) in air; toxicity based on genotoxic effects would be no more than 0.7 ug/m^3 , in accordance with the NIOSH recommended occupational level of 1 ppm (EPA, 1977).
- q. Estimated permissible concentration (annual average) in air; toxicity of zero-threshold pollutants based on genotoxic effects (EPA, 1977).

Until now the Gunning Creek drainage has remained free of permanent geothermal development and associated impacts, with the exception of two Aminoil exploratory well pads (see Water Quality Section). Occidental's power plant and supporting well field is the first permanent geothermal development with drainage into Gunning Creek. Additional geothermal development is projected within the Gunning Creek drainage. Oxy's development will contribute incrementally to the overall significant adverse impact which geothermal development could cause in this drainage.

Futhermore, Oxy or Oxy's subcontractor(s) will have to transport materials to and from the power plant and supporting well pads through the drainage basin, increasing the likelihood of toxic spills on Gunning Creek due to truck accidents. Based on information provided by Occidental, the power plant will produce approximately 76 deliveries of chemicals annually and will produce approximately 62 truckloads of wastes annually (see Oxy's responses to CEC data requests on transportation). For associated well field development, approximately 100 truckloads of sludge are produced per well (Oxy Workshop, May 21, 1981). As many as 30 wells may be required to support the power plant over its 30-year lifetime (see EIR Summary).

Given the currently limited available information on vehicle traffic in The Geysers and reported accidents, a vehicle accident rate per trip or per mile cannot be calculated. However, while the probability that an Oxy #1 related vehicle, transporting potentially toxic chemicals or wastes along Socrates Mine Road, will have an accident resulting in a spill into Gunning Creek is probably low, the consequence of such a spill would be significant. The introduction of thousands of gallons of drilling muds, hydrogen peroxide, or sludge into Gunning Creek upstream of the Anderson Springs water supply intakes would contaminate the drinking water to a far greater extent than existing natural sources of turbidity or organic pollution and could cause effects ranging from simple disruption of the water supply until contamination ceased, to acute adverse health effects to domestic water users. Possible health effects are discussed in Appendix B-2.

MITIGATION MEASURES

Oxy could achieve mitigation of potentially adverse health effects from exposure to geothermal air pollutants by reducing air pollutant emissions where possible (methods of H₂S abatement are discussed the Air Quality Impact section). There are no demonstrated technologies for abating emissions of radon-222 or other nonregulated geothermal power plant pollutants specifically, although H₂S abatement systems, particularly upstream treatment, may scrub pollutants other than H₂S to some degree (Accurex, 1980). Incorporation of a turbine bypass to avoid steam stacking is expected to reduce emissions of condensable nonregulated air pollutants.

Occidental has proposed mitigation measures to reduce the potential for degrading local creeks by erosion and accidental spills. If the mitigation measures are adequately implemented and maintained (1) there will be little likelihood of enough sediment washing from well pad B to cause water quality problems in Gunning Creek, (2) the likelihood of toxic spills entering Gunning Creek from well pad B will be small, (3) there will be an unknown chance of

CUMULATIVE ANALYSIS
HEALTH TABLE 2

OCCURRENCE OF MATERIALS INVOLVED IN WATER POLLUTION
INCIDENTS AT THE GEYSERS KGRA (1965 - 1980)

<u>Condensate (cooling tower water)</u>	<u>29</u>
<u>Drilling muds, wastes, sump discharges</u>	<u>9</u>
<u>Siltation, sedimentation, turbidity</u>	<u>8</u>
<u>Petroleum products (e.g., diesel oil)</u>	<u>3</u>
<u>Unknown substances</u>	<u>4</u>
<u>Detergent</u>	<u>1</u>
<u>Vehicular accident</u>	<u>1</u>
<u>Acid ferrous sulfate</u>	<u>1</u>
<u>Caustic soda</u>	<u>1</u>

Source: CEC staff report, October 1981. Based on data from California Department of Fish and Game.

spills at the Socrates Mine Road crossing,* and (4) Anderson Creek will still be vulnerable to degradation due to sediment deposition and hazardous materials spills outside bermed areas (see Water Quality section).

Oxy's proposed measures should substantially mitigate potential water quality degradation. However, due to the history of accidental spills in The Geysers KGRA and the need to ensure the safe domestic use of water downstream from the project, staff believes further measures are appropriate to detect and mitigate the effects of any accidental spills.

*CEC staff understands that Aminoil has temporarily moved the Anderson Springs water supply intake in Gunning Creek upstream from the Socrates Mine Road crossing to avoid potential impacts from activities to upgrade the road. Condition qq in the PGandE Geysers Unit 16 decision requires maintenance of the intakes above the crossing for three years or until a permanent water intake system or storage facility is constructed [CEC Decision, 79-AFC-5 (PGandE Geysers Unit 16), Condition qq]. While moving the intake upstream from the road crossing should mitigate the impact of accidental spills of transported materials at the crossing, the relocation of the intake is only temporary. Neither Aminoil nor PGandE has been able to secure permanent agreement from other water users on Gunning Creek as to the acceptability and permanence of the new intake location.

Occidental has agreed to monitor water quality as described in Brown and Caldwell's report (May 1981), plus quarterly monitoring of aqueous constituents in Table 2 of that report, plus benzene, vanadium, oil, and grease.

This monitoring is the minimum necessary to identify chronic water quality problems. Periodic monitoring alone will not prevent water quality degradation nor will it quickly identify all acute problems, such as accidental spills.

The CEC staff recommends the following mitigation measures, in order of preference:

1. Permanently enclosing the headwater springs on Anderson and/or Gunning creeks and pipe the water to Anderson Springs.
2. Constructing an off-stream storage system capable of diverting and impounding a supply of unpolluted water from Gunning Creek. Storage should be adequate to meet the needs of the Anderson Springs residents for a period of at least three days.
3. Providing a temporary supply of bottled water for the citizens of Anderson Springs in case a spill or high sediment episode occurs.

The first measure, a permanent, enclosed system, would protect the raw water from geothermal (and other) pollution, completely eliminating the potential for public health impacts from the proposed development. An enclosed water supply has also been recommended by the Lake County Health Department and the California Department of Health Services as the best means for ensuring a safe drinking water supply if geothermal development is allowed within the Gunning Creek watershed (letter from S.M. Maurer and P.I. Crosby to Valerie Campbell, October 28, 1981; letter from B. David Clark to Valerie Campbell, November 3, 1981). A study by Brown and Caldwell (1981), funded by Oxy, found it technically feasible to enclose the ASWC water source.

Lake County Director of Planning, John Thayer, suggests that regulatory agencies develop a means of providing such a permanent water distribution system. He recommends assessing and collecting contributions from all steam developers in the Gunning Creek watershed.

Constructing an off-stream storage system has been recommended by Lake County Flood Control District (letter from H.C. Porter, Director, to John Thayer, Planning Director, September 30, 1981). This proposal would modify the existing water supply system by incorporating a storage tank with inlet valves connected to pollution detection monitors. Staff believes this temporary safeguard could be designed to mitigate most pollution episode impacts on the domestic use of Gunning Creek until such time that a permanent enclosed system is provided. (An additional benefit from this particular emergency arrangement would be that its component parts could be incorporated into a permanent upgraded water supply system.) Staff recognizes that such a system would not eliminate all the flaws in the existing water supply system. Specifically, it would not protect the five direct users on Gunning Creek upstream of Socrates Mine Road, nor would it protect users on Anderson Creek.

Lake County is considering the issuance of production permits for continued geothermal well field development pertaining to the Oxy #1 power plant. County Planning Department staff is recommending that as a permit condition Oxy be required to fund initially the proposed off-stream storage system. Lake County staff drafted an ordinance which would require developers to pay a share of the emergency water supply system in proportion to the leasehold acreage in the watershed. (Lake County staff has estimated Oxy's contribution to be approximately \$20,000 of the \$100,000 system.) The Lake County Board of Supervisors is expected to vote on the ordinance in the very near future. Oxy has indicated a willingness to fund the proposed system with the understanding that other developers would reimburse Oxy according to the ordinance (letter to Mr. Alex Hinds, Lake County Planning Dept. from Mr. Bob Ward, Oxy, October 30, 1981). Oxy is working with Lake County staff on the details of such an agreement.

Staff's last recommended mitigation measure is for providing a temporary supply of bottled water for Anderson Springs residents in case of a spill or high sediment episode.

Lake County Use Permit Modification UP 80-11 for Occidental Geothermal/Site "B" requires that "In case of a spill, a Contingency Plan will be approved to provide water to the community of Anderson Springs." In response to this requirement, Occidental established an agreement with a private water company to supply bottled water to Anderson Springs residents in the event of a water pollution incident related to the Oxy project (personal communication with Mr. Tom Hamilton, Oxy, September 30, 1981). Lake County Planning Department staff interprets the permit condition as applying to any activities related to pad construction and exploratory drilling of two wells on well pad B (personal communication with Mr. Alex Hinds, September 28, 1981).

Providing bottled water to downstream residents in the event of a spill could reduce short-term contamination and disruption of the drinking water supply. For the plan to be effective, the following must occur: (1) water pollution incidents must be identified and reported promptly, (2) adequate emergency water supplies must be available, and (3) the distribution plan must be adequately designed and immediately implemented. (It should be noted that provision of bottled water may not mitigate contamination and disruption of water supply for other domestic uses, e.g., bathing, clothes washing, etc.) A method by which Anderson Springs residents would be warned of a pollution incident contaminating their drinking water has not yet been developed. CEC staff recommends that Oxy be required to design and implement a contingency plan for the lifetime of the project or until an alternative water supply system is implemented. The contingency plan should be submitted to the CEC and the Lake County Planning Department and Health Department for approval.

In the absence of a reliable means of automatically warning water consumers in Anderson Springs about water contamination incidents, Oxy should notify all downstream water users of the contingency plan details, including:

- o Agency or person responsible for determining the need for providing bottled water on short-term notice in the event of a water pollution incident;
- o The method for determining need and notifying affected water consumers;

- o The method of providing and the way in which residents may obtain bottled water; and
- o Provisions for consumers initiating the bottled water response if they first detect a contamination problem (particularly outside of normal working hours).*

Although providing bottled water to downstream residents in the event of a spill could reduce the impacts of short-term contamination and disruption of the drinking water supply, it does not ensure as much protection of public health as the two previous recommended mitigation measures.

With the bottled water plan, it would take time for the water to be delivered to a central distribution point in Anderson Springs and for the residents to pick up the water. The proposed tank system would have no interruption of water supply and no inconvenience to residents.

Bottled water would probably satisfy only drinking and cooking needs; the tank system should satisfy other domestic needs as well. (However, operating off the tank during a water pollution incident, residents may be asked not to use water unnecessarily in order to maximize the life of the tanked water supply.)

Oxy representatives have stated that they would supply bottled water only if it can be determined that Oxy caused a particular pollution incident. This could take time. With the proposed tank system, the cause of a pollution incident would not have to be determined; Anderson Springs residents would receive safe water without interruption, regardless of the source of pollution. Most importantly, the monitors would detect spills developers may not be aware of. This would prevent Anderson Springs residents from drinking contaminated water.

CEC staff recommends supporting the Lake County staff proposal that Oxy fund an interim emergency water supply system for Anderson Springs. This proposal includes a mechanism for payback by future developers in the area.

Staff recommends that Lake County's requirement allow use of Oxy's contribution towards a permanent enclosed water system if the remainder of the system cost becomes available from other sources. Failing timely imposition of such a requirement by the county, staff recommends that Oxy be required as a condition of Oxy #1 AFC approval to provide safeguards to the Anderson Springs water supply. Oxy should be required to pay the entire cost of the interim emergency water supply and pollution detection system previously described. Staff recommends that this requirement allow use of Oxy's contribution towards a permanent, enclosed water system if the remainder of the system cost becomes available from other sources. OXY has agreed to (a) comply with Lake County

*On October 14, 1981, Oxy submitted to CEC staff a draft plan for making bottled water available to Anderson Springs residents. CEC staff and Lake County Health Department staff have recommended major revisions to Oxy's draft plan (see summary notes from October 28, 1981 workshop).

proposal; and (b) failing timely imposition of such a requirement, to fund the same safeguards as a condition of certification. The CEC is conducting generic proceedings concerning a variety of cumulative environmental impacts associated with full resource exploitation in the Geysers KGRA. The intent of these proceedings is to assess the significant potential impacts which may be beyond the scope of any single regulatory proceeding and identify measures to mitigate these impacts. Measures which may be recommended to allow geothermal development in the Gunning Creek watershed include permanently relocating the water system intakes to a less vulnerable location, developing a method for warning consumers of pollution incidents, and developing an alternative water supply. The generic proceedings will also attempt to identify ways of implementing these mitigation measures which provide for equitable participation by current and future resource developers and other affected parties.

CEC staff believes it is appropriate for Oxy to participate in CEC sponsored generic proceedings on the cumulative impacts of current and planned geothermal development on water quality in the Anderson and Gunning creeks watershed and participate along with other affected developers and parties in implementing any measures deemed necessary.

HEALTH RELATED MONITORING PROGRAMS

Monitoring alone does not mitigate any potential public health impacts; rather, it assists in determining the magnitude of project impacts, and those of geothermal development in general, on ambient pollutant concentrations and ultimately on public health.

CDHS, in cooperation with EPA, plans field and source sampling for radon-222 and its daughter products in The Geysers KGRA. These efforts represent an attempt to minimize uncertainty in anticipating the total impact on human radiation exposure associated with the operating Geysers units (Vold, 1980).

CEC staff is examining the feasibility of conducting a program assessing the health status of Geysers KGRA residents.

CEC staff suggests that Oxy establish a baseline ambient air monitoring and incoming steam monitoring program for the following reasons:

- o Available data on background air concentrations of nonregulated pollutants are outdated and inadequate for use in determining resultant concentrations in populated areas.
- o Ongoing and future development will increase pollutant emissions at The Geysers during the operating lifetime of this project.

CEC staff further recommends that Oxy conduct or participate in the following monitoring programs:

- o Ambient monitoring for ammonia, arsenic, benzene, boron, fluoride, mercury, silica, and vanadium.

- o Incoming steam monitoring (operational) for ammonia, arsenic, benzene, mercury, silica, boron, and radon-222.
- o Mass balance measurements (operational) for mercury and arsenic, if warranted and if measurement techniques will yield meaningful results.

Similar monitoring requirements are included as conditions of the Lake County Air Pollution Control District's Determination of Compliance for this project (see site-specific health mitigation measures).

The Water Quality section addresses water quality monitoring in creeks which supply drinking and recreational waters. In addition, CEC staff recommends that during power plant operation, Oxy monitor potentially toxic constituents in Gunning Creek, which supplies drinking water for Anderson Springs.

Occidental has agreed to monitor quarterly for one year prior to and one year after commencement of power plant operation in Gunning Creek downstream of the project area the constituents listed in the proposed Brown and Caldwell water quality monitoring program (May 1981), including aqueous constituents in Table 2 of that report, plus benzene vanadium, oil and grease. The data from the first year's monitoring will be evaluated in relation to baseline data, and a decision will be made as to the necessity of continuing monitoring for some or all of the constituents. Oxy should not be required to conduct the monitoring if water quality protection measures, such as enclosing the Anderson Springs water supply, are undertaken.

These programs will be described in the Compliance Monitoring Report to be developed by CEC staff and Occidental Geothermal, Inc., during AFC proceedings for this project.

TRANSPORTATION

SETTING

ACCESS

The most direct access to the proposed project, including the steam field, is from Lake County via State Highway 175 to Socrates Mine Road and then to a fire road to the site. Ford Flat Road is occasionally used by workers to commute from Cobb Village to Socrates Mine Road. With the exception of the first one and one-half miles of Socrates Mine Road the county roads are unpaved graded roads. Please refer to Transportation Figure 1 regarding roads.

CalTrans estimates the 1979 annual daily average traffic on Highway 175 to be 800 (CalTrans, Office of Traffic Engineering), and a 1980 estimate of traffic on Socrates Mine Road is 684 vehicles per day; truck traffic constitutes about 20 percent of this 1980 estimate (Lake County, 1980). In July 1980, Lake County performed a short traffic count at Ford Flat Road which showed an estimated 45 vehicles per day travel this road.

From Sonoma County, the proposed site can be reached from U.S. Highway 101 via State Highway 128 and Pine Flat Road or the Healdsburg-Geysers Road. Access is also possible from Highway 101 via the Cloverdale-Geysers Road. The Healdsburg-Geysers Road and Cloverdale-Geysers Road both go to the Geysers Resort then past Geysers 14 (via private Union Oil Road which is not open to the public) to the fire road leading to the site. The Pine Flat Road goes past Geysers 18 to the fire road to the site. The county roads are paved to the Geysers Resort, and Pine Flat Road is paved for the first 11.3 miles. The remainder of the routes are unpaved graded roads.

Waste Disposal

The most likely route for the disposal of geothermal wastes is down Socrates Mine Road to Highway 175 then on Butts Canyon Road to the disposal site near Middletown. Butts Canyon Road is a paved county road; an August 1979 traffic count by Lake County was 430 vehicles per day for this road. Subsequent population growth in the county increased this figure by 10 to 15 percent to a current level of approximately 485 vehicles per day (Lake County 1981).

ROAD CONDITIONS OF CONCERN

Socrates Mine Road--Socrates Mine Road, with the exception of the initial one and one-half miles, is a narrow, winding, unpaved road. The road, particularly the part through the Aminoil leasehold (south of the Oxy leasehold), is steep and has apparently been a source of increased erosion which can result in increased turbidity and other water quality problems in Anderson and Gunning creeks. Heavy traffic on the road damages the surface, increases excessive dust, and has severely deteriorated the road surface.

OXY GEOTHERMAL #1

FIGURE 1: TRANSPORTATION-Regional Map

OXY GEOTHERMAL #1

Source: Geysers 16 AFC, 1979

FIGURE 2: TRANSPORTATION-The Geysers Development Area

The road generally has poor alignment, the grade is steep and the road exceeds minimum county standards in many places. The road is too narrow in most parts and lacks adequate shoulders or guardrails. There are two bridge structures located on short radius curves, and these bridges are in poor condition because of excessive use.

In summary, Socrates Mine Road is below Lake County's Mountain Standards for collector roads (Lake County standard specification resolution number 70-222). Before additional traffic is added to this road it should be upgraded (e.g., improved alignment, construction of adequate surface and base with drainage and erosion control facilities, improved safety measures such as guardrails and proper safety signs, and improved bridge structures over Anderson and Gunning creeks). Agreement was reached on 3 August 1981 between the County of Lake and Aminoil (representing the operators) for the improvement of the road. Construction started on 24 August 1981 on the upper portion of the road. The lower remaining portions, including the creek crossings, will be done during the next construction season. Paving will be done upon completion of all other work. (Collins, 16 October 1981.)

Butts Canyon Road--This Lake County road gives access to the Middletown waste disposal site owned by Geothermal Incorporated. Frequent use by heavy geothermal disposal trucks has caused failure of the road surface. The base, pavement, and drainage of this road is not adequate for heavy traffic. Even though Oxy has not indicated where they will dispose of their geothermal wastes (CEC staff estimates one or two trucks per month), they will probably use the Middletown waste site. Adding more heavy truck traffic to this road will only aggravate the existing impaired conditions. Lake County has appropriated \$186,000 of 1981 AB 1905 funds to repair the road.

Healdsburg-Geyers Road--This is a two-lane, paved county road and a major access to The Geysers from Sonoma County. This road, in sections, has poor alignment, sharp curves, and short sight distances. The pavement structure, although fair in most parts, is damaged and is in need of repair in some other parts. Sonoma County estimates that 870 vehicles travel this road in an average 24-hour period and that the traffic mix could range from 2 to 5 percent truck traffic (Sonoma County, January 1981).

In summary, sections of the Healdsburg-Geyers Road are below county standards, and CEC staff considers them inadequate and unsafe with respect to heavy loads and multi-axle vehicles. To assure safer traveling, staff recommends upgrading and improvement to Healdsburg-Geyers Road.

Cloverdale-Geyers Road--This road is a poorly maintained, narrow Sonoma County road which connects The Geysers to Cloverdale and Highway 101. The surface is extremely rough, sight distances are inadequate, and heavy trucks have problems negotiating sharp radii curves.

There is a one-lane bridge over Squaw Creek which may be inadequate for heavy truck crossings. The travelway and shoulders in some parts are eroded away, leaving the effective width of the road at about eight feet, which is barely enough for one lane of traffic.

CEC staff concludes that this road is in poor condition and its use by construction traffic must be prohibited until proper maintenance and safety measures are implemented. The ability to implement this mitigation measure rests with Sonoma County.

Ford Flat Road--This three-mile long narrow dirt road winds through mountainous terrain. It connects Socrates Mine Road to the Whispering Pines and Cobb area in Lake County. It could also serve as a short-cut to Highway 175 and Bottle Rock Road leading to the Kelseyville waste disposal site. This road is inadequate for heavy truck traffic. Lake County (Eugene Collins, 21 May 1981) emphasizes the fact that commute traffic on this road causes excessive dust and noise problems for the residences along the road, and its use must be limited to local residents.

Pine Flat Road is a long, narrow, winding road in Sonoma County. It is poorly maintained with a deteriorating road surface. The last portion of the road is graded, but the road as a whole is inadequate for heavy truck traffic.

Use of Roads--An agreement with Union is required for the use of their private roads, and Oxy has no agreement at present. In addition, Oxy has indicated that they do not plan to use any access roads from Sonoma County, and will not use the Healdsburg-Geyers Road or the Cloverdale Geyers Road on Pine Flat Road. Ford Flat Road in Lake County will not be used. (Stone and Webster comments for Oxy, 30 September 1981.)

Safety--Many of these roads have a high potential for accidents. The following table lists accident statistics for the roads as reported to the California Highway Patrol, although reported accidents do not necessarily render complete and accurate statistics.*

	1979	1980
Highway 175 near Cobb Village	23	26
Butts Canyon Road	4	4
Socrates Mine Road	0	3
Healdsburg-Geyers Road	10	17
Pine Flat Road	2	2
Ford Flat Road	0	0

IMPACTS

LIGHT TRAFFIC

During the peak construction phase of the project, Oxy estimates that 65 autos/light trucks will travel to and from the project area per day. The

*(Lt. Flint, CHP Lake County; Officer Gardner, CHP Santa Rosa; 23 February 1981)

majority of the trucks will use the Socrates Mine Road, and the light traffic is expected use Socrates Mine Road. Oxy will not use Healdsburg-Geysers Road, and private traffic cannot use Union's private roads. This small increase in light traffic will not significantly affect the local transportation network. To further decrease the light traffic impact, Oxy will furnish buses for their workers (see "Socioeconomic" section of the EIR).

HEAVY EQUIPMENT TRAFFIC

Construction traffic will reach the power plant site from Middletown, using State Route 175 and Socrates Mine Road. Oxy estimates that an average of five heavy trucks will travel to and from the site each day during construction (81-AFC-1). This number will reduce to about 10 trucks per week during the operation phase of the plant. Truck traffic associated with the steam field may increase this number.

The main impacts of Oxy construction on the roads are summarized below.

Socrates Mine Road--Oxy plans to transport about 40,000 tons of cement, aggregate, gravel, and asphalt to the site via Socrates Mine Road. Assuming an average payload per truck at 25 tons, it will take 1,600 trips to take the required material to the construction site. In addition, heavy construction equipment and water trucks will travel over this road. Oxy estimates that about 1,900 tons of steel and concrete blocks will be transported via this road. In addition, heavy construction equipment such as D8 tractors, concrete mix trucks, and heavy equipment components for the power plant travel via this road. Again, assuming the trucks are carrying 25 tons of payload each, it will take an estimated 100 trips to haul necessary material and equipment to the site.

The conditions described in the setting portion of this discussion will be aggravated by construction of Oxy #1. Unless these conditions are mitigated, significant adverse impacts to transportation and safety will result.

Cloverdale-Geysers Road--Oxy indicates that no construction truck traffic will use this road and there is no accurate estimate of passenger car trips which will occur on this road due to the proposed development. CEC staff estimates that an increase in traffic on this road due to Oxy #1 construction will not be significant.

Ford Flat Road--Construction of Oxy #1 may generate some traffic on Ford Flat Road, in addition to the present 45 vehicles per day. This could only aggravate the conditions described in the Setting. CEC staff estimates that an increase in traffic on this road due to Oxy #1 construction will have minor significance.

Butts Canyon Road--This is a major access road to the Middletown waste disposal area, and if Oxy decides to use this waste disposal area, trucks hauling geothermal waste to the site could exacerbate the conditions described in the Setting. Staff estimates that Oxy's contribution to an increase in truck traffic once the power plant is operable will not independently cause significant deterioration to this road. Cumulatively, however, Oxy's disposal trucks will add to the existing problem.

Highway 175--If the Kelseyville dump site were used there would be an increase of traffic on this road, and, as a result, traffic safety would decrease somewhat.

Additionally, one must consider truck traffic associated with steam field development. Full development will require 12 wells yielding perhaps 100 loads of sludge per well. This would generate 1,200 truck loads of sludge for full development prior to operation. This volume could contribute significantly to traffic in the area.

The high volume of traffic associated with the Oxy project, particularly at peak periods, could result in a significant impact on traffic safety. Presently, Socrates Mine Road is steep and winding with much traffic. Highway 175, Butts Canyon Road, and Bottle Rock Road also contain curves and are experiencing increases in traffic. The Middletown Unified School District (21 May 1981) has stated its concern for the safety of school children during the hours of pickup and delivery, due to the mixture of heavy geothermal truck traffic and school buses. In addition to traffic safety, many trucks carry toxic materials (chemicals, wastes) with the potential for hazardous spills.

Access Road--Access to the plant will be gained from an existing graded fire road through Birdsong Meadow to the site vicinity (approximately 1.5 miles distance) and then on separate access roads to the plant and well sites. SMUD proposes to widen this fire road in parts and pave it in order to handle construction traffic to the nearby SMUDGE #1 site, and Oxy indicated (April 24, 1981) that they will share the cost of improving and maintaining the road. Improvements to the road through Birdsong Meadow and the fire road have been completed, and the road paved. Paving the road will alleviate dust problems from vehicles and will decrease erosion and sediment transport to streams. CEC staff considers these proposed access road improvements to be acceptable. The proposed mitigation measures, such as erosion control measures, hydro-seeding exposed disturbed surfaces, and placing and maintaining culverts, should decrease or prevent sediment from impacting the Cobb Creek and Calm Creek drainage. (See Biology section of the EIR for impact and mitigation to biological resources.)

MITIGATION MEASURES

Oxy will maintain the roads within the leasehold. County roads are maintained by the respective county. If the county determines that roads within its jurisdiction are being abused by heavy truck and construction equipment (load limits are set by the County Road Commission), the county may request the involved developers to participate in improvement and maintenance costs.

The extent of deterioration of other private and county roads due to Oxy #1 alone will likely be insignificant if those roads are properly managed and maintained. However, cumulative impacts to such roads, resulting from all geothermal development, may still be significant.

A suggested mitigation (CEC Workshop, 21 May 81) of the potential conflict between project related vehicles and school bus traffic would be to schedule project traffic to avoid the times of school traffic. Oxy has agreed to do this to the extent feasible.

Socrates Mine Road--As mentioned above, Socrates Mine Road, in its present condition and alignment, is below county standards and poses a traveling hazard. Staff feels that improving the road is necessary. Major road users (Aminoil, SMUD, Occidental, Shell, and NCPA) have agreed with Lake County to improve and upgrade the road. An agreement to rebuild the road and a final design for the improvements have been reviewed and signed by Lake County. (Collins, 16 October 1981.)

The plans for improvement to Socrates Mine Road include widening the road in certain sections, better alignment through tight curves, improving or replacing structures over Anderson and Gunning creeks, proper base and surface throughout the improved section, and proper drainage and erosion mitigation measures. The present improvement schedule would finish work on the road in the spring or summer of 1982. This will result in safer traveling on Socrates Mine Road.

Butts Canyon Road--The section of Butts Canyon Road leading to the Geothermal Inc., waste disposal area should be improved and maintained with proper base, surface, and drainage systems. The question of funding is uncertain, although the county may apply for federal funds (Collins, 21 May 1981).

Ford Flat Road--If Socrates Mine Road is improved, geothermal traffic on Ford Flat Road may decrease to an insignificant level. This assumes that travelers would prefer a paved, faster, and better aligned road to the winding, graded Ford Flat Road.

CUMULATIVE IMPACTS-TRANSPORTATION

SETTING

The Occidental project is part of ongoing geothermal development in The Geysers KGRA which includes existing PGandE units 1 through 15. The same transportation network used by the Oxy project is used to one degree or another by most of the existing and planned developments in The Geysers. Projects which are presently under construction or which may overlap with the Oxy project are as follows: PGandE Units 17 and 18, NCPA #2, DWR Bottle Rock, and SMUDGE #1 are under construction; PGandE Unit 16, and DWR South Geysers may be under construction. Other projects which are planned, but which have not yet entered the AFC process, are NCPA 1 and 3 and PGandE Unit 20. Several other projects may overlap in the final stages of Oxy construction. For information on the status of these projects, see introductory section on Cumulative Analysis regarding current and anticipated geothermal development.

IMPACTS

The construction of Oxy #1 is expected to start April 1982 and continue through May 1984. During this period there will probably be 7 or 8 other geothermal projects under different phases of construction and some 15 plants under commercial operation within the KGRA region. Four of the plants likely to be under construction (PGandE 16, 18, SMUDGE #1, NCPA 2) are in the same general area as Oxy and can be expected to impact the same roads. In addition to the impacts caused by plant construction traffic, one must also consider the impact of truck and general traffic associated with steam field development. The other projects which may be under construction (PGandE 17, DWR Bottle Rock and South Geysers, and possibly NCPA 1) will contribute to traffic and truck impacts on the roads in the wider Geysers region.

The cumulative work force will peak at about 950 workers (steam field, plant construction, and operation and maintenance) around 1982 and steadily decrease to about 450 at end of 1984.

The CEC staff estimates an average of 30 to 40 heavy trucks per day traveling The Geysers region. As the development and traffic volume in The Geysers area increases, so do the travel hazards on the roads in this area. Current traffic volumes on Socrates Mine Road were obtained by CalTrans District 1 on 4 May 1981, as part of a study for Lake County (CalTrans), August 1981). An ADT of 690 is indicated. The study also includes percentages of trucks and types of trucks (see Figure 3 and Table 1 from study). In conjunction with these numbers, it should be realized that they represent averages. Actual traffic figures will vary, and during a construction season the numbers may be considerably higher.

The CalTrans study indicates peaks in the traffic from 6:00 - 7:00 a.m. and 3:00 - 4:00 p.m. Figure 4 shows traffic and turning movements at the Socrates Mine Road--Highway 175 intersection. Given the peak flows and seasonality of traffic, it is evident that traffic safety can be hazardous at best at certain times.

FIGURE 3: TRANSPORTATION—Average Daily Traffic and Percent of Trucks

Table 1

Truck Distribution by Number of Axles

	ADT (Including Trucks)	% Trucks ADT	Average No. Trucks/Day (% of Total Trucks)				
			2-axle	3-axle	4-axle	5-axle	Total
Geyser Rock Road	250	18.8	25 (53%)	4 (9%)	-- --	18 (38%)	47 (100%)
Socrates Mine Road	690	20.3	25 (30%)	11 (13%)	1 (1%)	46 (56%)	83 (100%)
<u>Bottle Rock Road</u>							
Just North of Jct. Geyser Rock Rd.	850	10.5	47 (49%)	18 (19%)	3 (3%)	28 (29%)	96 (100%)
Just South of Jct. Geyser Rock Rd.	1,080	9.5	56 (55%)	21 (20%)	-- --	26 (25%)	103 (100%)
<u>Route 175</u>							
Just South of Jct. Socrates Mine Road	1,470	19.5	155 (51%)	36 (13%)	2 (1%)	108 (35%)	301 (100%)
Just North of Jct. Socrate Mine Road	1,750	16.9	253 (80%)	22 (7%)	3 (1%)	40 (12%)	318 (100%)
Just North of Jct. Bottle Rock Road	1,600	14.5*	45* (63%)	16* (22%)	7* (10%)	4* (5%)	72* (100%)

* % Trucks from Caltrans 1969 counts

OXY GEOTHERMAL #1

SOURCE: Caltrans, 1981,
" A Report on the
Impact of Geothermal
Development on State
Highways And County
Roads in Lake County"

**FIGURE 4: TRANSPORTATION—Present
Traffic and Turning Movements
(Highway 175 and Socrates
Mine Road)**

The extent or significance of road deterioration resulting from heavy equipment traffic due to this project cannot be accurately assessed. However, the increasing number of geothermal power plants in The Geysers KGRA results in increased heavy equipment traffic associated with construction and operation activities. This traffic results in a significant cumulative effect of accelerated deterioration of the private and public roads in Lake and Sonoma counties which serve the geothermal area.

MITIGATION

The potential number of vehicles which may travel in The Geysers is quite high. To decrease the number of vehicles traveling within The Geysers area, the construction personnel will be bused to work, and ride-sharing for smaller work forces will be encouraged. Oxy will participate in efforts to improve Socrates Mine Road which should alleviate some of the traffic problems experienced as a result of geothermal development.

ENERGY AND MATERIAL RESOURCES

SETTING

STEAM SUPPLY

The most important control to a geothermal power plant is the steam which drives the system. As explained in the Geology section of the EIR, not enough is known about the size and nature of the steam reservoir to accurately predict depletion rates; however, CEC staff recognizes that the steam reservoir is finite, and that the Oxy design requires approximately 1,600,000 lbs/hr. CEC staff expects that by 1986, with as many as 24 geothermal plants on line, total steam use in the KGRA will approximate 28,305,000 lbs/hr. This estimate includes PGandE units 1 - 18, Oxy #1, NCPA 2, SMUDGE #1, DWR Bottle Rock and South Geysers.*

OTHER ENERGY INPUTS

Construction of the power plant and related facilities will consume various forms of energy. The Oxy AFC (Section 9.3) indicates the types of construction equipment which they will use, most of which will rely on gasoline and diesel fuel. Once construction is complete, Oxy will use small amounts of fossil fuel to operate and maintain the facilities and will rely on the power plant itself to supply the electricity needed internally.

MATERIAL RESOURCES

Construction of the proposed power plant will require the following materials: concrete, steel, aluminum, metal alloys and catalysts, paint and wood.

IMPACTS

STEAM SUPPLY

Steam consumption as a result of the operation of Oxy #1 and other geothermal units in the KGRA may eventually deplete the steam supply. However, neither the characteristics of the reservoir nor the rate of depletion as compared to the rate of recharge is fully understood at this time, so CEC staff cannot accurately predict reservoir depletion rates. Nevertheless, staff is aware of reported pressure losses in the KGRA (Geyser 16 Draft EIR, p. I-47). The Oxy #1 plant will contribute incrementally (1,600,000 lbs/hr) to the overall steam loss in the KGRA. By 1986, Oxy plus other geothermal plants may consume steam at an approximate rate of 28,305,000 lbs/hr.

*Sources: CEC staff draft, May 1981, Potential Development of Geothermal Electric Power Resources in The Geysers, Table 2, and CEC staff draft, June 1981, Mitigation of Hydrogen Sulfide Emissions in The Geysers KGRA, p. 13.

OTHER ENERGY INPUTS

Fossil fuels and electrical energy used to construct and operate Oxy #1 will be insignificant in comparison to the amount of electrical energy the plant will produce and the amount of fossil fuels which Oxy will save by displacing their use with geothermal energy for electrical production.

MATERIAL RESOURCES

The amount of construction material used in the Oxy #1 plant represents an insignificant portion of the available supply of these materials.

MITIGATION MEASURES

STEAM SUPPLY

The Oxy design incorporates the use of independent dual turbines, as well as turbine bypass devices. These two features will (1) reduce the likelihood of a total plant shutdown, and (2) in the event of a shutdown, will circulate steam via the turbine bypass through the air abatement systems in order to reduce air pollution which would otherwise result from steam venting freely into the atmosphere.

Oxy's dual turbines and raised inlet pressure, as well as their use of turbines with long last stage blades will result in improved efficiency. Another mitigation measure to conserve the steam resource would be to use a more efficient turbine design which would make power more efficiently and use less steam to do it.

OTHER ENERGY INPUTS

Oxy and its subcontractors should minimize the use of gasoline and diesel fuel by consolidating trips and using fuel-conservation operational procedures.

MATERIAL RESOURCES

Oxy will recycle such materials as steel, aluminum, copper, and wood, provided they have a net salvage value.

CULTURAL RESOURCES

SETTING

Cobb Mountain marks the geographical boundaries of territories traditionally claimed by the Western and Northern Wappo and Central and Eastern Pomo and Lake Miwok Indians (Kroeber, 1925). Kroeber reports a Wappo town, Tekenantsonoma, was situated within the developed KGRA. Its location has not been precisely determined, although a large archaeological site has been recorded by Fredrickson (1974). This large, dispersed site is characterized by a large house depression, possibly the remains of a dance house, and a number of isolated groups of house pits suggestive of single family hamlets.

A dispersed community organization such as at Tekenantsonoma was common for ethnographic groups in the North Coast Ranges (Heizer, 1975). In general, each local community appears to have had a single permanently inhabited town which served as a politically autonomous group, which may have numbered from about 100 to perhaps 300 individuals. Smaller sites, occasionally made up of only a single household, would also be a part of the settlement system, as would be task-specific sites such as camp sites, hunting stations, food processing stations, quarries and manufacturing stations, and sites of religious significance.

Because of different economic foci, experts believe that settlement systems contrasting with the ethnographic Wappo existed in the North Coast Range during earlier time periods. Details of earlier social and environmental relationships are scant, since little archaeological work has been done within the North Coast Ranges.

A cultural resources survey of what is now the Occidental federal leasehold was conducted in 1976 as part of a Burmah Oil Company geothermal leasehold survey (Pacific Bioarchaeology Laboratory, 1976). Additional cultural resource investigations within the leasehold were conducted by Frederickson and Hayes, 1978; Peri and Patterson, 1978; PGandE (Frederickson), 1978; and Origer, 1980. The findings of these studies are summarized below.

IMPACTS

PALEONTOLOGY

Project impacts to paleontological resources should be limited, since no resources have been identified within the leasehold. However, Franciscan melange units, which commonly contain fossiliferous chert, occur. These melange units may contain as yet unmapped and possibly fossiliferous chert. If excavation takes place in these Franciscan melange areas, impacts to paleontological resources could occur. Provided the specific mitigation measures are implemented no significant adverse effects will take place.

ARCHAEOLOGY

Prior studies have identified one prehistoric archaeological site, CA-LAK-711, in the study area. CA-LAK-711 has particular significance because of its high elevation, its hinterland location at the presumed boundary between the Wappo

of The Geysers and the Lake Miwok of southern Lake County, and its location on or near an aboriginal trail (see AFC, Figure 5.7-1). A Native American consultant of Lake Miwok ancestry identified the general vicinity of CA-LAK-711 as an area within which during his lifetime Indians hunted bear and deer. The consultant suggested that the site may have been a hunting camp from which large game was pursued. In addition, the consultant suggested that the site was a border outpost from which the local Lake Miwok could guard their remote hunting and collecting grounds. Excavation testing indicated the archaeological site contains cultural materials to a depth of 190 cm below the surface. The site was listed on the National Register of Historic Places in 1980. No other prehistoric archeological resources were identified.

No construction activity will take place in the immediate vicinity of the site. Nonetheless, Occidental will be required to establish a buffer zone around the site to eliminate the possibility of accidental damage. With the establishment of the buffer zone, there will be no impact to archaeological resources.

NATIVE AMERICAN SITES AND ETHNOGRAPHY

Review of ethnographic and archaeological literature and field visits with Lake Miwok and Wappo consultants revealed no sites of sociocultural significance within the leasehold. However, it was noted that several plants of ethnobotanical importance were present and that a major Native American trail once passed through the leasehold. The trail followed the ridgeline of the Mayacmas Mountains and gave access to Clear Lake, the greater Geysers region, and Knights Valley, serving as an important link between Indian communities of the region. No traces of the trail could be identified in the field. Archaeological site CA-LAK-711, discussed more fully above, was identified by Indian consultants as a hunting and border outpost location. Therefore, no impacts will occur to ethnographic resources.

HISTORY

Although no historic properties were identified within the leasehold, a literature search revealed that the area had been used for logging, mining, recreation, and stock raising. A homestead patent was taken out in 1903 but was cancelled in 1907. Following passage of the Homestead and Stockgrazing Act of 1916, the land was patented and the current owner holds rights to surface use of the land. Evidence of logging was found within the leasehold, while evidence of recreational use and mining were restricted to the leasehold's easternmost portion. None of the above activities resulted in remains that warrant site status. The project will not impact any historic resources.

MITIGATION

1. If an excavation greater than four meters in depth is required in an area of Franciscan melange, a field check by a qualified paleontologist or geologist will be made after the excavation to determine if any fossil-bearing chert was uncovered. Occidental will notify the CEC within 24 hours of the geological or paleontological specialist's evaluation of the resource. Should mitigation be necessary, representatives of the CEC, the Bureau of Land Management's Ukiah office, and Occidental will meet

with the specialist within two working days of this notification to discuss proposed mitigation measures. All construction or excavation activity in the resource area shall remain stopped, pending resolution of this matter.

2. Occidental will protect site CA-LAK-711 by a buffer zone to be established around its perimeter. The buffer zone should be no less than two hundred feet (65 meters) in width.
3. If other as yet unidentified archaeological materials are discovered or unearthed during construction, work in the immediate area will be halted and a qualified archaeologist will be consulted to evaluate the find. Any construction in the immediate area will remain stopped until the specialist can evaluate the extent and significance of the resources. In consultation with CEC and interested agencies, Oxy will develop the necessary mitigation plan. If an agreement between Oxy and CEC cannot be reached regarding a mitigation plan, the matter will be considered under the provisions of the CEC Dispute Resolution Procedure. Occidental will notify CEC within 24 hours of the resource discovery and the work stoppage. Within one working day of this notification, representatives of the CEC, the Bureau of Land Management's Ukiah office, and Occidental will meet with the archeological specialist to discuss the possible significance of the resources and proposed mitigation measures. Pending resolution of this matter, construction activity in the resource areas shall cease.

SOCIOECONOMICS

SETTING

The Geysers Known Geothermal Resource Area is located in portions of Lake, Mendocino, Napa, and Sonoma counties. While the proposed power plant and associated facilities are in Lake County, geothermal development primarily has taken place in Sonoma County. As more of the KGRA develops, however, CEC staff expects more geothermal activity to occur in Lake County. Since geothermal activities and their resulting impacts have concentrated within these two counties, the impact discussion will emphasize Lake and Sonoma counties.

The four counties that comprise The Geysers KGRA have all undergone rapid growth over the past decade, and CEC staff expects this growth to continue well into the future. In-migration is the predominant growth factor for all four counties, which condition is most likely due to their rural characteristics.

Sonoma County, the largest and most urbanized of the four counties, had a total population of 292,275 in January 1980 (California Department of Finance, 1981). This growth represents a 42 percent increase over the 1970 population. Much of this growth centered in the incorporated communities of the south.

Those communities adjacent to the KGRA in Sonoma County have not kept pace with the countywide growth rate. The largest community, Healdsburg, 15 miles southwest of the proposed project, has a population of 7,137, a 31 percent increase over the past decade. Other Sonoma County communities adjacent to the KGRA are small, with populations less than 3,000.

Lake County, with a total population of 35,000 in January 1980 has one of the highest growth rates in the state over the last decade—89 percent (California Department of Finance, 1981). This growth is entirely due to in-migration, mainly of elderly retirees, and balances evenly between urban and rural areas. This influx of older people gives Lake County the highest median age of any county in the state.

Lake County contains many communities which are adjacent to the KGRA. Middletown, located 8 miles to the southeast of the proposed Occidental site, has an approximate population of 1,500. Anderson Springs and Whispering Pines are the two closest Lake County communities to the proposed site, with an estimated permanent population of 200 people and 145 people, respectively. This portion of Lake County has not experienced the high median age common in the rest of the county. CEC staff attributes growth in this area mainly to the influx of geothermal workers.

Mendocino and Napa counties, with populations of 66,751 and 97,361, respectively, have also grown rapidly. Much of Mendocino's growth occurred in rural areas, while Napa's has concentrated more in the incorporated communities.

Although agriculture is still the leading industry for the region, its importance is declining, while recreation, construction, and mining (including

geothermal activities) are on the increase. This is especially true in Sonoma County, which has greatly expanded its service, retail, and industrial sectors.

Government and retail trade sectors are the largest employers in the four county area; the one exception is Mendocino, where the manufacturing sector has the largest number of employees. Employment in agriculture is generally understated due to the large percentage of self-employment.

The fact that the region's economy relies on agriculture creates a demand for seasonal, unskilled labor. Lake County, for example, has an unemployment rate well above the statewide average due to the large percentage of seasonally employed workers. Sonoma County, on the other hand, is the exception within the region, with a declining unemployment rate due to the diverse economic base.

IMPACTS

CEC staff anticipates employment opportunities and the resulting impacts upon population, housing, and public services to result from the proposed project as well as from the cumulative impacts from other geothermal activity. While the proposed project is located in Lake County, project-specific and cumulative impacts will occur in Sonoma County and, to a much lesser degree, Mendocino and Napa counties as well. Specific levels of impacts which staff anticipates to occur within each county are discussed below.

EMPLOYMENT

Most of the employment impacts associated with the development of the proposed Occidental #1 power plant will occur during the construction phase of the project. Oxy plans to begin construction of the power plant in April 1982, employing a peak construction force of 230 workers. Once Oxy completes construction, operation and maintenance of the facility will only require four employees.

The development schedule in the KGRA has provided an effective staggering of employment activity, which allows many employees to work on several projects on a sequential basis. Thus, new geothermal projects, such as the proposed Occidental development, do not directly translate into new employment opportunities for those workers outside the current four county labor pool.

Although the proposed Occidental project is one of three developments scheduled to begin construction in FY 82, extensive use of the existing labor pool will still be possible. Additionally, since this is during the peak employment period (see Socioeconomics Figure 1), the net impacts from those projects prior to and subsequent to the Occidental development will overshadow any project-specific impacts resulting from this development.

As shown in Figure 1, peak employment for all phases of steam field development, power plant construction, and operation will occur within the period 1981 - 1984. Besides the proposed Occidental project, this anticipated cumulative workforce assumes all other facilities that are currently proposed will be built (assumed cumulative capacity of 1,731 megawatts) on schedule. These would include DWR's Bottle Rock and South Geysers, PGandE's 16, 17, and 18, SMUDGE #1, and NCPA's 1, 2, and 3.

OXY GEOTHERMAL #1 **FIGURE 1: SOCIOECONOMICS-Cumulative Development Workforce/the Geysers KGRA**

Since the Occidental project is part of the peak period of geothermal development, the following discussion reviews the cumulative impacts of development in The Geysers. The estimated cumulative labor demand for 1983 will be 948 workers. This figure includes all 3 phases of geothermal development and is an increase of 446 workers over the previous labor peak in 1978 of 502 (this includes steam drillers and operation and maintenance crews).

Based upon this figure and the following assumptions, it is possible to derive an estimate of the number of new residents for each county generated by geothermal development.

- o All of the approximately 300 workers that were employed during the 1978 peak construction period still reside in the 4 county area (Lake, Mendocino, Napa, and Sonoma) and are available for employment for geothermal development. Those living in each county will not move to another county because of a specific project.
- o Of the 446 new workers, 40 percent of 178 nongeothermal workers with the necessary skills already reside in the 4 county area and are willing to commute to a given project site. As existing residents, their employment will not represent a population increase nor will they cause an increase in induced employment. CEC staff obtained the 40 percent figure from a study entitled Construction Worker Profile (Mountain West Research, Inc., 1975). This study derived the 40 percent figure from a survey of 14 energy projects. Staff feels that this is a reasonable estimate as evidenced by unemployment trends within the four county area.
- o Of the remaining 268 workers, it is estimated that 50 percent will reside in Sonoma County, 40 percent in Lake County, and 5 percent in Mendocino and Napa counties each.
- o Based on data in the Construction Worker Profile study, 50 percent of the workers moving into the 4 county area will bring families, and each average family will consist of a spouse and 1.5 children.

Using these assumptions, staff estimated the following figures for new residents within the 4 county area due to geothermal development.

	<u>Sonoma</u>	<u>Lake</u>	<u>Napa</u>	<u>Mendocino</u>	<u>Total</u>
Single Workers	67	54	7	7	135
Workers with Families	67	54	7	7	135
Spouses	67	54	7	7	135
Children	100	80	10	10	200
Total New Residents*	301	242	31	31	605

*These numbers have been rounded up and are therefore a little high.

According to these figures, during the peak period the estimated total population increases in the 4 counties from the cumulative effect of geothermal development in the KGRA will be an additional population of 605 people, 200 of them children. (See Socioeconomics Figure #1.)

Increased employment in geothermal development may also generate employment in other sectors of the local economy through the increased demand for services. Since the major employment phase of The Geysers development is temporary, however, staff expects these induced job opportunities to be limited. Additionally, the high unemployment rate for the area, resulting from the seasonal employment patterns of agriculture and the large tourist serving industry, provides a large pool of workers which may be assumed to fill these geothermal induced positions. This will further reduce the likelihood that these induced employment opportunities will attract new residents into the four county area.

The level of new, direct, and induced employment represents only a small addition to each county's labor supply; therefore, further geothermal development, including the Oxy project, will not have an adverse significant impact on the labor supply in the four county area. However, geothermal development may provide increased employment to the local labor force.

HOUSING

All four counties within the KGRA report an increased demand for housing in order to meet population pressures and to replace currently substandard housing. Preliminary 1980 census data indicates actual housing availability is quite limited. The data shows Mendocino's overall vacancy rate is 7.3 percent; Napa's and Sonoma's average 9.5 percent, while Lake's rates are over 20 percent. Actual vacancy rates are much lower due to the large percentage of seasonally occupied second homes that are counted as vacant units. The Sonoma County Housing and Community Development Office undertook a condominium conversion study for the city of Healdsburg which indicates a vacancy rate of less than 2 percent (Christine Gouig, personal communication). The community of Calistoga in Napa County reports a similar vacancy rate. These rates are well below a desirable level and result from many factors, including geothermal development. In an impacted housing market, such as Healdsburg and Calistoga, additional demand must be considered a significantly adverse effect. However, based upon the nature of transient workers' housing demand and the large distance which workers commute (for example, Ukiah, a round trip of 70 miles each day), the housing requirements resulting from geothermal development will disperse over a large area and reduce the significance of this impact. Because of existing bus transportation new residents will have a large area to choose from within the housing market.

Based upon the cumulative employment impacts discussed above, staff estimates a worst-case housing demand for each county.

<u>Sonoma</u>	<u>Lake</u>	<u>Mendocino</u>	<u>Napa</u>
134	108	14	14

This assumes single workers as well as workers with families will occupy a single dwelling unit each. Based upon the overall growth experienced by each county, the countywide impacts on housing will be significant under worst-case conditions.

CEC analysis of housing demand attributable to the proposed Occidental project finds that no adverse effects will occur in Sonoma County and only temporary adverse effects may occur in Lake County. Based on discussions with union representatives, analysis of housing costs in general, and the general state of the economy, CEC staff does not expect many construction workers to move into either county on a permanent basis. Those moving will select various types of rental facilities, e.g., hotel, motel, apartment, and mobile home/RV facilities. Additionally, since Occidental will not pay for use of Union Oil roads, there will be no direct access from Sonoma County to the site. Any operation workers moving into the area for this project will therefore tend to move into Lake County, given commute time and the cost of gasoline.

In conclusion, staff feels there will be a temporary adverse impact on housing within the four county area, especially Lake County. The availability and location of dwelling units for the transitory construction workers will determine the significance of this impact. While the CEC staff believe that no mitigation measures are warranted for this project, this issue will be analyzed further in the CEC Geysers cumulative effects proceedings to determine what, if any, measures should be instituted by all developers.

EDUCATION INSTITUTIONS

Due to the rapid growth rate in Lake County in recent years, several school districts have experienced a sharp increase in the number of new students, mainly of elementary school age. Of the seven Lake County school districts, three districts--Kelseyville, Konocti, and Middletown--are operating at or near capacity.

The Middletown Unified School District undertook a survey which showed that one-third of the students in the district have parents who are employed in geothermal or related occupations (Bill Cornelison, December 1980). This district may be the worst impacted within the four county area because of the high numbers of geothermal workers locating in the Middletown area due to its proximity to the KGRA. PGandE estimates that between 25 and 50 percent of those geothermal workers living in Lake County reside in the Middletown-Cobb Mountain Area (PGandE, 1981).

To date, the Middletown and Konocti School Districts have received a total of \$46,500 from the Lake County Board of Supervisors in 1905 monies. No applications have been made for AB 1905 funds administered by the CEC.

On the other hand, Sonoma County School Districts have reported declining enrollments since 1977. Since most of the existing power plants are located in Sonoma County, the Geyserville and Cloverdale School Districts have benefited from geothermal development as a result of increased tax revenues and total assessed valuation (Vollintine et al, 1977). With the passage of Proposition 13, school financing does not rely on local property taxes but now comes directly from the state. State funding of schools, however, is in a state of flux due to current budget reductions. Thus, further funding for impacted Lake County School Districts may not be sufficient to meet their needs.

MITIGATION MEASURES

One of the considerations used in identifying appropriate mitigation measures is to determine which measures are both feasible and reliable. Recent information provided by the Lake County Board of Supervisors (see attached letter) clearly indicates that the board does not consider its AB 1905 funds appropriate for mitigating direct impacts from specific geothermal projects. According to the Board of Supervisors, such funds will be used for mitigating indirect effects, i.e., those which cannot be identified with or attributable to any specific geothermal project and which may appear over a period of time as a result of overall development. As of October 21, 1981, the CEC has adopted a grant program for AB 1905 funds under its jurisdiction. CEC funds available for mitigation are also intended to mitigate impacts not directly attributable to any one project (CEC, Geothermal Development Grant Program for Local Governments, p. 9, as amended October 21, 1981). Therefore, both local and state AB 1905 funds are not a reliable source of monies to mitigate direct impacts of the proposed project.

The Lake County Board of Supervisors also takes the position and is convinced that in most cases reliable but not precise estimates of impacts and costs are possible. While impact estimates vary depending upon method and assumptions, all parties in this case agree that the Lake County Schools are being adversely affected by increasing enrollments due to geothermal development. The two parties most appropriate to determine the magnitude of direct impact and the associated cost are Occidental and the Lake County Office of Education. Consistent with Occidental's intent as expressed in the AFC (p. 592) to work with the Lake County schools, staff recommended that as a condition of certification the California Energy Commission require Occidental and the Lake County Office of Education to enter into good faith negotiations to determine the extent of mitigation required of Occidental for direct adverse impacts on the county's school facilities which may be attributed to the proposed project. However, at the October 29, 1981, Compliance Workshop with CEC staff, Occidental clearly stated that it did not agree with and could not voluntarily enter into negotiations with the Lake County Office of Education. Therefore, to ensure mitigation takes place in a timely manner, staff recommends the following rationale and conditions of approval. (Staff uses educational costs provided by the Lake County Office of Education.)

Findings:

Payment by the Applicant to the intervening school districts of Lake County provides a feasible and reliable source of mitigation for the direct adverse impacts of the Applicant's project on the school facilities of Lake County.

The current cost of construction of school facilities is approximately \$100.00 per square foot. The current cost of school buses is approximately \$1,000 per child.

Based upon Education Code sections 16047, 16052, and 16054, the recommended space for school students is 55 square feet or more.

The proposed project, by causing the enrollment in the intervening Lake County school districts to increase, will have a significant adverse impact. The most reasonable and feasible method of determining the exact impact is by

means of an annual survey among the parents of the school children within each such district for a period of 10 years from the date of approval of the AFC. Such a survey is already taken pursuant to the agreement between the Department of Water Resources and the intervening school districts, entered into as a condition of approval of the Application for Certification for the South Geysers Geothermal Power Plant Project.

Conclusions:

The following conditions shall be applied to the project:

1. The exact impact of the project on school district enrollment shall be determined upon the annual survey taken pursuant to the Department of Water Resources South Geysers Agreement for a period of 10 years from the date of approval of the AFC.
2. Applicants shall pay the sum of \$6,500 per student for the total number of students enrolled in the intervening school districts attributable to the project to be calculated as follows, less any sums paid in previous years:
 - A. If at least one parent of any student owns or is employed by a power plant developer or a power plant construction contractor or subcontractor and if such employment is primarily on the site of or primarily connected to the power plant; or if such parent owns or is employed by any other business firm and, within the course and scope of said employment, is primarily on the site of or primarily connected to the power plant; and if such power plant is Oxy Geothermal Project No. 1, then said sum of money shall be paid for each such student.
 - B. If at least one parent of any student owns or is employed by an off-site or multiple-site firm whose operations are primarily involved in providing services for construction and/or operation of geothermal power plants and if the Oxy Geothermal Project No. 1 is among the projects serviced by any such firm, the Applicant shall pay 5 percent of the specified sum for each such student.
 1. Service for construction and/or operation of geothermal power plants includes, but is not limited to, the following: waste disposal, water supply, trucking and other transportation, heavy equipment operation, and equipment maintenance and repair.
 2. The use of "primarily" in the survey shall mean "50 percent or more."
 3. In the fourth and eighth years of the survey, the definition of "primarily" and the formula for the project's pro-rata share of the impacts of off-site or multiple-site firms shall be open to negotiation between the Applicant and the Lake County school districts if either party, in a written notice to the other, claims the definition or formula to be incorrect.

- C. The money shall be paid by the Applicant within 60 days following the presentation to Applicant of the annual survey results and shall be paid to the Lake County Superintendent of Schools on behalf of the intervening school districts according to their pro-rata shares of the students identified in the survey.
- D. Any disputes arising from these conditions may be submitted at the request of either party to the Commission under CEC's Compliance and Monitoring dispute resolution procedure as mutually agreed to by the parties and the Commission.

PUBLIC SERVICES

SETTING

For information on the setting for public services, refer to socioeconomic setting.

IMPACTS

Project-specific impacts on most public services from the proposed Occidental geothermal development will be insignificant. Since the facility will be located in Lake County, on-site fire and police protection will be provided by the California Department of Forestry, the Middletown Volunteer Fire Department, and the Lake County Sheriff's Department. Hospitals in either Santa Rosa or Clear Lake Highlands will provide medical services. Sewage disposal will be on site. Oxy will truck in bottled water for human consumption while cooling tower condensate will meet most other water needs. While the incremental increase of the proposed facility on these public services, especially police, fire, and medical services, are insignificant, the cumulative impacts of geothermal development cause greater concern.

One significant project-specific impact on public services will be the deterioration of the Anderson/Gunning Creek watershed, which provides both recreational and domestic water for the community of Anderson Springs. Degradation of Gunning Creek would require improvements to the domestic water supply system and result in fiscal impacts to the community. (For further discussion please see Water Quality section.)

Of additional concern are the cumulative impacts to local jurisdictions which must provide public services to accommodate the population growth resulting from geothermal development. Staff estimates these impacts will be insignificant due to the dispersal of new geothermal related residents throughout the four county area. CEC staff anticipates that impacts will occur in Lake County, where the existing infrastructure has been stressed to accommodate the drastic growth in recent years.

MITIGATION MEASURES

The Lake County Board of Supervisors and the CEC separately administer monies provided under AB 1905 (Bosco) which have been used to identify and mitigate geothermal impacts. The now publicly owned Anderson Springs Water Company is eligible for 1905 money. No mitigation measures are required of Occidental except for those pertaining to the watershed (see Water Quality section).

FISCAL IMPACTS

Local economies receive direct and indirect fiscal benefits from geothermal development. These benefits include an approximate \$678,000 paid to Lake County from property taxes on the proposed project the first year alone (Occidental AFC, 1981). The purchase of materials and employee spending within the four county area will also provide sales tax monies.

For Sonoma County, staff estimates that geothermal development comprises 7 percent of the total county economic base taxes, while for Lake County this figure is 12 percent. Since future geothermal development will occur increasingly in Lake County, this figure could become much higher.

Negative fiscal impacts of geothermal development are difficult to predict or quantify. These may include increased demand for public services. However, the four counties have experienced rapid population growth which is unrelated to geothermal development; thus, it overshadows those impacts directly related to geothermal activities. Staff anticipates that negative fiscal impacts to Sonoma and Lake counties from the proposed project and the cumulative development of geothermal resources will be insignificant at this time compared to the positive fiscal benefits coming from property and sales taxes.

Proposition 4, passed by the voters in 1979, limits government appropriation on the basis of changes in population and the cost of living. With a rapid expansion of geothermal development, which could generate significant new property taxes, a county might exceed its spending limit imposed by Proposition 4 if the cost of living and population growth were minimal during a given year. Thus, a county might be placed in the position of not being able to use a certain portion of the tax revenues generated by geothermal development. Since these limits are tied to the county's population growth and the cost of living, estimates of the impact of the proposed power plant, when it comes on line, concerning the county's appropriations are difficult to make. Without undertaking a complete tax revenue and government costs study, the cumulative effect of geothermal development due to Proposition 4's limitation are not known.

LAND USE

SETTING

Before the advent of geothermal development, principal land uses in The Geysers KGRA were recreation (predominantly hunting) and mining. Mining activities have been discontinued and recreation has been limited by restricted and, in some areas, difficult access. Extensive use of nearby areas (e.g., Cobb Mountain) for recreational purposes continues. However, geothermal exploration and development have expanded into the site area in recent years. SMUD's Unit #1 site lies within one mile to the west of the proposed Occidental site. PGandE's Units 9 and 10 lie slightly further to the northwest, while PGandE Units 13 and 14 lie to the west and southeast, respectively.

Occidental has already acquired geothermal leases for the leasehold from the federal government, numbers CA 5636 and CA 5637. Surface land rights do not belong to Occidental, rather they belong to the Charles T. Simmons family. (An agreement to site the proposed power plant has been reached between Occidental and the Simmons family.) The U.S. Department of Interior governs the relationship between the two land use parties through administration of mineral reserve leases on 1916 Homestead Act lands.

The leasehold for the proposed project contains approximately 550 acres, of which about 480 acres are in Lake County with the remainder in Sonoma County. That portion of the leasehold in Lake County is "Extensive Agriculture" in the Lake County General Plan; its zoning is "unclassified." These designations allow geothermal development; the zoning requires a use permit. Lake County's General Plan is currently undergoing revision and should be adopted late this year (1981). Discussions with Lake County Planning Department staff indicate geothermal development will continue to be allowed under the new General Plan. The 70 acre portion of the leasehold in Sonoma County lies within an area designated in the Sonoma County General Plan as primary geothermal resource area.

IMPACTS

Development of the proposed Occidental project will continue the current and prospective principal land use in this portion of the KGRA. As proposed, the project complies with both Lake and Sonoma County General Plans.

MITIGATION

No mitigation measures are required.

AESTHETICS

SETTING

The proposed Oxy development is located within the Mayacmas Mountains, a northwest trending range characterized by steep hillsides and deeply incised valleys. The leasehold is located on a prominent ridge that drops away to the southwest of Cobb Mountain (elevation 4,722 feet). Other visible landforms surrounding the leasehold besides Cobb Mountain on the north are Ford Flat (elevation 2,500 feet) to the east, Little Geysers (2,200 feet) to the south, and Burned Mountain (3,800 feet) to the west. Actual topographic relief within the leasehold is mild with only several hundred feet difference in vertical elevation. The location is at the top of the Anderson and Gunning creeks watershed.

A variety of plant communities provides a dense vegetative cover over most of the leasehold. A majority of the proposed site is covered by chaparral species, mostly coarsely textured, grey-green low-lying shrubs. Other plant communities present, such as grasslands and oak woodlands, provide a visual contrast to the dominant vegetative cover.

Off site, the leasehold is mainly visible to areas east of the proposed development. Views over five miles from the site from the north, south, and west are interrupted by intervening ridgelines.

To the east, the site is visible from points within Collayomi and Long valleys, including locations in Anderson Springs, Middletown, and along Highway 29 and 175. However, views from those recreational developments along Highway 175 in Cobb Valley-Whispering Pines, Cobb, and Pine Grove are obstructed by topography and heavy vegetation (AFC, p. 5-96). Foreground views of the area are also mostly limited to the east, mainly along Socrates Mine Road. Foreground views from other directions are mainly from areas which already contain geothermal development.

Land scars which result from geothermal exploration activities are visually evident within the leasehold. These include access roads and the three well pads, with a fourth planned.

The proposed transmission line would be approximately 1 mile long and require three 140 foot towers. The proposed transmission corridor would traverse the ridge above the power plant and then descend into the Big Sulphur Creek drainage before connecting with an existing line. Only one of the towers would be visible from the populated areas to the east. The other alternative route, however, would create a greater visual impact with three transmission towers visible to the east.

IMPACTS

Impacts to the aesthetic qualities of an area are not easily quantified, especially scenic values. Generally, aesthetic impacts resulting from development depend on the perceived degree the original environment is altered. This environment includes both man-made features, such as roads, and natural features, such as land forms or vegetation.

Development of the steam field, power plant, and transmission line will convert an essentially undisturbed area into an industrialized one. While the actual disturbed area will be only a small percentage of the total leasehold, CEC staff anticipates short-term unavoidable, adverse aesthetic impacts during the construction phase of development will result. This stage of development includes the construction of roads, drill pads, the power plant, and the associated clearing and grading activities. Those development activities occurring near the ridge top will create the most significant visual impacts and would include the power plant, transmission line, and road construction. These activities will substantially alter the natural contours of the hill-sides, and the areas cleared of vegetation will present a sharp contrast to adjacent areas. The power plant will be visible to certain areas within Long and Collayomi valleys. The Cooling Tower plume will even be more significant visually than the power plant. This will lessen the visual value for the residents and many tourists of this area. During operation of the facilities, these adverse visual impacts will continue.

Adverse aesthetic impacts during the construction phase include a sharp increase in noise and road traffic. These impacts would affect residents of those communities located along the major access roads into the KGRA. However, their effect will be minimized once the construction phase of development is completed. Road traffic, noise, and other impacts will decline to an insignificant level. Another adverse impact will be a lessening of aesthetic values of Anderson Creek. CEC anticipates some degradation of Anderson Creek will result from the proposed Occidental development. This water quality degradation may be sufficient to result in aesthetic impacts as well. (For further discussion regarding impacts and mitigation see Water Quality section.) Aesthetic impacts may decrease the real estate market for some properties in Anderson Springs.

MITIGATION MEASURES

Certain impacts to aesthetic resources can be lessened through the implementation of mitigation measures. Oxy plans the following measures to reduce the visual impacts of the proposed project.

1. Reestablish vegetation on land surfaces disturbed by geothermal development.
2. Use colors and nonreflected materials to minimize the contrast between the development and the natural background.
3. Landscaping, erosion, and sedimentation control.
4. Selection of the preferred transmission line alternative.
5. Other mitigation measures such as noise, air, and water pollution control are discussed under their appropriate sections.

By implementing these measures Oxy can reduce most short-term unavoidable aesthetic impacts that occur during the construction phase. CEC staff anticipates that visual impacts will continue throughout the life of the project. Additional aesthetic impacts resulting from water quality degradation may occur in Anderson Springs.

III. CUMULATIVE ENVIRONMENTAL ANALYSIS

The project will contribute to the cumulative impacts of geothermal development in The Geysers KGRA, which are significant and increasing.

These cumulative impacts are made no less significant by the fact that substantial portions of the KGRA have, in effect, become "industrialized" due to geothermal development. The proliferation of well pads, access roads, steam conveyance lines, transmission lines, and power plants is gradually altering the undisturbed natural environment of The Geysers KGRA, and no amount of mitigation at individual project sites can alter this basic fact.

CEC staff predicts maximum develop of the KGRA at 2,700 MW dry steam production by 1992, with an additional 550 MW from hot water production by the year 2000.

Accurate assessment of the cumulative impacts of geothermal development at the KGRA is in a fledgling stage. Although this document attempts to address cumulative impacts, each of these effects should be viewed as extremely speculative. There is simply not enough data to make an accurate statement at this time nor is it logical to propose mitigation of these impacts until the needed data is available. For this reason CEC has initiated several generic studies on the matter: (1) "Mitigation of Hydrogen Sulfide Emissions in the Geysers KGRA", CEC Draft, July 1981; (2) "Potential Development of Geothermal Electric Power Resources in the Geysers", Draft scheduled for distribution in August 1981; and (3) "Status and Overview of Cumulative Impact Issues in the Geysers", CEC Draft, estimated for distribution, late 1981. These studies will address the following topics: health effects of H₂S; water-related resources; biological resources; socioeconomic; seismic performance and design criteria; erosion/sedimentation potential; transmission system; and air quality monitoring. Once these studies are complete we will have an accurate picture of the cumulative impacts of geothermal development at the KGRA. At that time it will be appropriate to discuss proposed mitigation of these impacts.

CATEGORICAL CONCERNS

It is difficult to determine to what degree impacts associated with the Oxy #1 project will contribute to the cumulative impacts of the overall development in the KGRA. Cumulative impacts are of concern in the areas of land use and aesthetics, transportation, air quality, public health, water quality, erosion and sedimentation, biological resources, and safety.

Current and Anticipated Geothermal Development

The following list summarizes the status of geothermal development within the KGRA.

	<u>Unit</u>	<u>Net Capacity (MW)</u>	<u>Cumulative Capacity (MW)</u>	<u>Commercial Operation</u>	<u>Target for Operation</u>
<u>Operational</u>					
PGandE	1	11	11	9/25/60	
	2	13	24	9/13/63	
	3	27	51	4/28/67	
	4	27	78	3/02/68	
	5	53	131	12/15/71	
	6	53	184	8/18/72	
	7	53	237	11/23/72	
	8	53	290	11/23/72	
	9	53	343	10/25/73	
	10	53	396	11/30/73	
	11	106	502	5/31/75	
	12	106	608	3/01/79	
	13	135	743	4/15/80	
	14	110	853	9/12/80	
	15	55	908	6/17/79	
<u>Under Construction</u>					
PGandE	17	110	1,018		1982
	18	110	1,128		1983
NCPA	2	110	1,238		1983
SMUDGE #1		72	1,310		1983
<u>Approved for Construction</u>					
DWR Bottle Rock		55	1,365		1984
DWR South Geysers		55	1,420		1985
PGandE 16		110	1,530		1984
<u>Proposed</u>					
Oxy Geo #1		80	1,610		1984
<u>To Be Proposed</u>					
NCPA	1	66	1,676		unknown
NCPA	3	55	1,731		unknown
PGandE	20	110	1,841		unknown
Total			1,841 MW		

IV. UNAVOIDABLE SIGNIFICANT ADVERSE ENVIRONMENTAL EFFECTS

EFFECTS SIGNIFICANT DESPITE MITIGATION

For project impacts judged to be significant unless mitigated, this section summarizes adverse effects remaining after implementation of all proposed mitigation measures. This summary includes those impacts which would be significant as well as those rendered insignificant through effective mitigation. For more thorough discussion of each topic, refer to the specific section of the Environmental Analysis chapters of this EIR.

GEOLOGY

Earthquake Shaking

There may be an increase in microseismic activity due to the presence of a geothermal power plant; however, accurate predictions regarding such activity are not possible. Not enough is known about the phenomenon as related to geothermal power plants. However, it is anticipated that such microseismic activity will not have far-reaching effects. Some degree of subsidence is expected due to reduction of the geothermal steam reservoir.

Compliance with design criteria will reduce the risk of earthquake-induced structural damage to an acceptable level.

Landslide and Slope Stability

Proposed design and construction methods combined with the site-specific geology would probably reduce the hazard to insignificance.

Differential Settlement

Proposed design and construction methods would reduce the hazard to insignificance.

SOILS

Power Plant Site

Construction of cut and fill slopes connected with the power plant site will result in increased sediment deposition and transport into Anderson Creek. Erosion may persist in the vicinity of culverts, cuts, and fills. Once Oxy completes construction and applies mitigation measures, CEC staff expects it will take three years for the area to stabilize and return to new pre-construction rates.

Transmission Corridor

To develop the preferred transmission route, Oxy will disturb the soil mantle on approximately 1 acre. CEC staff expects some erosion from this disturbance to occur, although it is not seen as significant.

Leasehold

Full leasehold development will remove the existing vegetative cover and disturb or remove the soil mantle from 50.3 acres of the 550 acre Occidental parcel. Fifty of the acres lie in the Anderson Creek watershed, or about 9 percent of the watershed area enclosed within the leasehold. An increase in erosion from denuded slopes and deposition of additional sediment in Anderson Creek is inevitable as a result of the proposed disturbance.

HYDROLOGY/WATER QUALITY

Power Plant Site

Construction of cut and fill slopes connected with the power plant site will result in increased sediment deposition and transportation in Anderson Creek. An unavoidable consequence will be water quality degradation, particularly during intense rainstorms typical of The Geysers KGRA.

Leasehold

See comments under SOILS (Leasehold) above. Various regulatory agencies (CEC, Lake County, USGS, BLM, CVRWQCB) are working with Oxy to ensure that degradation to recreational and domestic water sources are kept to a minimum. Nevertheless there will be impacts. Oxy proposes full leasehold development despite environmental documentation indicating the sensitivity of placing a geothermal development at the top of a relatively fragile watershed, which provides both potable and recreational waters to downstream users. Because of the extraordinary mitigation measures which Oxy has applied, staff concludes that Oxy will mitigate to compensate for any adverse affect on the potable water for Anderson Springs.

BIOLOGY

Vegetation

Construction of the power plant, access road, and transmission line will remove about 21 acres of vegetation. Full leasehold development will disturb 50.3 acres and reduce various vegetation types. Although CEC does not expect these losses to directly impact any legally protected species, species of special concern, or species of commercial importance, Oxy has not yet completed adequate studies on the occurrence of rare plants, so staff's conclusions are tentative.

Wildlife

As explained under the Soils and Hydrology/Water Quality section of the EIR, sediment entering local streams could result in impacts to aquatic biota, which include (among others) the recreational species, rainbow trout.

Should a toxic spill occur and enter the creeks, it could kill fish and other forms of aquatic life. Safe handling of toxic materials as well as various power plant and steamfield design features should reduce this possibility to a minimum.

The loss of vegetation due to Oxy's full project will reduce habitat for a number of wildlife species; however, if mitigated, these impacts should not be significant. The one fully protected species which Oxy's development may affect is the ringtail. This small raccoonlike creature frequents riparian zones. Although CEC staff considers the Oxy leasehold likely to contain ringtail, the impacts to this fully protected species cannot be assessed due to lack of data concerning their existence on the leasehold.

The riparian habitat is of particular value to wildlife in the area because it provides them with a source of water. Oxy's access road within the leasehold as well as their drill Pad B both encroach on the riparian protection zone recommended by BLM in the 1978 5-Tract EAR. Oxy's placement of drill Pad B within 160 feet of Gunning Creek encroaches on the setback distances recommended by the following agencies in response to the 1980 Draft Environmental Assessment by UGSG: California Department of Fish and Game, U.S. Fish and Wildlife Service, and Lake County.

AIR QUALITY

CEC staff anticipates the Lake County Air Pollution Control Officer (LCAPCO) will issue a Determination of Compliance (DOC) for Oxy #1 which indicates that the project will contribute incrementally to an existing violation of the California Ambient Air Quality Standards (CAAQS). To achieve compliance, and under rule 608, the APCO will probably require Oxy to limit their H₂S emissions to eight lbs/hr. Oxy will employ best available control technology (BACT) to reduce their emissions accordingly; however, even if they could reduce their emissions to zero, it would not eliminate the probability of violations occurring in the KGRA. Factors contributing to the air quality violation are cumulative in nature, with existing power plants contributing heavily. The main point, in terms of environmental consequence, is that recent monitoring shows a decreasing number of violations. Oxy #1 may contribute incrementally to this violation, but on a very small scale.

Small quantities of potentially deleterious substances contained in geothermal steam may be carried in the cooling tower plume, lifted into the air, and deposited on soils, vegetation, wildlife, and populated areas. The effects of small concentrations and cumulative deposition of substances such as radon, mercury, arsenic, and boron are not sufficiently understood, and the significance of the impacts is unknown. The use of BACT, mentioned above, will reduce these emissions considerably; nevertheless, small amounts will be deposited on the local environment as a result of Oxy Geothermal #1.

NOISE

If Oxy implements all proposed mitigation measures, operation of the power plant will not result in significant noise impact.

Sensitive receptors near the steam field may hear such activities as production testing, unmuffled well venting, and wellhead master valve changes. These activities occur infrequently and can be restricted to daylight hours. Construction traffic along access routes to the leasehold may subject people along the route to intermittent noise levels which exceed the nighttime

standard of the Lake County draft noise ordinance. If Oxy limits heavy truck traffic to daylight hours, staff believes their impacts will be insignificant.

WASTE MANAGEMENT

Provided Oxy stores and disposes of wastes according to regulation, CEC anticipates no adverse impact from hazardous wastes.

HEALTH

The project will contribute, albeit in a relatively small amount, to existing violations of the California Ambient Air Quality Standard for H₂S. Although experts do not know at this time if adverse health effects result from exposure to low levels of H₂S, the inference is that increasing H₂S concentrations will increase the possibility of public odor complaints as well as the possibility for adverse health impacts in The Geysers area. In addition, the project's emissions of nonregulated pollutants, combined with other power plant emissions, increase the possibility of adverse health impacts from these pollutants. With only scarce data on steam quality, actual emission rates, and transport of nonregulated pollutants, comparisons to suggested safe levels or proposed standards for exposure to nonregulated pollutants cannot be made with a great degree of confidence. Oxy will either conduct or participate in programs to monitor steam quality and ambient air pollutant concentrations and to perform mass balance studies if warranted and if measurement techniques will yield meaningful results. The data base provided by these programs will aid in determining:

1. The need for further abatement of H₂S and other nonregulated pollutants in the future; and
2. The acceptability of additional power plant projects in the area.

In addition, there is a possibility that the construction and operation of the Oxy facility may degrade local recreation and drinking water supplies. Oxy has agreed to periodically monitor water quality in Anderson and Gunning Creeks to detect any chronic degradation so that appropriate corrective actions may be taken. They have also agreed to fund safeguards for the existing water supply system, which staff believes will adequately protect the system from immediate risks to public health. Therefore, staff finds that the Oxy project should not have an adverse impact on public health.

TRANSPORTATION

CEC staff does not expect the small increase in lightweight (auto/truck) traffic due to Oxy's construction to significantly impact the local transportation network. Oxy's increase in heavy truck traffic, however, will worsen existing problems on Socrates Mine Road. To mitigate, Oxy and other geothermal developers will share the costs of improving Socrates Mine Road. Work began in the late summer of 1981, and will be completed in 1982.

If Oxy disposes of wastes in Middletown, their disposal trucks will add to an existing deterioration problem on Butts Canyon Road. Lake County has appropriated funds to repair the road.

ENERGY AND MATERIAL RESOURCES

The Oxy #1 plant would consume approximately 1,600,000 lbs/hr of geothermal steam and will use a governor to throttle back unwanted steam. Oxy could maximize the use of geothermal steam by incorporating a more efficient turbine design.

On a cumulative level, Oxy #1's use of energy and material resources is about on a par with other geothermal developments in the KGRA, although they could improve on the efficiency of their steam utilization. CEC staff estimates that by 1986 a total of 24 geothermal power plants may operate in the KGRA and consume an estimated 28,305,000 lbs/hr of geothermal steam. Neither the capacity, duration, nor recharge rate of the geothermal steam reservoir is known, but staff recommends efficient use of this resource.

Aside from the geothermal steam, construction and operation of the Oxy plant will require some use of fossil fuel driven equipment. CEC staff considers these amounts of fuel as well as the amount of construction materials which Oxy will use to be insignificant.

CULTURAL RESOURCES

The Oxy development area contains one significant prehistoric hunting camp site, which is listed on the National Register of Historic Places. Oxy will establish a buffer zone to protect this site, although no construction activities are planned for the area. If Oxy implements all mitigation measures, no adverse impact to cultural resources should occur.

SOCIOECONOMICS AND PUBLIC SERVICES

CEC staff anticipates significant socioeconomic impacts due to Oxy and other geothermal developments. These will occur primarily in Lake and Sonoma counties and, to a much lesser extent, in Napa and Mendocino counties. Specifically, there will be an increased demand for housing on an already impacted housing market and an increased burden on public schools within Lake County. Staff recognizes the potential for the Oxy development to cause a significant public service impact on the water system for Anderson Springs. Cautious engineering and adequate mitigation measures will dispell this concern.

AESTHETICS

Power Plant Site

The Oxy project will be visible from portions of the Colloiyami and Longs Valleys to the east and from part of Highways 29 and 175. It will be partially visible from the vicinity of Anderson Springs, Middletown, and Whispering Pines, although geothermal development is common in the KGRA.

Transmission Lines

Oxy's preferred transmission corridor (westward over the ridge to SMUDGE0 #1) will be visible from the valleys to the east. However, the preferred route would be less visible than the alternate route which would traverse the ridge to the south-southwest.

Leasehold and Cumulative Impacts

Cumulative geothermal development (Oxy #1 and others) in this watershed will degrade the water quality of Anderson Creek. Anderson Creek mainly provides recreational waters for local residents, so the visual impact of increased sediment and pollution may lessen the creek's recreational appeal.

V. IRREVERSIBLE ENVIRONMENTAL CHANGES AND IRRETRIEVABLE COMMITMENTS OF ENERGY AND MATERIALS

Environmental categories not listed have no irreversible changes.

AIR QUALITY

During the 30-year lifetime of the plant, there will be a limited contribution to pollutant concentrations in the ambient air. Once the plant is decommissioned and the steam wells are no longer producing, the contributions to air pollution will cease. Thus, air quality will not be affected permanently and irrevocably, but it will be affected during the lifetime of the project.

HEALTH

CEC staff cannot determine from available data whether plant emissions will cause irreversible adverse health effects, but adherence to existing health standards on regulated pollutants should render impacts from regulated pollutants insignificant. Monitoring nonregulated pollutants and their effects will determine the need for additional abatement.

SOILS

During construction and for about three years afterward, an as yet unknown amount of soil will be lost because of power plant construction and subsequent erosion.

Oxy's full field development will remove vegetation and disturb soils on approximately 50 acres, or 9 percent, of the leasehold. Ordinarily, the amount of disturbance proposed by Oxy would not be alarming, but in this case the disturbance will occur close to creeks, on highly erodible soils, at the very top of a watershed which supplies both recreational and domestic waters to the downstream water users. CEC staff concludes that the Oxy development will cause some loss of soil and vegetation but that Oxy has mitigated adequately to prevent soil erosion from the full development from degrading the quality of the main domestic source of water for Anderson Springs. Nevertheless, Anderson Creek, which has recreational value, may receive incremental sediment deposition. Oxy will participate in a program to monitor the effects of such deposition into Anderson Creek.

HYDROLOGY/WATER QUALITY

Based on average water consumption rates for other geothermal developments, staff estimates that Oxy will irrevocably commit approximately 4.5 million gallons (nearly 14 acre-feet) of water to the project. Of this, about 3.5 million gallons will be used during construction; Oxy will need the remaining 1 million gallons for initial charge to the cooling towers. Beyond construction and initial startup, Oxy will need less than one acre-foot of water per year to operate the power plant. This make-up water will be taken from the condensate.

Oxy will purchase water for the plant and for steam field development from outside sources. They will not use water from within the leasehold nor will they purchase water taken from either Anderson or Gunning creeks without the express permission of USGS and the local water master.

Oxy's leasehold is located at the top of the Anderson Creek watershed. Full field development may impact both Anderson and Gunning creeks, although the degree of impact is uncertain. The presence of geothermal development at the top of the watershed will irreversibly commit the watershed to geothermal development and will inevitably subject downstream users to potential impacts from such development.

Accidental Spills

If chemicals used in the H₂S abatement process were to spill and reach surface waters, they could cause adverse effects on the aquatic biota and recreational appeal of Anderson Creek. The health of those few families which use Anderson Creek as a source of domestic water could be adversely affected in case of a toxic spill. The entire power plant will be bermed adequately to hold the maximum possible spill, and Oxy will dispose of hazardous and toxic materials according to regulation. The proposed design, construction, and operation measures should serve to adequately mitigate against the possibility of adverse effects from accidental spills on site. Due to the location of the sumps and power plant, staff find it unlikely that any toxic materials would enter Gunning Creek as a result of ground failure on the Oxy development. Oxy has agreed to fund safeguards which will help protect the existing domestic water supply from potential pollution from toxic truck accidents where Socrates Mine Road crosses Gunning Creek.

BIOLOGY

Vegetation

Construction of the power plant and appurtenant facilities will remove approximately 21 acres of vegetation, and the full field development may take as much as 51 acres. Staff does not expect any species of particular environmental concern (rare, protected, endangered, etc.) to be lost.

Oxy intends to operate the power plant for at least 30 years. If at the end of that time it is decommissioned, the facilities will be removed and the site revegetated.

Wildlife

The loss of vegetation from about 9 percent of the leasehold will result in similar reductions in wildlife habitat. These reductions will persist for the lifetime of the power plant. (Current projections by Oxy are for 30-years of plant life.) When and if the power plant is decommissioned, the lease conditions require that with concurrence of the surface owner the leasehold be returned to its natural state.

The internal access road within the leasehold crosses Anderson Creek and leads out to well pad B which is located within 160 feet of Gunning Creek. The road and well pad encroach on the riparian protection zone proposed by BLM in 1978. Riparian habitat is particularly important to fish and wildlife in this area because it provides a source of water. CEC staff considers it likely that the fully protected ringtail occupies riparian habitat within the leasehold. Oxy should conduct studies to determine the presence of ringtail and whether

encroachment on the riparian habitat will have either a permanent or adverse impact.

ENERGY AND MATERIAL RESOURCES

Geothermal Resources

The Oxy geothermal plant will irreversibly consume 1,600,000 lbs/hr of geothermal steam. CEC staff estimates that by 1986 as many as 24 geothermal power plants may operate in the KGRA and will consume an estimated 28,305,000 lbs/hr of steam.

Reduction of the geothermal steam reservoir may occur; if so, the impact could be significant, particularly in view of the cumulative geothermal development in the KGRA. Because the size, extent, and natural recharge rate of the steam reservoir are unknown, the potential rate of depletion is also unknown. To some extent, reinjection of geothermal fluids and steam condensate may mitigate this hazard, but the extent of possible mitigation is also unknown. Depletion of the geothermal resource would be a significant environmental change if the steam reservoir is not adequately recharged.

Other Energy Inputs and Material Resources

Implementation of this project would entail the commitment of the workers' time to construct it and a portion of the useful life of the equipment that could otherwise have been used to implement a different project. Considering the available supply, an insignificant amount of fossil fuel will be consumed for construction and operation of this project.

Much of the material used in the project such as concrete would be irreversibly committed, but some portions, such as various systems, components, and equipment, or structural steel, expensive metal alloys, and catalysts, may be reused. Fossil fuel used would be irretrievably committed.

LAND USE AND AESTHETICS

The commitment of the leasehold area to geothermal development will likely be an irreversible change. Other land uses will be permanently precluded in the area. The aesthetic impacts of the facility will also be permanent. However, if the project is eventually decommissioned, the area could be used for recreation and wildlife habitat, and if the facility is removed and the site revegetated, the aesthetic impact will be substantially reduced. Cumulative land use impacts in the KGRA may be irreversible, since areas once developed typically remain that way. Even if plant facilities are removed and sites are revegetated, roads would remain providing access to formerly undisturbed wildlife habitat.

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

SHORT-TERM USES

The project provides short-term employment and other fiscal benefits to individuals in Sonoma and Lake counties. It will also cause stress on some of the public services and facilities such as schools and roads, especially during the construction phase of the project. It may also cause stress on the water supply system for the Anderson Springs community due to the potential to degrade the raw water; however, the extent of this possible impact is uncertain and should be viewed more appropriately within the context of cumulative impacts of current and further geothermal projects within the watershed.

With respect to water quality, trade-offs exist between the long-term (30-year) benefit of 80 MW of preferred geothermal energy versus the immediate impairment of beneficial uses and potential degradation of the waters in Anderson and Gunning creeks.

The Oxy #1 power plant, operating at 88 percent capacity, will generate 6.167×10^8 kWh/yr. The value of the output at 27.3 mills (2.73 cents) per kilowatt-hour would be \$16,835,910 per year.

The revenue to the federal, state, and county treasuries, based on a 12.5 percent royalty, would be :

Federal - \$2,104,489 minus 50 percent for the State =	\$1,052,244
State - \$698,798 minus 40 percent for the County =	631,347
County =	420,898
	<hr/>
	\$2,104,489

The economic advantage is apparent, since the estimated costs of protecting the Anderson Springs water system varied in capital costs from \$400,000 to \$1,000,000 with annual operational costs of \$40,000 to \$170,000.

If geothermal developers in the Anderson and Gunning creeks watersheds are unsuccessful in controlling erosion and sedimentation, however, the environmental and economic costs could escalate and last longer. Soil eroded from geothermal sites could contribute to surface water quality degradation and channel siltation all the way to Lake Berryessa and throughout the Anderson and Putah creeks system.

LONG-TERM PRODUCTIVITY AND CUMULATIVE IMPACTS

The proposed Oxy #1 project will offer long-term (30 or more years) benefits by providing electricity to the PGandE service area, while allowing PGandE to further diversify its electrical generation resource base. The proposed project will have potential long-term (greater than the life of the project) adverse effects on vegetation, wildlife, land use, aesthetics, and the geothermal resource (see Irreversible Environmental Changes Section). Because use of geothermal resources for electrical generation is relatively new, the significance of some of its effects is unknown, including the potential health effects of long-term exposure to varying concentrations of hydrogen sulfide and other potentially deleterious components of geothermal steam and emissions and the long-term production capacity of the KGRA.

If the steam for the project proves to be a reliable long-term source for electrical power, the benefits of development will be long term, but the adverse impacts could also increase proportionally.

VII. GROWTH-INDUCING IMPACTS

Geothermal development in the KGRA has induced some growth in Napa, Mendocino, Lake, and Sonoma counties. Roads in the latter two counties are affected, while the public schools in Lake County have been particularly impacted by the influx of geothermal workers' families. Impacts of this type are cumulative in nature, so, while the Oxy #1 proposal would contribute growth impacts to both counties, it would not be the sole source. All geothermal developments contribute to growth within the counties; although the impacts are somewhat dispersed, so far Lake County has demonstrated the greatest geothermal related impact on their schools.

To mitigate the more drastic impacts to Lake County, Oxy offers to provide construction workers with a van pool for transportation to work in Lake County. Designed to provide workers with incentives to locate in Sonoma County, the proposed transportation program will shift craft union workers to the Sonoma County site of the KGRA. Additionally, the school districts in Lake County can apply for monies made available through AB 1905 to further mitigate impacts to the schools. Regarding impacts to County roads, Oxy entered into an agreement with Lake County to pay for their proportionate share of cost to upgrade Socrates Mine Road.

VIII. ALTERNATIVES TO THE PROPOSED PROJECT

There are a wide variety of potential alternatives to the proposed project power plant. These alternatives assume that the basic need and purpose of the project is to supply 80 MW net of baseload generation capacity by May 1984. The alternatives are no project, alternative location, alternative facilities, alternative size, alternative designs, alternative means of accomplishing project objectives, alternative transmission facilities, alternative steam gathering facilities, and alternative uses of geothermal steam.

NO PROJECT

The Oxy #1 power plant would generate 615 million kilowatt-hours (kWh) of energy each year (based upon an 88 percent capacity factor). Denial of this project will impede state efforts to diversify power sources and expedite geothermal development in order to increase reliability and reduce dependency on fossil and nuclear based electrical generation.

ALTERNATIVE LOCATIONS

The location of a geothermal power plant is limited to areas containing proven geothermal resources within a designated leasehold and to specific areas within that leasehold in regard to topographic and geologic features and environmental concerns. In addition, Oxy should locate the power plant at a distance no greater than one mile from each geothermal steam supply well. Transport beyond this distance causes the steam to lose the temperature and pressure required to efficiently operate the steam turbine.

Oxy selected their proposed and alternative sites based on the site selection criteria* listed below:

SITE SELECTION CRITERIA

Category I (Mandatory)

- o On the leasehold.
- o Slope less than 2:1.
- o Adequate space available.
- o No geologic hazard (fault, landslide).

Category II (Avoid or Mitigate)

- o Rare and endangered species.
- o Critical habitats.
- o Sensitive paleontological, archaeological, or ethnic areas.
- o Adverse atmospheric dispersion characteristics.

*Oxy #1 AFC, Table 1.1-1.

Category III (Evaluate)

- o Mineral resources.
- o Earth work required for site preparation.
- o Site development costs.
- o Central location to minimize steam lines.

The major factors determining potentially suitable sites are the topography (slope) and geologic hazards such as landslides and faults. These combined with the other criteria resulted in only two potential site areas, labeled "preferred" and "alternate Site 1" on Alternative Site Selection, Figure 1.

Both the preferred and the alternative sites are near the ridgetop, which may correspond with favorable atmospheric dispersion characteristics. As discussed in the appropriate Biology and Cultural Resource Section of the AFC, the other criteria of Category II are satisfied. As discussed in AFC Section 1.1.2 (Site Selection), the choice between the two potential sites was resolved on the basis of the least amount of earthwork necessary and the best overall site stability as determined by geological investigations.

Based on these considerations, Oxy determined that the most stable site would be "preferred". CEC staff concurs in this determination.

ALTERNATIVE FACILITIES

The primary determinate for consideration of alternative facilities is the time required for planning, design, licensing, and construction of an alternative facility in relation to the date when the electricity is scheduled to be on line. Due to the long lead times required to construct coal-fired, nuclear, and hydroelectric generating plants, these types of plants are not considered as feasible alternatives to the project.

New energy sources such as fuel cells, solar, tidal energy, magnetohydrodynamics, and wind power have limited applications, may not be commercially available within the necessary time frame, and would not provide sufficient base load reliability comparable to this project. Oil-fired generating plants such as combined-cycle units, the repowering of existing generating plants, and cogeneration are all possible alternatives because the lead time required from planning to operation varies from slightly less to a little more than the time required for a geothermal project. However, using fuel oil for combustion purposes is contrary to the federal Powerplant and Industrial Use Act, which precludes the use of fuel oil for new generation facilities with only a few exceptions.

ALTERNATIVE SIZE

Oxy proposes to build a power plant which will generate a net of 80 MW. Geothermal power plants of a smaller magnitude are feasible, but they do not significantly reduce the initial environmental loss due to power plant construction. Therefore, an optimal design is desirable. Geothermal power plants can be large or smaller in size. In The Geysers KGRA, the PGandE

Source: Oxy #1 AFC, 1981

LEGEND

	SLOPES GREATER THAN 2:1		THRUST FAULTS
	LANDSLIDES		WELLPAD AREAS
	CONTACT FAULTS		SITING AREAS

FIGURE 1: LEASEHOLD-Alternative Site Selection

Geysers Unit 13 power plant currently produces 135 MW, the largest in The Geysers. PGandE's Geysers Unit 17 and 18 (recently certified by the Commission) and its proposed Geysers Unit 16 are all rated at 110 MW. Some geothermal plants, such as PGandE Unit 15 and the DWR Bottle Rock project, are each 55 MW. The smallest power plant in The Geysers is PGandE Unit 1, which produced only 11 MW.

The components of a geothermal generating facility which allow some flexibility of design are the cooling systems, hydrogen sulfide abatement systems, and turbine design.

Oxy's current design will use 1,600,000 lbs steam/hr. to generate a net of 80 MW. If Oxy would adopt an improved turbine design, CEC staff believes that Oxy could:

- A. Use 1,200,000 lbs steam/hr to generate 80 MW net, and that more efficient use of steam would allow Oxy to,
- B. Extend the life of the power plant by approximately six years, or
- C. Using the current 1,600,000 lbs steam/hr, with improved turbine efficiency, Oxy could generate a net of 107 MW. Although such a design would result in higher net generation, it would not extend the life of the plant beyond Oxy's current projection of 30 years.

Proposed Cooling System

The proposed cooling system is comprised of a surface condenser, which condenses the steam exhausted from the turbines, and two five-cell, fan-assisted, wet-type cooling towers, which cool the water heated during its passage through the surface condenser.

Prior to start-up of the power plant, the cooling system will be charged with approximately 1,000,000 gallons of water. Oxy will purchase this water from outside the leasehold. Once the power plant is in operation, the initial start-up water lost during the evaporative cooling process at the cooling tower will be supplemented by steam condensate from the surface condensers. Excess condensate not needed to replace cooling water lost through evaporation and draft emissions will be reinjected into the steam reservoir.

Alternative Cooling Methods

- o Direct Contact Condenser--This system has been used by PGandE in their Geysers Power Plant Units 1 through 12. In this cooling method, steam exhausted from the turbines is mixed directly with the cooling water and then pumped to the cooling tower. The initial cost of this system is less than a surface condenser, but it does not give the degree of H₂S partitioning that can be achieved with the surface condenser in conjunction with the Stretford process for H₂S abatement.
- o Air-Cooled Condenser--With this system, the exhaust steam from the turbines is condensed in a tubular type of heat exchanger by air passing

over the tubes. This system has three major disadvantages: large size, greatly increased cost, and decreased operating efficiency. An air-cooled condenser requires an extremely large surface area in order to be effective, and the chemical and physical properties of the steam in The Geysers require use of higher cost materials, thereby increasing costs. The efficiency of the power plant and Stretford H₂S abatement unit would probably be reduced because of size factors associated with an air-cooled condenser, which would increase turbine back-pressure much of the time.

- o Closed Cycling Cooling—The cooling water, in a closed-cycle system, circulates within a closed system using surface condensers and indirect contact, water-to-air, "dry" cooling towers. All the condensate would be reinjected if such a system were used for the proposed plant site. The noncondensable gases in the steam would still have to be removed from the condenser and treated to comply with air quality standards. However, complete reinjection would eliminate H₂S emissions that occur in direct water-to-air contact type towers.

The use of a closed-cycle cooling system would approximately double the total cost of the proposed power plant. The capital cost of a closed-cycle system could be reduced by reducing the capacity of the plant during the summer peaking period, but this would reduce the value of the generating capacity.

- o No Cooling System—In this system, the turbine exhaust steam is discharged directly to the atmosphere from the turbine and requires no cooling. This system was considered in early geothermal power cycle studies but was found to be very inefficient due to the level of back pressure in the turbine units. In order to generate the same amount of power much more steam is required per unit of power generated. Direct discharge of the exhaust steam to the atmosphere also requires consideration of noise mitigation and would not comply with air quality standards.
- o Once Through Cooling System—Use of this system would eliminate the need for a cooling tower but is not considered for the Oxy #1 project since the large water supply required is not available in The Geysers areas nor within economically reasonable transport distance.
- o Natural-Draft Cooling Tower—A natural-draft cooling tower is not practical for a power plant of this size, since it would have to be very large to create the required air flow. In addition to creating greater visual impact, the large natural-draft towers would also compound the difficulty of locating satisfactory plant sites in the mountainous terrain of The Geysers KGRA. The cost of this type of tower is several times greater than the cost of the proposed mechanical-draft cooling tower.

Proposed H₂S Abatement Systems

Oxy will use the combination of improved surface condenser turbine by-pass devices to deal with occasional steam venting conditions* and Stretford chemical scrubbing process to initially reduce the H₂S emissions. Further reduction of H₂S emissions, if required by the APCO in the Determination of Compliance, will be accomplished with a secondary abatement system using hydrogen peroxide with catalyst.

o The Stretford Process

The Stretford and H₂O₂ abatement systems scrub the steam once it is exhausted by the turbine. After leaving the turbine the steam condenses and splits into two flow paths. One path contains gaseous chemical constituents including H₂S, while the other flow path contains liquids. The gas flow path contains the majority of the H₂S. This gas stream passes through the primary abatement system which employs the Stretford chemical scrubbing process to treat the H₂S.

o H₂O₂ with Catalyst

The second flow path contains liquids resulting from the condensed steam and includes chemical constituents such as H₂S which are absorbed by the liquid. This second path containing the smaller amount of H₂S, also requires treatment in order for the plant to meet H₂S emission standards. SMUD's secondary abatement system will employ hydrogen peroxide with a catalyst to promote a high H₂S removal efficiency.

o Turbine By-Pass

As part of the overall H₂S abatement system, a piping system will be installed to divert steam around the turbines to the surface condensers during plant start-up or shut-down conditions. This will give the steam access to the abatement systems; without this system, steam would vent into the air untreated.

Alternative H₂S Abatement Systems

- o The Metal Catalyst System—Hydrogen sulfide dissolved in water, in the presence of air and at normal temperatures, is unstable and undergoes oxidation to form free sulfur. This reaction is ordinarily slow but can be accelerated by use of appropriate catalysts such as dissolved ferric ion. In the process the ferric ion is regenerated so that more hydrogen sulfide is oxidized. The iron concentration in the cooling water is maintained at 30 ppm by weight or higher. The condenser off-gas is released in the cooling water so that its hydrogen sulfide content is

*Steam venting occurs during plant start-up or shut-down. This condition, known as "stacking," would send untreated steam into the air unless corrective measures are taken.

also oxidized. The major problems associated with the iron catalyst system are corrosion of metal parts in contact with the cooling water and rapid accumulation of sludge.

A metal catalyst, supplemented either with hydrogen peroxide or with caustic soda, is being used at PGandE Units 3 and 6 and Unit 11. This system will also be used at other PGandE Units only during H₂S episodic alert days.

PGandE reports that they have achieved 90 percent abatement in their existing direct condenser units by use of high concentrations of iron catalyst. However, systems using this form of abatement experienced serious operational problems which caused reduced reliability due to sludge formation and induced corrosion. By using an iron catalyst with their H₂O₂ system, SMUD can probably avoid such reliability problems. This is due to the small quantities of H₂S as well as the nature of the catalyst itself.

- o Sulfur Dioxide pH Control--Injection of sulfur dioxide (SO₂) into the condensate to control the pH of the condensate and to displace the H₂S dissolved in the condensate is an attractive method for reducing the amount of H₂S in the condensate. Sulfur obtained from the Stretford process could be burned to provide a readily available source of SO₂.

Significant development and prototype testing remain to be done on this system before it can be adapted for commercial use. However, if the Stretford process does not provide the necessary H₂S abatement, the use of sulfur dioxide pH control should be considered and evaluated as a secondary H₂S abatement method.

Other H₂S abatement systems which have been or could be used are discussed below. Most have proven ineffective or have been displaced by the Stretford and surface condenser/partitioning process.

- o Condensate Stripping and pH Control

SMUD on its SMUDGEO #1 project and Occidental Geothermal, Inc., on its Occidental Geothermal Plant #1 are investigating two alternatives to the Hydrogen Peroxide abatement process to treat condensate--the Condensate Stripping process and the Condensate pH Control process.

The petroleum industry has successfully used the Condensate Stripping process (with an inert gas) to remove H₂S dissolved in water. The H₂S removal efficiency of the Condensate Stripping process is expected to be in excess of 85 percent. This is based on a computer model used in a report entitled "A New Correlation of NH₃, CO₂, and H₂S Volatility, Data from Aqueous Sour Water Systems," published in the American Petroleum Institute Publication No. 955, 1978. The Condensate Stripping process is an alternative proposal which would boost the partitioning efficiency obtained in the surface condenser. Additional H₂S liberated from the condensate would be treated by the Stretford process.

Various utilities are investigating the Condensate pH Control previously suggested by PGandE. This control has not yet been utilized for geothermal applications. Theoretically, this control will increase partitioning efficiency of H_2S in the condenser housing. SMUD has indicated that there is little supporting data available to allow design calculations for this process. PGandE has used caustic soda ($NaOH$) in conjunction with H_2O_2 in some of their existing plants where direct contact condensers are used instead of surface condensers. PGandE is conducting investigations into Condensate pH Control, using direct injection of ammonia into the condenser. SMUD's approach is to utilize the abundant CO_2 in the noncondensable gas stream to produce carbonic acid (H_2CO_3). This reaction takes place in a CO_2 absorption tower. The carbonic acid is then recycled back to the condenser where it is sprayed into the condenser neck to cause both a desorbing of H_2S already in the soluble form of ammonium bisulfide and the lowering of pH to prevent more H_2S from becoming dissolved in the condensate (i.e., increase partitioning).

o EIC Process

This process is one that can treat steam upstream of the power plant. It removes the H_2S in the steam by a scrubbing process similar to the Stretford process. It uses a chemical solution whose main constituent is copper sulfate. The system has not been used commercially; however, it has undergone pilot plant testing on one well at the PGandE Unit 7 plant in The Geysers under a development contract funded by the DOE. The attractive features of the process appear to be:

- (a) Potential for high H_2S abatement efficiency and partial removal of other desirable steam constituents.
- (b) Potentially superior combined capital/operational cost aspects than the Stretford and hydrogen peroxide system combination costs.
- (c) Regeneration capability of the chemical solution in the scrubbing process.
- (d) Potentially cleaner steam supply to the power plant, which in turn reduces potential problems or maintenance at the plant.
- (e) H_2S abatement capability in a steam stacking process.
- (f) Waste that is generated in the EIC process is joined with the cooling tower purge stream to be reinjected.
- (g) Potential for retrofitting existing power plants.

The unknown aspects are:

- (a) Actual abatement efficiency as a commercial process.
- (b) Reliability of the system.

(c) Carry-over of chemical products to the power plant that may be detrimental to the plant.

(d) Total costs.

Although the EIC process has not been used commercially, the Department of Water Resources Bottle Rock project in Lake County, received CEC certification based on the use of the EIC process. The H₂S concentration for the Bottle Rock project is so high that the EIC process was required in addition to two other abatement techniques. Recent information from DWR indicates the capital cost of the EIC process may be exceptionally high, which may affect the viability of the process. Oxy #1 does not have such high H₂S concentrations; so Oxy can reduce its emissions adequately using only Stretford and H₂O₂ with catalyst.

- o Steam Converters--An old geothermal industry process, the steam converter, was the only effective way of reducing the high gas content of the steam. However, the process seriously degrades the quality of the steam, and nearly double the mass of steam is required to produce the same amount of power as unconverted steam.
- o Preplant Oxidation--PGandE has briefly experimented with the injection of oxygen (O₂) into the incoming geothermal steam, upstream of the turbine units. The results were not encouraging, since injection of twice the amount of O₂ theoretically required for full oxidation only caused an H₂S reduction of 5 percent. Upstream injection of H₂O₂ has also been tried but with poor results.
- o The Burner-Scrubber System--This system mixes the condenser off-gases with air and burns them. The system was used on PGandE's Unit 4 but was discontinued because it was unable to reduce H₂S emissions by more than one-half of that required and because the off-gases are only marginally flammable.
- o The Deuterium Process--The Deuterium Corporation has installed and tested a liquid absorption type of scrubber to remove H₂S from a portion of the incoming steam at PGandE's Unit 7. Details of the process are considered proprietary information, but early test results indicated 90 percent or better H₂S abatement. There were problems associated with regeneration of scrubber solutions which have yet to be resolved.

ALTERNATIVE TRANSMISSION FACILITIES

TRANSMISSION ROUTES

Oxy will construct a double circuit transmission line from the proposed power plant to an existing 230 kV transmission line in The Geysers. Oxy proposes to string one circuit initially. Oxy identified two alternative termination points in The Geysers at which to terminate their tapline--a preferred and an alternative (see Transmission Figure 1).

THE PREFERRED ROUTE

The preferred tapline route would terminate on the recently certified SMUDGE #1 double circuit tapline, which is scheduled for completion in 1983. The preferred route would require three (3) transmission towers and would be constructed within 4,700 feet of new right-of-way between the Oxy site and the SMUD Tower C-2. When SMUD builds their tapline they will string only one of the two circuits. When Occidental constructs their tapline, the second circuit of the SMUDGE #1 tapline will be strung for Towers C-2 and C-3 to the PGandE line.

The tap itself would be 4,700 feet long and would use 1,800 feet of the SMUD tapline.

Oxy will locate each of the proposed tower locations near an existing access road, so that no new access roads would have to be constructed.

THE ALTERNATIVE ROUTE

Oxy also identified an alternative tapline which would be 5,400 feet long and would terminate on the existing Unit 13 tapline, approximately 3,000 feet from the collector line. This alternative route would require four (4) transmission towers and approximately 2,300 feet of new access road.

Comparison of Preferred and Alternative Routes

The preferred route (1) requires less transmission construction and new right-of-way (4,700 feet as compared to 5,400 feet), (2) requires no new access roads (compared to 2,300 feet for the alternative route), (3) is preferable aesthetically, (4) has comparable transmission losses and overall costs compared to the alternative route, and (5) would require less disturbance of vegetation than the alternative and would therefore result in reduced potential for soil erosion and impact to wildlife species.

Comparison of Conductor Sizes

Oxy originally proposed to use 795 kcmil ASCR conductors. They have subsequently evaluated the following conductor sizes:

- (1) 795 kcmil bundled*
- (2) 1113 kcmil
- (3) 1113 kcmil bundled
- (4) 1431 kcmil
- (5) 1431 kcmil bundled

*Two conductors per phase.

OXY GEOTHERMAL #1

Source: Oxy #1 AFC

LEGEND

- OXY SITE
- × PROPOSED OXY TOWER SITES
- ▲ PG&E UNITS
- △ EXISTING PG&E TOWERS
- SMUDGE=1
- PROPOSED SMUD TOWERS
- EXISTING ROADS AND TRAILS
- - - PROPOSED TRANSMISSION
- ... PROPOSED ACCESS ROADS

FIGURE 1: TRANSMISSION-Proposed and Alternate Transmission Routes

These calculations indicate that 795 kcmil, 795 kcmil bundled, and 1113 kcmil have comparable costs, when considering transmission losses. Oxy considered the alternative conductor sizes, but rejected them as they felt that additional initial cost did not justify the minimal lifetime savings.

Transmission Structures

The Applicant proposes to use steel lattice towers (see Transmission Figure 2). Although the Applicant could propose steel pole type towers, only steel lattice type towers have been used to date in The Geysers. In addition, most observers consider the lattice type towers to blend into the natural environment better than the pole-type structures which may be more visible against the brush and tree covered hillside. Also, the lattice type structures are generally superior in regard to structural stability in the unstable terrain typical of The Geysers. In building their transmission structures, Oxy will comply with the following provisions (81-AFC-1, p. 8 - 6):

FAA-49 USCA 1348
14 CFR, Part 77

FCC-47 USCA 151 et seq.
47 CFR, Part 15.25; and

California Division of Aeronautics--PUC 21655 et seq.
21 CAL 3500 et seq.

An underground, low pressure, oil filled, self-contained cable could be used as an alternative for the overhead transmission line. This underground cable has generally not been used in The Geysers area. It is quite expensive--approximately five to ten times as expensive as overhead transmission. Underground transmission would require excessive cleaning, grading, and trenching. Undergrounding the proposed transmission line would reduce the visual impact and physical obstruction, but the greatly increased cost and potential effects of erosion or slope failures on cable reliability make this an undesirable alternative.

OXY GEOTHERMAL #1

DOUBLE CIRCUIT 230 kV TOWER

Source: Oxy #1 AFC

FIGURE 2: TRANSMISSION-Transmission Structures

ALTERNATIVE MEANS OF ACCOMPLISHING PROJECT OBJECTIVES

Energy Conservation

The discussion of need in the chapter on "Project Description" refers to the Energy Commission's adopted forecast for energy and peak demand. The forecast incorporates some conservation measures. New and expanded measures are being implemented by PGandE in an effort to reduce electrical demand in the PGandE service area, which Oxy's 80 MW generation will help serve.

Geothermal base load electrical generation is specified by the Energy Commission as a "preferred" technology (CEC, 1978) and is relatively cost effective compared to other alternative electrical generation technology. Conservation is an alternative technology that would be more applicable as an alternative to other less preferred and less cost-effective forms of electrical generation.

ALTERNATIVE STEAM GATHERING FACILITIES

Alternative Structures

In order to maintain the high temperature of the geothermal steam, it must be transported in insulated pipes. Physical and chemical properties of the steam resources constrain the types of materials feasible for use in construction of the gathering steam. Since the steam often carries solid debris and other foreign materials which settle out as the steam is transported, the steam gathering system must have vents and centrifugal filters at intervals along the pipeline. These vents and traps must be accessible for periodic cleaning and maintenance. For these reasons an above-ground construction of the steam gathering system is preferred.

Alternative Routes

In order to maintain the maximum usefulness of the natural steam resource, the distance between the steam supply and the power generating facilities must be minimized. The exact location of the steam supply pipelines and support towers associated with the Oxy #1 project are listed in the federal environmental documentation identified in the SUMMARY portion of this document, under "Steamfield." The policy of the federal agencies which manage steam development within the proposed project leasehold is to encourage the lessee of the lands to route the steam gathering system along the existing system of access roads constructed during the development of the geothermal resource. Oxy also prefers to route the gathering system along already existing roads, since it provides easier access for maintenance of the system and reduces costs. As the steam developer, Oxy has constructed an access road within the leasehold which fulfills this purpose.

ALTERNATIVE USES OF GEOTHERMAL STEAM

In addition to its use for electrical generation, geothermal steam can be used for a variety of domestic and industrial processes. Typically, these processes depend on a resource with a 100° to 150° temperature range, which is considered "moderate." Direct heating uses of geothermal energy include water

heating, space heating and cooling, food processing, refrigeration, and process-heating applications. The most common of these uses are direct heating for buildings or for industrial dehydration processes. The most efficient uses of this heat require that the user be not more than a mile away from the resource due to heat loss in transportation, and there are not residences within this distance. Geothermal resources above 150°C are considered to be potential for commercial power production; these additional temperature resources could also provide process heat to favorably located industries. The steam resources at The Geysers are about 250°C.

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APPENDIX B-1

POTENTIAL HEALTH EFFECTS OF GEOTHERMAL POLLUTANTS

AIR POLLUTANTS

Geothermal steam contains contaminants which, when inhaled or ingested in sufficient quantities, can adversely impact human health. These include regulated pollutants, such as hydrogen sulfide (H_2S), radon-222, and particulate matter, and nonregulated pollutants such as ammonia, mercury, arsenic, and boron. Abatement systems also emit varying amounts of pollutants such as vanadium, anthraquinone disulfonic acid (ADA), hydrogen peroxide, iron, sodium carbonate, sodium sulfate, and sodium thiosulfate. Some of these pollutants can react in the ambient air to form secondary pollutants such as sulfur dioxide and sulfates.

The potential for adverse impacts to public health depends on (1) the toxicity of the emitted contaminants, (2) the concentration or quantity to which the public is exposed by inhalation of polluted air or ingestion of contaminated drinking water or food, and (3) the duration of that exposure. The following discussion addresses potential adverse human health impacts associated with these contaminants.

REGULATED POLLUTANTSHydrogen Sulfide (H_2S)

Hydrogen sulfide is a toxic gas which can be fatal to humans when inhaled in concentrations of 1,000 ppm and above for several minutes (NIOSH, 1977). Longer exposure to lower concentrations can also be fatal. In concentrations above the state occupational standard of 10 ppm (8-hour average), H_2S causes eye and respiratory tract irritation, lung damage, and unconsciousness. Hydrogen sulfide levels below 10 ppm may induce decreased corneal reflex, nausea, insomnia, headaches, loss of sleep, and other symptoms (Walton and Simmons, 1978). The effects of exposure to various concentrations are summarized in Table B-1.

Relatively few studies examine adverse health effects from exposure to H_2S at low concentrations (less than 0.1 ppm) such as those measured in populated areas around The Geysers KGRA. The small number of relevant studies and questions concerning the validity of results from some of these studies leads to controversy regarding the potential for adverse effects from H_2S at low concentrations.

Some experts do not believe that exposure to concentrations below one ppm adversely affects human health (Simmons, 1979). The State of Montana recommends an H_2S standard of 0.05 ppm based on reported health effects (MAQB, 1980). The Canadian Ambient Air Quality objectives include a proposed maximum desirable level for H_2S of 0.66 ppb (1-hour average), and proposed maximum acceptable levels of 3.6 ppb (24-hour average), and 10.8 ppb (1-hour average) (Katz, 1980). The lowest concentration accepted by other experts as inducing adverse health effects is 0.08 ppm (IIEQ, 1974), almost 3 times greater than the California ambient air quality standard for H_2S ; chronic exposure to

TABLE B-1

HUMAN HEALTH EFFECTS OF HYDROGEN SULFIDE

ppm*	Health Effects	Reference
0.00047- 0.0045	Odor threshold	Leonardos, 1969 Wilby, 1969
0.007- 0.03	Slight odor	Gurinov, 1952
0.03	California ambient air quality standard for one-hour average (concentration based on the odor threshold)	ARB, 1970
0.04- 0.13	Clear definite odor	Gurinov, 1952
0.08	Increased incidence of mental depression, dizziness and blurred vision	IIEQ, 1974
0.30	Increased incidence of nausea, insomnia, shortness of breath and headaches with chronic exposure	Indiana APCD, 196
0.7-7	Incidence of decreased corneal reflex with chronic exposure	IIEQ, 1974 Rubin, 1975
4.6	Readily apparent, offensive odor	Simson, 1971 Yant, 1930
10	Threshold limit value for 8-hour exposure at the work place	ACGIH, 1977
10- 50	Threshold for irritative action with prolonged exposure: eye irritation such as conjunctivitis and at the higher concentrations dry throat. Fatigue, loss of appetite and insomnia with chronic exposure	Ahlborg, 1951 Gurinov, 1952 NIH, 1941
20- 30	Very strong, but not intolerable odor	IIEQ, 1974 Yant, 1930
70- 150	Eye irritation after several hours of exposure; conjunctivitis, keratitis and photophobia. Threshold for olfactory paralysis occurring within minutes	Devege, 1956 Evans, 1967 Mitchell, 1925 AIHA, 1963
200- 300	Serious local irritation to eyes and respiratory tract caused upon inhalation for one hour, with possible subsequent pulmonary edema. This is the maximum concentration which can be inhaled for one hour without serious consequences.	Mitchell, 1925 Haggard, 1925

Adapted from Walton and Simmons, 1978

this concentration may cause nausea, fatigue, loss of appetite, dizziness, blurred vision, and increased incidence of mental depression.

Some studies report adverse health effects at exposure levels below 0.08 ppm; the validity of these low level studies, however, is questionable (Weres, 1977; Walton and Simmons, 1978). Nevertheless, the possibility that these low levels can induce adverse health effects calls for further investigation.

Exposure to H_2S may be more harmful to certain groups of individuals than to the general population. These H_2S sensitive groups include infants; individuals with anemia, eye or respiratory problems, and schizoid or paranoid tendencies; and those who have recently consumed alcohol (IIEQ, 1974; Walton and Simmons, 1978).

Hydrogen sulfide's characteristic rotten egg odor can be detected at low concentrations. The odor detection threshold, varying with individual sensitivity, has been reported as high as 0.14 ppm and as low as 0.00047 ppm (Walton and Simmons, 1978). Different experimental techniques, subject training, and difficulties in accurately preparing very dilute hydrogen sulfide concentrations may contribute to the wide discrepancy between reported thresholds. At high concentrations (70 - 150 ppm) hydrogen sulfide causes olfactory paralysis--loss of sense of smell (Weres, 1977; Walton and Simmons, 1978).

The California State Ambient Air Quality Standard for H_2S is 0.03 ppm (1-hour average). Although public health protection was considered, this value was based on the average H_2S odor threshold obtained in a study conducted by the California Department of Public Health (CARB, 1970). In that study H_2S odor thresholds for 16 individuals ranged from 0.012 to 0.069 ppm; the average was 0.029 ppm H_2S . In a report prepared by Lawrence Berkeley Laboratories, Case (1977) states that if the standard is to be based on known odor threshold, "...then the standard should be lowered by a factor of 3 to 5 to the more recently accepted value for the odor perception threshold."

Radon-222

The primary health hazard associated with radon-222 and its short-lived daughter products is inhalation and possible deposition in the lung. Radon-222 itself is usually inhaled and exhaled without deposition on lung tissue. However, the short-lived daughter products of radon-222 (especially those which emit alpha particles) have a high probability for deposition. Deposition of an alpha-emitting substance on the lungs provides a greater potential for temporary or permanent tissue damage from the natural destructive action of the alpha energy.

NONREGULATED POLLUTANTS

Geothermal steam also contains pollutants for which there are no federal or California ambient air quality standards, including mercury, arsenic, benzene, silica, boron, and ammonia. Abatement systems emit ADA, vanadium, hydrogen peroxide, iron, sodium carbonate, and sodium thiosulfate. These substances could cause adverse health impacts if present in sufficient concentrations. Suggested standards and safe levels for these pollutants in air are listed in Table 4, Public Health Impacts.

Ammonia

Ammonia is primarily an eye, mucous membrane, and upper respiratory tract irritant. The lowest reported concentration causing irritation in humans via inhalation is 20 ppm (EPA, 1977). Barely noticeable eye irritation may occur at five ppm (NIOSH, 1974). EPA believes that exposure to low levels of ammonia does not cause permanent adverse health effects (EPA, 1977). The odor threshold for ammonia ranges between approximately 0.7 ppm and 50 ppm (NAS, 1977). A recent study (Larson et al., 1978) reported mean concentrations of ammonia in human breath of 157 ug/m³ (0.23 ppm).

Mercury

Inhalation of mercury compounds can induce cough, fever, bronchitis and pulmonary edema. Accumulation of mercury in the brain, kidneys, and hair causes chronic poisoning with symptoms such as headaches, dizziness, and fever. Children are especially susceptible to mercury poisoning (Britt and Hushon, 1976). Certain mercury compounds may cause cancer or birth defects (EPA, 1977).

Arsenic

Geothermal steam contains arsenic and arsenic compounds in varying forms, such as suspended particulates or vapors. Depending on concentration and form, acute exposure to arsenic may cause headaches, dizziness, numbness, chills and fever, nausea, vomiting, abdominal pain, pulmonary edema, jaundice, and leukocytosis. Chronic exposure may cause irritation to nose and throat, hair loss, tremors, anemia, and cancer of the skin, lung, or liver (Britt and Hushon, 1976).

Boron

Compared with information on other atmospheric pollutants, the medical literature on boron and its compounds is sparse (Waldbott, 1973). Boron and most boron compounds are not highly toxic (Waldbott, 1973; Durocher, 1969), although boron hydrides are rated as highly toxic (Durocher, 1969). Chronic exposure to boron and boron compounds can result in reduced appetite, nausea, weight loss, increased risk of lung infection, central nervous system depression, and kidney injury (Britt and Hushon, 1976). Inhalation of boric acid and boron oxide in the form of dust can cause respiratory irritation but is not likely to induce permanent damage (Waldbott, 1973). Inhaling boron hydrides (boranes) can result in severe central nervous system damage with symptoms including headache, dizziness, drowsiness, convulsions, fever, cough and pneumonia (Wilcox, 1973; Waldbott, 1973); such exposure may also cause death or permanent damage (Durocher, 1969).

Vanadium

Acute exposure to excessive concentrations of vanadium can cause conjunctivitis, skin irritation, chest pain, cough, asthma, pneumonia, nausea and vomiting, headache, and tremor. Effects include hypertension, cardiovascular disease, kidney damage, anemia, emphysema, and pulmonary fibrosis (Britt and Hushon, 1976). Studies suggest that vanadium may be an essential element for some animals, including man, at low concentrations (WHO, 1973).

Anthraquinone Disulfonic Acid (ADA)

Stretford solution contains anthraquinone 2:7 disulfonic acid (PGandE, 1979b), an aromatic compound most commonly used in the dye industry (Stern, 1977). Few sources describe health effects from exposure to ADA. Anthraquinone is a naturally occurring mutagenic compound (Ames, 1979). It has low systemic toxicity to humans, but may cause skin irritation sensitization (The Merck Index, 1968). Anthraquinone 1:5 disulfonic acid and anthraquinone 1:8 disulfonic acid are suspected to have low toxicity (The Condensed Chemical Dictionary, 1972).

Hydrogen Peroxide

Exposure to hydrogen peroxide fumes represents an occupational health concern rather than a public health concern. Hydrogen peroxide is nonflammable but, since it is an oxidizing agent, it helps to support combustion. Hydrogen peroxide, by itself, is not as toxic as when it is in combination with other pollutants such as ozone. Svrbely et al. (1961) reported ozone (1 ppm) combined with hydrogen peroxide at concentrations above 1.5 ppm was lethal to some animals, whereas hydrogen peroxide by itself, in a concentration of 200 ppm, produced only slightly toxic responses.

Iron

Fine iron oxide particulates at high concentrations may cause conjunctivitis, chronic bronchitis, pulmonary fibrosis, and emphysema. Iron oxide can penetrate the walls of the lung bronchi and alveoli without damage to the mucous or ciliary barrier. In this way it can transport other compounds into the lungs (Waldbott, 1973). Ingesting very high concentrations of ferric sulfate causes vomiting, tachycardia, liver insufficiency, and capillary damage.

Sulfates

High sulfate concentrations are associated with increased asthmatic attack frequency, worsened symptoms in cardiopulmonary patients, decreased ventilatory function in school children, and symptoms of acute and chronic diseases in children and adults (Bachman, 1975).

Benzene

Chronic benzene exposure may result in poisoning characterized by blood disorders (leukemia), changes in body organs, chromosomal aberrations, and cancer; acute exposure to benzene has a narcotic effect (EPA, 1977). Benzene can be absorbed through the skin, but inhalation is the usual mode of exposure.

Silica

High silica concentrations, especially crystalline free silica, can cause silicosis, a serious disabling lung disease also affecting the heart.

Asbestos

Inhalation of asbestos particles can cause asbestosis, scarring of the lungs similar to other "dust lung" diseases. Early symptoms, cough and breathlessness on exertion, are often not manifest for 20 to 30 years after the first exposure to asbestosis. Advanced stage symptoms include bluish skin discoloration and restricted chest expansion (Waldbott, 1973).

Prolonged inhalation of asbestos can cause lung cancer, particularly in smokers. Experimental asbestos exposure has produced cancers of the intestine and pulmonary airways (Sax, 1979; Waldbott, 1973).

APPENDIX B-2

POTENTIAL HEALTH EFFECTS OF GEOTHERMAL POLLUTANTS

WATER POLLUTANTS

Geothermal development may degrade drinking water quality due to soil erosion, trucking accidents, petroleum product and other chemical spills, pipeline breaks, and well pad sump failures. The potential for adverse public health impacts depends on (1) the toxicity of the contaminants, (2) the concentration or quantity of contaminants to which the public is exposed, (3) the duration of exposure, and (4) the contaminant removal ability of local water treatment facilities. The following discussion addresses potential adverse human health impacts associated with water pollutants.

Suspended and Settleable Solids and Turbidity

Suspended and settleable solids include materials such as clay, sand, finely divided organic matter, bacteria, and plankton (Britt and Hushon, 1976). Suspended clay particles may absorb toxic chemicals, including metals, radioactive materials, and pesticides, that may be in the water (Britt and Hushon, 1976). Suspended matter also provides surfaces where microorganisms are protected from chlorination, resulting in either higher chlorine demand or, if chlorine levels are not adjusted, greater numbers of viable microorganisms in drinking water. If consumed, toxic chemicals and microorganisms in drinking water can adversely affect human health (see following sections on these contaminants).

Turbid water can interfere with recreational use and aesthetic enjoyment of water. Low visibility in turbid water creates safety problems for swimming and diving (EPA, 1976).

The federal standard is one turbidity unit* (as determined by a monthly average) at the point of entry into the drinking water distribution system (EPA, 1976). Bean (1961) has proposed that for drinking water of ideal quality, suspended matter concentrations be limited to 0.1 mg/l or less.

Recommended limits for industrial uses are 10 turbidity units for baking and 1 to 5 turbidity units for ice making (McKee and Wolf, 1963). In raw water sources for domestic use, levels of suspended solids in streams are generally required by state and regional agencies to be below concentrations that are objectionable or interfere with normal treatment processes (McKee and Wolf, 1963).

*Measurement of turbidity is based upon a comparison of the amount of light passing through the given water sample with that passing through a standard sample (McKee and Wolf 1963).

Bacteria

Coliform bacteria serve as primary indicators of contamination with fecal matter from humans and warm-blooded animals (EPA, 1976). Ordinarily coliforms are harmless, though some strains may cause diseases in humans (McKee and Wolf, 1963). Growth of some coliform bacteria can impart tastes and odors to water due to their own metabolic waste products or by transformation of proteins, sulfates, or other chemicals present in water (McKee and Wolf, 1963).

Bacterial diseases that have been transmitted by contaminated water include intestinal illnesses, such as dysentery and gastroenteritis, and less frequently, tuberculosis and other diseases (McKee and Wolf, 1963).

The transmission of disease by bathing waters has not been established epidemiologically as a major public health hazard (McKee and Wolf, 1963; EPA, 1976). Water containing an average of 0 to 50 coliform/100 ml is considered to be good quality for recreational use (McKee and Wolf, 1963).

Petroleum Products

The potentially deleterious effects of oily substances upon domestic water supplies include (a) health hazards to consumers, (b) foul tastes and odors, (c) turbidity, films, or iridescence, and (d) difficulty of water treatment (McKee and Wolf, 1963).

Petroleum derivatives cause objectionable tastes and smells at concentrations far below human chronic toxicity levels. Therefore, drinking oil-polluted waters is unlikely to cause health hazards because such water supplies would be unfit for human consumption (EPA, 1976; McKee and Wolf, 1963).

H₂S Abatement System Chemicals and Wastes

- o Anthraquinone Disulfonic Acid (ADA)--Very little information is available which describes health effects from exposure to ADA. Toxic effects to animals injected with anthraquinone have been reported (Patty, 1963). Anthraquinone may be toxic to humans, but studies indicate that it is not carcinogenic (Santodonato, 1979).
- o Vanasol--Vanasol is a vanadium compound. Vanadium may be an essential element for mammals (Britt and Hushon, 1976), and in low concentrations reduces the incidence of dental caries in both primary and permanent teeth (McKee and Wolf, 1976). Vanadium is absorbed through the lungs and to a slight extent through the intestine, although it is largely unabsorbed and rapidly excreted (Britt and Hushon, 1976). Vanadium inhibits synthesis of cholesterol and accelerates its catabolism. Long-range effects of vanadium exposure include hypertension, cardiovascular disease, kidney damage, anemia, emphysema, and pulmonary fibrosis (Britt and Hushon, 1976). High concentrations can inhibit growth and cause death (McKee and Wolf, 1963). There is no evidence that vanadium is teratogenic, carcinogenic, or mutagenic (Britt and Hushon, 1976).

The Multimedia Environmental Goal for vanadium in water is 7 ug/l, based on human health effects (EPA, 1977). Vanadium can be fatal to fish in concentrations as low as 4.8 mg/l, 96-hour exposures.

- o Stretford Unit Sulfur Cake and Sulfur Compounds--Elemental sulfur is insoluble in water but may be present in suspension in colloidal state (McKee and Wolf, 1963). Sulfates occur naturally in water as a result of leachings from gypsum and other common minerals. The federal drinking water standard of 250 mg/l sulfates is based on a laxative action toward new users (McKee and Wolf, 1963). The state water quality criterion is 500 mg/l for domestic water supply (McKee and Wolf, 1963).

The federal water quality criterion for sulfides is 2 ug/l undissociated H_2S , based on protection of fish and other aquatic life, not human health. Due to the unpleasant odor and taste of sulfides in water, it is unlikely that people will drink a harmful dose (McKee and Wolf, 1963).

- o Hydrogen Peroxide--Hydrogen peroxide is a strong oxidizing agent and supports combustion, especially in the presence of metallic compounds acting as catalysts (CEC, 1980). Hydrogen peroxide can irritate skin, eyes, and mucous membranes via oral and inhalation routes (Sax, 1979).
- o Iron--At The Geysers, iron catalysts are used in H_2S abatement processes. Humans require a daily iron intake of 1 to 2 milligrams. The state and federal water quality criterion of 0.3 mg/l iron in domestic water supplies is based on prevention of objectionable tastes and laundry staining and is an aesthetic rather than toxicological criterion (EPA, 1976). The taste threshold varies for iron compounds, ranging from 0.04 mg/l for ferrous sulfate to 1.8 - 10 mg/l for ferric sulfate (McKee and Wolf, 1963).

Drilling Wastes

Drilling wastes are a combination of drilling mud and rock cuttings. Drilling mud is predominantly composed of water and bentonite clay with various minor additives including tannins, lignin, chromium compounds, caustic soda, and sodium phosphate compounds (Gennis and Associates, Engineers, 1977).

- o Tannic Acid--Tannic acid occurs naturally in tree bark. It is highly soluble in water and has a high chlorine demand. Tannic acid gives water a woody taste and odor in concentrations of 2.0 to 4.0 mg/l (McKee and Wolf, 1963).
- o Lignin--Lignin is the noncellulosic portion of wood which holds the cellulose fiber together (Hampel and Hawley, 1976). Available data do not indicate that lignin is toxic to humans.
- o Chromium Compounds--Chromium is an essential trace element for humans; however, excessive levels can be toxic. Hexavalent chromium, generally considered to be the more hazardous form (EPA, 1977), can irritate and corrode mucous membranes when inhaled or ingested. Other health effects include dermatitis, ulceration, gastritis, stomach ulcers, and colitis (Britt and Hushon, 1976). The state water quality criterion is 0.050 mg/l for domestic water supply based on protection of human health. The California Department of Health Services lists some chromium compounds as

hazardous wastes due in part to toxic and irritant properties (DHS, 1979). The federal criteria are 0.05 mg/l for hexavalent chromium and 170 mg/l for trivalent chromium (EPA, 1980).

Although chromium is a potent skin sensitizer, the possibility of skin problems from bathing in water containing 0.050 mg/l chromium is remote (EPA, 1976). Chronic toxicity to freshwater aquatic life can occur at 0.044 mg/l chromium (EPA, 1980).

Geothermal Steam Condensate and Cooling Tower Sludge

CEC staff does not have complete data on cooling tower sludge constituents but expects the sludge to contain the following geothermal steam constituents and radionuclides.

- o Hydrogen Sulfide--See comments on sulfides under Stretford Unit Sulfur Cake.
- o Ammonia--Although ingestion of very high concentrations of ammonia (28 - 29 percent) in water can be fatal, there appears to be no physiological harm to humans in concentrations of ammonia that might occur in natural or polluted waters (McKee and Wolf, 1963). The federal criterion is 0.02 mg/l (as un-ionized ammonia) for protection of freshwater aquatic life (EPA, 1976). The Multimedia Environmental Goal estimated minimum acute toxicity concentration in water is 2.5 mg/l based on human health effects (EPA, 1977). The lethal concentration for fish varies from 0.2 to 2.0 mg/l ammonia; trout are the most sensitive (EPA, 1976).
- o Arsenic--Arsenic in drinking water is toxic and may be carcinogenic (EPA, 1976; McKee and Wolf, 1963). Both acute exposures to high concentrations and chronic exposures to low concentrations can be fatal (McKee and Wolf, 1963). Symptoms of mild chronic arsenic poisoning are fatigue and loss of energy; severe intoxication is characterized by kidney degeneration, liver cirrhosis, bone marrow injury, and other symptoms (EPA, 1976). Studies in Taiwan found that people drinking water containing 0.3 mg/l arsenic had increased incidence of hyperkeratosis, a skin disease, and skin cancer (EPA, 1976). The state criterion is 0.05 mg/l arsenic in domestic water supplies based on protection of human health. The federal criterion states that "for the maximum protection of human health from the potential carcinogenic effects due to exposure of arsenic through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical" (EPA, 1980). EPA estimates an incremental increase of cancer risk over the lifetime of 1 in 100,000, 1 in 1,000,000, and 1 in 10,000,000 if arsenic concentrations in water are 0.022 ug/l, 0.0022ug/l or 0.00022 ug/l, respectively (EPA, 1980).
- o Boron--Boron in drinking water is generally not regarded as a hazard to human beings. In very high concentrations it may interfere with digestion due to its preservative action on foods (McKee and Wolf, 1963). The federal criterion is 0.750 mg/l boron in irrigation water for sensitive crops; no criterion exists for human health (EPA, 1976).

In 1968, the federal Committee on Water Quality recommended a level of 1 mg/l boron in drinking water; later it was not included because it was felt it was not necessary (EPA, 1977). The Multimedia Environmental Goal's ambient level goal for boron in water is 43 ug/l based on health protection (EPA, 1977).

- o Mercury--Mercury and its salts are considered to be highly toxic to humans (McKee and Wolf, 1963). Mercury intoxication may be acute or chronic, the latter resulting from exposure to small amounts over extended time periods. Fish can accumulate mercury in concentrations up to 10,000 times levels in surrounding water (EPA, 1976). The LC₅₀ for freshwater fish ranges from 8.5 to 310 ug/l mercury (EPA, 1976). Consuming fish from mercury-contaminated waters can cause mercury poisoning in man. The federal criterion is 0.144 ug/l mercury to protect human health. The federal guideline to protect freshwater aquatic life is 0.00057 ug/l 24-hour average total recoverable mercury, never to exceed 0.0017 ug/l at any time (EPA, 1980). The federal Food and Drug Administration guideline for edible fish flesh is 0.5 ug/l mercury (EPA, 1977).
- o Radionuclides--Chronic effects arising from frequent small doses of radiation are difficult to evaluate. Production of eye cataracts, induction of leukemia from irradiation of the bone marrow, development of bone cancer from ingestion of radium, production of skin cancer, and reduction of life span by imperceptible impairment of many bodily functions may result (McKee and Wolf, 1963). Experts do not agree on threshold levels for exposure to radioactivity giving rise to these effects.

The U.S. Environmental Protection Agency has promulgated the following maximum contaminant levels for radiation in drinking water based on health effects and control costs: 5 picocuries per liter of radium-226; 15 pCi/l gross alpha particle activity (excluding radon and uranium); less than 4 millirems per year to total body or any organ of manmade beta particle and photon emitters (Britt and Hushon, 1976).

Based on PGandE estimates of radionuclide content in Geysers Unit 18 sludge (Table B-2), contamination of creeks with cooling tower sludge would have a similar impact on radionuclide levels as contamination with an equal amount of soil.

- o Silica--Silica, or silicon dioxide, is insoluble in water, but it may occur as suspended matter. In concentrations found in natural or treated waters, silica or silicates appear to cause no adverse physiological effects. At 50 mg/l or greater concentrations silica may cause turbidity problems (McKee and Wolf, 1963).
- o Benzene--Benzene poisoning occurs most commonly through inhalation of the vapor (Sax, 1979). Chronic benzene exposure may result in poisoning characterized by blood disorders (leukemia), changes in body organs, and chromosomal aberrations (EPA, 1977). Benzene is listed in the NIOSH Suspected Carcinogens List. For the maximum protection of human health from the potential carcinogenic effects of benzene, the federal criterion states the ambient water concentration should be zero based on the

Table B-2

ESTIMATED RADIONUCLIDE CONTENT IN GEYSERS UNIT 18 SLUDGE

<u>Radionuclide</u>	<u>Sludge Concentration pCi/g</u>	<u>Soil¹ Concentration Range pCi/g</u>	<u>Reference Standard² Concentration pCi/g</u>
²³⁸ U	0.4	.08 - 3.0	40
²³² Th	0.1	.028 - 4.3	40
²²⁶ Ra	0.7	.074 - 3.0	30
²¹⁰ Pb	9.0	.14 - 830 ³	200
⁴⁰ K	5.0	0.2 - 39	NA
Fallout and cosmogenic	2.0 ⁴	-	40 ⁴

Source: CEC, 1980.

1. Reference data and Geysers measurements.
2. California Administrative Code, Code of Federal Regulations.
3. Measurements of ²¹⁰Pb in a atmospheric particulates.
4. Typical values.

assumption that there is no threshold for carcinogenic effects (EPA, 1980). EPA estimates an incremental increase of cancer risk over the lifetime of 1 in 100,000 at 6.6 ug benzene/liter, 1 in 1,000,000 at 0.66 ug/l, and 1 in 10,000,000 at 0.066 ug/l (EPA, 1980).

Acute toxicity to freshwater aquatic life has been reported at concentrations as low as 5.3 mg/l benzene; no chronic toxicity data are available (EPA, 1980).

- o Asbestos--Asbestos exposure through ingestion of contaminated water and contaminated aquatic organisms may cause cancer in the human digestive tract. Currently available data, however, does not provide adequate information to assess this potential health hazard (Spath, 1981; Seversen, 1979). The federal government is presently funding several studies designed to help determine the significance of asbestos exposure by ingestion (Millette, 1981).

The federal criterion states that for the maximum protection of human health from the potential carcinogenic effects, the ambient water concentration should be zero based on the assumption that there is no threshold for the effects of this chemical (EPA, 1980). EPA estimates an incremental increase of cancer risk over the lifetime of 1 cancer per 100,000 people at 300,000 asbestos fibers/liter, 1 cancer per 1,000,000 people at 30,000 fibers/liter, and 1 cancer per 10,000,000 people at 3,000 fibers/liter (EPA, 1980).

Contaminants in water in The Geysers KGRA occasionally found in excess of standards (see Water Quality Setting section):

- o Turbidity--See discussion of suspended and settleable solids and turbidity above.
- o Iron--See iron catalysts above.
- o Manganese--Manganese is an essential element; daily intake in a normal human diet is about 10 mg. However, high concentrations in drinking water have caused chronic manganism, a disease of the central nervous system; initial symptoms include failure of strength, apathy, nervousness, headaches, and pains in lower extremities (Britt and Hushon, 1976). McKee and Wolf (1963) believe manganese cannot be considered a physiological hazard because toxic levels would not be tolerated aesthetically in drinking water. Manganese causes unpleasant tastes at 0.5 to 180 mg/m³, deposits on food during cooking, stains and discolors laundry and plumbing fixtures, and fosters microorganism growth (McKee and Wolf, 1963). Furthermore, low iron concentrations may intensify the adverse effects of manganese (EPA, 1976). The state criterion is 0.05 mg/l manganese for domestic water supply (McKee and Wolf, 1963).

The 96-hour LC₅₀ for freshwater fish is 1,400 ppm manganese (EPA, 1977).

- o Sulfate--See Stretford Unit Sulfur Cake above.

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APPENDIX C

ASSUMPTIONS FOR PUBLIC HEALTH IMPACT ANALYSIS

The following assumptions were used by CEC staff in the Public Health Impacts section.

1. Concentrations of pollutants in incoming steam were based on:
 - a. Utilities estimates where available;
 - b. Exploratory well data, where available; or
 - c. Average concentrations from 61 producing wells at The Geysers.
2. The total quantity of steam contaminants is released to the atmosphere through the cooling tower.

Note: This is an overestimation. In reality, some portion of incoming steam contaminants is reinjected with excess condensate or accumulates in sludge. The percentage that exits through the cooling tower varies depending on the volatility of the pollutant. This assumption allows for a worst-case analysis only; it is not precise.

3. The analysis assumes that all geothermal pollutants are transported in the atmosphere in the same manner as gaseous H_2S . This may not be entirely accurate, since some pollutants are likely to behave more like a particulate than a gas. Gaseous pollutants are generally more extensively dispersed than particulate pollutants.
4. The analysis for nonregulated pollutants is based on the cumulative impact study for H_2S . A similar set of assumptions used in the H_2S analysis applies:
 - a. Background pollutant levels assumed for nonregulated pollutants are lacking or outdated and may not apply in 1984 when the facility is scheduled for commercial operation.
 - b. It assumes that all nonregulated pollutants are emitted during normal operation and steam stacking, so there would be no increase during steam stacking or reduced H_2S abatement efficiency.
5. As meteorological conditions, this cumulative impact analysis assumes those conditions which result in the maximum impact of the project emissions on ambient pollutant concentrations in Anderson Springs (the nearest population center). These meteorological conditions do not necessarily cause the maximum impact from other units' emissions in this area. In addition, this analysis does not identify the maximum possible impact of these other units on Anderson Springs. Rather, it identifies the impact on pollutant concentrations in Anderson Springs when the project emissions have a maximum impact, given:

- a. All incoming pollutants are emitted through cooling towers and dispersed in the same manner as H_2S , and
 - b. Only limited emission and background and concentrations data are available.
6. Most available air quality data for The Geysers KGRA are expressed in terms of maximum hourly average pollutant concentrations. In order to make comparisons with suggested safe annual average concentrations, CEC staff assumes, as a worst case, that annual average pollutant concentrations are one-tenth the maximum hourly averages. Staff bases this assumption on historical H_2S data for The Geysers KGRA (Ruff et al., 1978). This value compares favorably to the value of roughly 0.1 predicted by a model used to compare pollutant concentrations in urban settings at various averaging times (Larsen, 1971) and to the worst case value of $0.09 + 0.02$ calculated by Tesche et al. (1980) from historical data for The Geysers KGRA. CEC staff assumes that the relationship between maximum hourly average and annual average concentrations is similar for geothermal pollutants other than H_2S .
 7. Health Table 3 lists values for assessing potential public health impacts from nonregulated pollutants in ambient air. The following paragraphs describe the types of values in that table.
 - o Threshold Limit Values (TLV^R), adopted by the American Conference of Governmental Industrial Hygienists, "...refer to airborne concentrations of substances to which nearly all workers may be exposed day after day without adverse effect. Because of wide variation in individual susceptibility, however, a small percentage of workers may experience discomfort from such substances at concentrations at or below the threshold limit; a smaller percentage may be affected more seriously by aggravation of a pre-existing condition or by development of an occupational illness....Threshold limits are based on the available information from industrial experience, experimental human and animal studies, and, when possible, from a combination of these. The basis for established values may differ from substance to substance; protection against impairment of health may be a guiding factor for some, whereas reasonable freedom from irritation, narcosis, nuisance, or other forms of stress may form the basis for others" (ACGIH, 1979). As previously noted, safe levels for generally healthy workers exposed for limited duration under controlled conditions may not represent safe levels for continual exposure of the general public, which can include pollutant sensitive individuals.
 - o The publication Multimedia Environmental Goals for Environmental Assessment (EPA, 1977) lists "levels of significant contaminants... in ambient air...that are judged to be appropriate for preventing certain negative effects in surrounding populations." The Multimedia Environmental Goals (MEGs) were developed as a first effort at establishing "a procedural approach to evaluate and rank a large number of pollutants for the purpose of environmental assessment." Such assessments can be used to determine further research needs and to set pollution control strategy development priorities.

Estimated permissible concentrations for the MEGs were derived using TLV^Rs or recommendations of the National Institute for Occupational Safety and Health (NIOSH), adjusting the values for continual exposure and incorporating a margin of safety. For some pollutants two values are listed: one based on toxicity, the other based on carcinogenic potential. Estimated permissible concentrations based on carcinogenic potential indicate estimated acceptable risk levels rather than established safe concentrations, since threshold levels for carcinogenic effects may not exist (EPA, 1977).

The MEGs receive criticism for their rather simple derivation and other inherent limitations or inconsistencies (such as the differing end points used in setting the TLV^Rs upon which the MEGs are based). CEC staff is currently following efforts by EPA to refine the MEGs.

- o The Wilcox (1973) study was part of a program with the EPA "to provide the analysis necessary to form a basis for planning and developing hazardous pollution control technology." The presumed safe ambient air quality levels reported by this study constitute estimates made by a panel of six experts. These experts in the fields of epidemiology, air pollution, and toxicology took experimental results, statistical data, and subjective philosophies of life into consideration to arrive at levels below which they would not expect any adverse health effects. Ideally, these proposed concentrations should be safe for the entire population to breathe daily. However, not all of the estimates for each pollutant are similar; not all of the experts have identical bases for their opinions. Health Table 3 lists the average of the six levels suggested by the experts.

APPENDIX E
AIR QUALITY AND NOISE
JOINT STIPULATIONS

Findings:

Compliance with Air Quality Laws

1. The Oxy Geothermal Plant No. 1 is proposed to be located in the Lake County Air Pollution Control District (LCAPCD). The following laws are applicable to the Oxy Geothermal Plant No. 1:
 - a. Clean Air Act and implementing regulations;
 - b. California Health and Safety Code and implementing regulations; and
 - c. LCAPCD Rules and implementing regulations.

Specific rules of concern are:

1. 411
 2. 412
 3. 421.2.A
 4. 430
 5. 602, 604 and 605 (New Source Review)
 6. 608
2. Oxy #1 has applied for a federal PSD permit.
3. LCAPCD Rule 411 limits emissions of particulate matter to whichever is the lesser of:
 - a. 0.2 grains per standard cubic foot of gas, or
 - b. 40 pounds per hour.
4. The maximum expected particulate emission rate from the proposed facility, assuming an oxidizer and evaporative cooler are used for the Stretford process, is 22.6 lbs/hr, or 0.0001 grains per standard cubic foot. This emission rate will comply with LCAPCD Rule 411.
5. LCAPCD Rule 412 limits emissions from any sulfur recovery unit producing elemental sulfur to the following:
 - a. 300 ppmv of sulfur compounds calculated as SO₂,
 - b. 10 ppm H₂S by volume, and

- c. 100 pounds per hour of sulfur compounds calculated as SO_2 . The Air Pollution Control Officer (APCO) interprets Rule 412 as applying to Stretford and EIC units.
6. Specifications for the Stretford Unit will require that H_2S in the tail gas will be controlled to 10 ppmv or less.
 7. LCAPCD Rule 421.2.A (as revised April 1981) limits H_2S emissions from a geothermal power plant receiving an Authority to Construct on or after January 1, 1981, to not more than 50 grams per gross megawatt hour (g/GMWh). Occidental has agreed to operate the facility such that H_2S emissions will not exceed 8.0 lbs/hr, or approximately 41 g/GMWh.
 8. A general emissions limitation contained in LCAPCD's Rule 430 prohibits the discharge of any contaminant in an amount which causes injury, detriment, nuisance, or annoyance to any considerable number of persons or which causes injury or damage to business or property.
 9. Complaints from the Anderson Springs-Cobb area as a result of H_2S air pollution continue, although H_2S standard violations have been markedly reduced in the past one to two years. The LCAPCD and Northern Sonoma County Air Pollution Control District (NSCAPCD) specifically regulate H_2S emissions to attain and maintain the California Ambient Air Quality Standards (CAAQS) for H_2S , which is based in part on a nuisance emission threshold. Compliance with the H_2S standard and compliance with Determination of Compliance (DOC) conditions of the LCAPCD are adequate to ensure compliance with Rule 430.
 10. Occidental has applied for a permit under Rule 608. Notwithstanding New Source Review rules [Rules 602, 604, and 605(c)], Rule 608 allows the LCAPCD to permit a geothermal facility, provided the facility uses BACT and meets the following criteria:
 - o Power plants and geothermal fluid transmission lines must limit on a continuous basis the hydrogen sulfide emission rate to no more than five pounds per hour (5 lbs/hr) per one million pounds per hour of steam flow received.
 - o The power plant is not located within 0.6 miles of a permitted geothermal power plant (within the district) and is not located within 1.0 miles of a populated area [as defined in Chapter 21 of the Lake County Code, Article XXV, Section 21-73.6A(1)].
 - o Geothermal development wells must limit the hydrogen sulfide emission rate on a continuous basis during air drilling, clean-out, initial testing, and reworking to no more than five (5.0) pounds per hour (2.3 kilograms per hour).
 - o Wells on standby vent shall be located no closer than 0.5 mile from a populated area [as defined in Chapter 21 of the Lake County Code, Article XXV, Section 21-73.6a(1)], and emissions shall be no greater than an average of one (1) pound per hour per well based on the number of completed wells for the associated power plant's steamfield.

- o In the judgment of the APCO, the facility must be able to readily show compliance with all other rules and regulations which limit emissions other than hydrogen sulfide.
 - o Within 30 days of being notified, no individual property owner or legal resident within a one-mile radius of the proposed power plant site makes a request for a New Source Review of the project.
11. The power plant (within LCAPCD) nearest to the proposed Oxy #1 site is PGandE Unit 13, which is approximately 1.25 miles away. The nearest populated area to the proposed Oxy #1 site is Whispering Pines, which is approximately 2.3 miles away. The Oxy #1 project therefore meets the locational requirements of LCAPCD Rule 608.
 12. Occidental has agreed to limit H₂S emissions to 5 lbs/hr per million pounds steam received (8.0 lbs/hr based on 1.6 million pounds steam input to the facility) and meet the steam field requirements of Rule 608.
 13. The LCAPCO has determined that Occidental's proposed H₂S controls constitute BACT and the facility will comply with all other rules and regulations which limit emissions other than hydrogen sulfide.
 14. As of July 28, 1981 no individual property owner or legal resident within one mile of the proposed power plant has requested a New Source Review of the project.
 15. The proposed Oxy Geothermal Plant No. 1 and steam field meet the prescriptive requirements of LCAPCD Rule 608 and are therefore exempt from New Source Review (LCAPCD Rules 602, 604, and 605). Nevertheless, the parties have examined the environmental impacts of the proposed project which are summarized below.

Environmental Impacts

16. It is not expected that emissions of TSP, nonmethane HC, or SO₂ will prevent the attainment, interfere with the maintenance, or cause a violation of any AAQS for these pollutants.
17. To determine whether the proposed project's H₂S emissions will result in a violation or measurable contribution to a continued violation of the state H₂S AAQS, Systems Applications Incorporated (SAI) assessed air quality impacts at nearby receptor areas based on the 9.7 lbs/hr (H₂S) emission rate initially proposed. This impact assessment used tracer tests and computer modeling.
18. LCAPCD, Occidental, ARB, and CEC staff agreed that the meteorological conditions which would produce the worst-case impact from the Oxy #1 power plant are limited mixing conditions.
19. Based upon the tracer test and computer modeling (including examination of the tracer and modeling studies performed for the SMUDGE0 #1 facility) a reasonable estimate of the worst-case incremental impact of the Oxy #1 facility is 2 to 3 parts per billion (ppb) H₂S at receptor areas (based

on a 9.7 lbs/hr H₂S emission rate). Because of the inherent uncertainties in the above studies used to predict the incremental impact, a conservative estimate of the worst-case incremental impact is less than 5 ppb H₂S at receptor areas (based on a 9.7 lbs/hr H₂S emission rate).

20. To evaluate whether operation of the Oxy #1 facility will result in or contribute to a violation of the H₂S AAQS, the Oxy #1 impact must be added to the expected ambient H₂S level of 1984 when the facility comes on line. During the SMUDGE0 #1 proceedings, the SAI Hybrid Model projected the H₂S ambient air quality in 1984, using worst-case meteorology and the expected emission rates from the Wild Well and units operated by PGandE, DWR, SMUD, and NCPA. The projected ambient H₂S from the sources was just over 24 ppb at the sensitive receptor areas.
21. The ARB, which sets and enforces state ambient air quality standards, has determined that ambient concentrations of H₂S which equal or exceed 25 ppb constitute violations.
22. The projected worst-case background ambient of approximately 24 ppb H₂S, in light of the modeling uncertainties, is sufficiently close to 25 ppb that it is likely that a violation will occur in 1984 when Oxy #1 becomes operational. The Oxy #1 incremental impact will not add a measurable contribution to this violation as defined by LCAPCD rules.
23. SAI also estimated the likely ambient H₂S levels in 1985-86 resulting from NSCAPCD's requirement that PGandE retrofit its existing Units 1, 2, 7, 8, 9, and 10. Based on these emission rates the predicted H₂S level in 1985 - 1986 is 10 to 15 ppb in the receptor areas. Provided that PG&E retrofits these units, these levels are sufficiently below 25 ppb that it is likely that under normal operating conditions the Oxy #1 project will neither cause nor contribute to an H₂S violation after 1984.

Abatement Systems

24. Occidental proposes to use the Stretford process to abate H₂S emissions from the noncondensable gas stream and the Hydrogen Peroxide process to abate H₂S emissions from the cooling tower. Occidental also proposes dual turbine generators, and a turbine bypass mechanism to reduce stacking and corresponding emissions.
25. The H₂S in the steam supply, after it is exhausted by the turbine, separates (partitions) into both the noncondensable gas stream and the liquid condensates stream. The expected H₂S abatement efficiency of the Stretford Unit is 99+ percent of the H₂S in the noncondensable gas stream. The Hydrogen Peroxide process is capable of abating 95 to 98 percent of the H₂S in the liquid condensate stream. The partitioning efficiency (i.e., the percentage of H₂S in the noncondensable gas stream) experienced at PGandE Unit 15 is approximately 65 percent and at PGandE Units 13 and 14 is 80 to 90 percent. Based even on the lower partitioning efficiency, it can reasonably be expected that these controls will achieve H₂S emissions of no more than 8.0 lbs/hr.

26. Occidental has committed to use a Hydrogen Peroxide process (with or without catalyst) but is investigating alternative secondary H₂S controls, condensate stripping and condensate pH control. If the testing of these alternative processes show one to be economically and technically superior to the hydrogen peroxide process, Occidental may change its design, after obtaining approval from the LCAPCD and CEC.
27. The turbine bypass system will route steam around the turbines to the downstream abatement systems during unit outages and start-ups. If only one turbine is out of operation, the remaining turbine could use the excess steam from the other turbine for power production. This dual turbine/turbine bypass design will virtually avoid stacking events and provide greater operational flexibility.
28. The turbine bypass system is presently in the preliminary design stage. Such a system has never been used before on a geothermal power plant, although it has been used successfully on other power-generating facilities. The turbine bypass system is expected to operate reliably. However, successful avoidance of emission exceeds during unit outages will depend on the reliability of the proposed abatement systems.
29. PGandE, at a recent workshop on NSCAPCD proposed rule changes, indicated that they are experiencing corrosion effects on stainless steel screens located downstream of the hydrogen peroxide system on Unit 15. LCAPCD indicates this may also be a problem on PGandE Unit 13. Occidental recognizes potential corrosion problems; design of the facility will address any problems resulting from the abatement system chosen.
30. The design of the proposed H₂S abatement systems will provide for sufficient redundancy and capacity for critical components; the abatement systems should operate reliably and within the range of their expected abatement efficiency.
31. Drift eliminators will be installed on the cooling tower, which will limit the drift to 0.001 percent of the circulation water flow rate. This level of control is the current state-of-the-art. The use of this control measure will reduce particulates and some pollutants of concern to public health.

Conclusion

1. If Occidental implements the measures specified above and complies with the conditions below, it is likely that:
 - a. The abatement systems will perform effectively; and
 - b. The plant will conform to all applicable air quality laws.

Conditions

1. The LCAPCD shall perform all duties and functions normally conducted by the APCD and shall have the authority to issue a Permit to Operate, collect the permit fees, levy fines, order correction of operational or

mechanical procedures or functions, and perform compliance tests. The established LCAPCD appeal procedures shall apply for all contested LCAPCD actions.

Verification: Occidental shall summarize in a periodic compliance report (See Compliance Plan) interactions with the LCAPCD. Occidental shall immediately inform the CEC and ARB of any formal appeals filed with the LCAPCD.

2. Occidental shall comply with the requirements specified in the Lake County Air Pollution Control District document entitled, "Determination of Compliance," dated July 28, 1981. (A copy of conditions specified in this document are appended to this compliance plan.)

Verification: Occidental shall annually request a letter from the Lake County Air Pollution Control Officer verifying the status of Occidental's compliance with the conditions of the Determination of Compliance. Occidental shall provide the CEC with a copy of this letter in the annual compliance report. In addition, Occidental shall provide the CEC with a copy of all quarterly reports and testing/monitoring summary reports submitted to the LCAPCO.

3. Occidental shall obtain written approval from both LCAPCD and CEC before using any equipment other than the hydrogen peroxide/catalyst, Stretford/surface and dual turbine/turbine bypass system condenser system, as proposed in the AFC to control H₂S emissions (re: DOC Conditions).

Verification: Occidental shall file a copy of the written approval from the LCAPCO with the CEC prior to beginning construction of any alternative H₂S emissions abatement system, as specified in DOC Condition 2.

4. Occidental shall submit approved-for-construction drawings of the power plant secondary H₂S control system to the CEC only if requested by the CEC.

Verification: If requested, such drawings shall be submitted by Occidental to the CEC at least 30 days prior to commencing construction of the system.

5. DOC Conditions 3 and 6 require submittal of a detailed plan for testing the performance of the Oxy #1 H₂S emissions abatement system at normal full load operation. If continuous H₂S monitors are available, Occidental shall ensure that the detailed plan includes the following test parameters: (1) the test data shall reflect a minimum of 30 days (not necessarily consecutive days) operation at a minimum of 80 percent of the gross electricity generating capacity, and (2) in the event that at least 30 days of qualifying data could not be obtained during the 90-day test period specified in the Determination of Compliance, Occidental shall continue to collect test data until the required information has been obtained. (The application for a Permit to Operate shall be filed as specified in DOC Condition 10 and need only include the results of the performance test conducted during the initial 90 days of commercial operation.)

Verification: Occidental shall provide the CEC with a copy of the detailed plan submitted to the LCAPCO for review and approval and a copy of the plan as approved. In addition, if the test period extends beyond the initial 90 days after commercial operation, Occidental shall file a supplementary report with the CEC and the LCAPCO which reflects all the results of the performance test.

6. Occidental shall, if requested by the Lake County Air Pollution Control Officer, install, operate, and maintain an on-site meteorological station capable of determining wind direction, wind speed, and temperature.

Verification: Occidental shall furnish such data in a form acceptable to the LCAPCO. The submittals shall be noted in periodic compliance reports filed with the CEC.

LCAPCD DOC Conditions; Dated July 28, 1981

Condition 1

Occidental shall install and operate the power plant and air emissions control system described in 80-AFC-1 in the manner necessary to limit H₂S emission on a continuous basis from Oxy Geothermal Power Plant No. 1 to eight (8) pounds of H₂S per hour. This same emissions limitation shall apply during power plant outages, unless LCAPCD Rule 510 is complied with.

Condition 2

The hydrogen peroxide/catalyst, Stretford/surface condenser, drift eliminators, turbine by-pass, dual generating units with shunt and multiple power source constituting the air emissions control system as proposed in 81-AFC-1 and amendments shall be the equipment used to satisfy the requirements of Condition 1. In the event that Occidental seeks to change the above equipment necessary to control H₂S emissions as proposed prior to operation, they shall request that the LCAPCD Hearing Board hold a public hearing to determine whether the alternate technology is capable of satisfying the requirements of Condition 1. The alternate technology may be used only if the LCAPCD Hearing Board and CEC determine that it is capable of complying with Condition 1. All abatement systems shall be properly winterized and maintained to ensure proper and reliable functioning. Prior to construction, Occidental shall submit approved for construction drawings of the noncondensable gas and condensate H₂S abatement systems quantifying process flows and design capacities. If additional resource discoveries necessitate increased H₂S abatement capacity because of higher H₂S levels in the steam, such capacity shall be incorporated in the air emissions control system.

Condition 3

Occidental shall install when practicable continuous monitoring devices indicating total volume flow rates and H₂S concentrations at the following locations: (a) outlet of Stretford unit; and (b) in the treated condensate or in the circulating water upstream of the cooling tower. A log of such monitoring shall be maintained and made available to the LCAPCD staff upon request. The H₂S monitoring devices must have an accuracy of plus or minus 1

ppm, provide measurements at least every 15 minutes, and be readily accessible to LCAPCD staff. Flow rate measuring devices shall have accuracies of plus or minus 5 percent at 40 percent to 100 percent of the total flow rate, and calibrations must be performed at least quarterly. A Houston-Atlas or equivalent type instrument shall be acceptable for use in monitoring Stretford tail gas for H₂S. Calibration records shall be made available to LCAPCD staff upon request.

Alternatively a performance plan as specified in LCAPCD Rule 655 shall be developed to ensure operation in compliance with specified emissions limitations.

Condition 4

The power plant cooling towers shall utilize drift eliminators with a guaranteed drift rate of 0.001 percent or less and the Stretford cooling tower a guaranteed drift rate of 0.002 percent or less.

Condition 5

Occidental shall provide safe access to sampling ports that enable representatives of the LCAPCD or ARB to collect samples from the treated condensate or the circulating water upstream of the cooling tower, cooling tower stacks, the noncondensable exit gas from the Stretford unit, and the direct off-gas vent.

Condition 6

At least 60 days prior to scheduled commercial operation of the second generating unit, Occidental shall submit to the LCAPCD for approval a detailed plan for testing the performance of the OXY Geothermal Plant No. 1's abatement system at normal full load operation. A copy of the plan shall also be sent to the ARB for comment. Normal full load for this purpose is defined as operating at a minimum of 90 percent of the 1.6×10^6 lbs/hr steam flow capacity. This one time test shall incorporate tests for emission from the cooling tower of components of potential concern in geothermal steam including H₂S. The LCAPCO shall approve, disapprove, or modify the plan within 30 days of receipt from Occidental. Occidental shall complete the performance test approved by the LCAPCO within 90 days or as soon as possible following the date of commercial operation.

Condition 7

If a generic monitoring program for H₂S and/or other constituents of concern is initiated in The Geysers KGRA by responsible agencies (NSCAPCD, ARB, CEC, and LCAPCD), Occidental shall participate to the extent equitable with other parties in funding or causing to be performed such a program.

Condition 8

Occidental shall install and operate for one year in the Gunning Creek drainage a wet/dry deposition sampler and analyze a monthly composite of both wet and dry samples for soluble solids, boron, flouride arsenic, silica, and

mercury. The sampler utilized shall comply with or exceed the guidelines of the National Atmospheric Deposition Program.

Condition 9

Occidental shall perform biannual tests to determine the content of steam components as listed below upon written request of the LCAPCO and as required in the geothermal fluid transmission line permit. The continued need for such tests shall be reviewed after two years of operation. Copies of all tests shall be forwarded to the ARB and CEC. Such monitoring is not intended to be redundant.

STEAM CONDENSATE OR TOTAL STEAM

GAS PHASE

Ammonium (total)	Particulate mass in micrograms per kilograms of steam
Arsenic (total)	
Asbestos (total)	Arsenic from particulates above
Benzene	Lead from particulates above
Boron (total)	Cadmium from particulates above
Hydrogen Sulfide (total)	Sulfur from particulates above
Fluorides (total)	Mercury vapor
Mercury (total)	Total methane and nonmethane hydrocarbons
Carbon dioxide (total)	Other nongases as indicated by condensate
Total dissolved solids	NESHAP pollutants as requested
Total suspended solids	

Condition 10

Occidental shall file an application for a Permit to Operate with the LCAPCD within 90 days after the commercial operation date or as soon as possible thereafter and submit appropriate permit fees. The application shall include the results of the performance test referenced in Condition 6.

Condition 11

Occidental shall issue quarterly reports to the LCAPCO detailing a) hours of operation; (b) any periods of significant abatement equipment malfunction, reasons for malfunctions, and the corrective action; (c) types and amounts of chemicals used for condensate treatment; (d) periods of scheduled and unscheduled outages and the cause of the outages if known; (e) a summary of any irregularities that occurred with the continuous emission monitors, if used; and (f) if any, the dates and hours in which Oxy Geo #1 H₂S emission rate was in excess of the emissions limitations specified in Condition 1.

Condition 12

Occidental shall allow authorized representatives of the LCAPCD and ARB to enter the premises where the source is located, within one hour of notification, to inspect the plant for compliance with the conditions of this Determination of Compliance.

Condition 13

Occidental shall comply with all applicable federal, state, and local laws, standards, and ordinances in the operation of Oxy Geo #1.

NOISE

PROPOSED JOINT STIPULATIONS

Findings:

1. The following standards are applicable to the proposed Oxy Geothermal Plant No. 1:
 - a. The Noise Element of the Lake General Plan;
 - b. The Draft Lake County Noise Ordinance;
 - c. Title 8 Cal. Admin. Code, Article 105 (State Occupational Noise Limits); and
 - d. Occupational Safety and Health Act of 1970, 29 CFR 1910 et seq., (Federal Occupational Noise Limits).
2. Lake County adopted a Noise Element to the County General Plan which establishes an acceptable ambient noise level for residential receptors of 55 dBA L_{dn} from all sources. Lake County is currently considering a draft ordinance. At this time, it is speculative as to when and in what final form Lake County might adopt the ordinance. However, Occidental agrees to comply with the draft ordinance standards, which are 55 dBA for daytime hours (7 a.m. - 10 p.m.) and 45 dBA for nighttime hours (10 p.m. - 7 a.m.) for residences.
3. The applicable state regulations are the CAL/OSHA occupational noise exposure regulations, Title 8 Cal. Admin. Code, Article 105. The provisions of CAL/OSHA are enforced by the Division of Occupational Safety and Health (DOSH) of the Department of Industrial Relations, insofar as these provisions relate to construction and operational employee noise hazards.
4. The federal occupational noise standards, set by the Occupational Safety and Health Act of 1970, are basically the same as CAL/OSHA standards.
5. The ambient noise levels at sensitive receptors in the vicinity of the site are presented in Oxy #1 AFC Tables 5.6-1 and 5.6-6 and in the Draft Environmental Impact Report.
6. The closest identified sensitive receptor to the proposed plant site is a residence off the Socrates Mine Road (survey point 5), approximately 9,130 feet east of the site. The estimated construction and operational noise levels projected to this receptor will comply with applicable noise standards and will not adversely affect the receptor.
7. Communities or single family residences along the access routes to the proposed site may be exposed to intermittent noise levels from construction traffic, which will exceed the nighttime standard of the Lake County draft noise ordinance. Occidental Geothermal, Inc., agrees to limit construction traffic on the access routes to daytime hours (7 a.m. to 10 p.m.). Exceptions to this schedule are permissible where work conditions require.

8. Noise levels associated with steam field development and operation are identified in the EIR for the Oxy Geothermal Plant No. 1. Noise levels from steam field development and operation generally exceed those from power plant construction and operation. Because the site is remote, these noise levels will not adversely affect sensitive receptors.
9. Based upon the Occidental Geothermal, Inc.'s proposed mitigation measures, the proposed project will comply with CAL/OSHA regulations.
10. Occidental has proposed mitigation measures specified in Section 1.4.4 of the AFC, which are incorporated herein.
11. In implementing its proposed mitigation measures, Occidental agrees to do the following:
 - a. Except for the turbine generator set, which shall be specified for 90 dBA, require equipment manufacturers, where applicable, to supply equipment with a maximum sound level of 85 dBA at 3 feet. If the manufacturer cannot meet this specification, Occidental shall undertake appropriate mitigation measures to conform with OSHA/DOSH standards;
 - b. Route the steam drain lines from the turbine to the condenser so that steam will not be discharged into the atmosphere during unit start-ups; and
 - c. Utilize to the maximum extent feasible a rock muffler or an equivalent noise reducer to mitigate noise during unit outages.
12. To comply with CAL/DOSH requirements, Occidental agrees to do the following:
 - a. Post signs on all unavoidably high noise areas.
 - b. Provide hearing protectors for employees, whenever necessary.
 - c. Periodically check the hearing of employees, who are routinely subject to high noise levels.
13.
 - a. In the event LCAPCD or Oxy receives public complaints of the noise due to construction, the LCAPCD and Oxy agree to promptly conduct an investigation to determine the extent of the problem. Oxy shall take reasonable measures to resolve the complaints.
 - b. Oxy agrees to develop and submit to the Lake County Air Pollution Control Officer (LCAPCO) a procedure for handling public complaints. The LCAPCO will notify Oxy and the CEC when the LCAPCO deems the Oxy plan acceptable.
14.
 - a. Within 10 days of a request by the LCAPCO, Oxy agrees to conduct noise surveys at the sensitive receptors registering complaints and at the facility property line nearest the complaining receptors. Surveys shall be conducted for the period of the construction

working day and if possible under circumstances similar to those when the complaints were perceived. The survey should be reported in terms of the L_x and L_{eq} levels ($x = 10, 50, \text{ and } 90$). Based on this survey, Oxy shall identify and implement feasible mitigation measures necessary to assure compliance with the county standards.

- b. Oxy agrees to promptly forward to the LCAPCO the survey results, the mitigation measures applied to resolve the problem, and the results of these efforts. LCAPCO shall advise the CEC of any continuing noncompliance conditions.
- 15.
- a. Within 90 days after the plant reaches its rated power generation capacity and construction is complete, Oxy agrees to conduct a noise survey at 500 feet from the generating station or such a point acceptable to Oxy, CEC, and the LCAPCD. The survey will cover a 24-hour period with results reported in terms of L_x ($x = 10, 50, \text{ and } 90$), L_{eq} , and L_{dn} levels.
 - b. Oxy agrees to prepare a report of the survey that will be used to determine the plant's conformance with county standards. In the event that county standards are being exceeded, the report shall also contain a mitigation plan and a schedule to correct the noncompliance.
 - c. No future noise surveys of off-site operational noise are required unless the public registers complaints or the noise from the project is suspected of increasing due to a change in the operation of the facility.
 - d. Within 30 days of the noise survey, Oxy agrees to submit its report to the LCAPCO.
- 16.
- a. Within 180 days after the start of commercial operation, Oxy agrees to prepare a noise survey report for the noise-hazardous areas in the facility. The survey shall be conducted by a qualified person in accordance with the provisions of Title 8 CAC, Article 105. The survey results will be used to determine the magnitude of employee noise exposure. If employee complaints of excessive noise arise during the life of the project, CAL/DOSH, Department of Industrial Relations, shall make a compliance determination.
 - b. Oxy agrees to notify CAL/DOSH and the CEC of the availability of the report.

Conclusions:

If Occidental implements its proposed mitigation measures specified in Section 1.4.4 of the AFC and those measures specified in Findings 11, 12, 13, 14, 15, and 16, the proposed project will comply with applicable laws, ordinances, and standards.

APPENDIX F

COMMENTS ON OXY DRAFT EIR

State of California

GOVERNOR'S OFFICE
OFFICE OF PLANNING AND RESEARCH
1400 TENTH STREET
SACRAMENTO 95814

EDMUND G. BROWN JR.
GOVERNOR

October 1, 1981

Ms. Valerie Campbell
California Energy Commission
1111 Howe Avenue
Sacramento, CA 95825

SUBJECT: SCH# 81082501 OXY GEOTHERMAL PLANT NO. 1 (OCCIDENTAL
GEOTHERMAL, INC.)

Dear Ms. Campbell,

State agencies have commented on your draft environmental impact report. If you would like to discuss their recommendations and concerns, contact the staff from the appropriate commenting agency.

AIR RESOURCES BOARD

The Board's primary concern with the DEIR is the lack of detailed information that would substantiate the estimated air emissions presented in the report. It is difficult to verify these estimates without knowledge of the assumptions used.

ENVIRONMENTAL HEALTH BRANCH

For the benefit of the nearest receptor, the durations of the expected operations and their associated noise levels should be indicated. Also, some of the L_{eq} values could be misleading to the layman.

CRWQCB, CENTRAL VALLEY REGION

The comments on page 19 should contain a specification that any road watering for dust control will be regulated to prevent run-off to natural surface drainage courses. There also needs to be further discussion and review as to whether or not the sedimentation pond below the plant site and/or an access road for maintenance should be constructed. Objectives for inland surface waters include suspended sediment load/discharge, settleable material, and turbidity. Drinking water health standards for turbidity are directed to the finished product and not to the raw supply.

When preparing the final EIR, you must include all comments and responses (CEQA Guidelines, Section 15146). The certified EIR must be considered in the decision-making process for the project. In addition, we urge you to respond directly to the agencies' comments by writing to them, including the State Clearinghouse number on all correspondence.

A recent Appellate Court decision in Cleary v. County of Stanislaus clarified requirements for responding to review comments. Specifically, the court indicated that comments must be addressed in detail, giving reasons why the specific comments and suggestions were not accepted and factors of overriding importance warranting an override of the suggestion. Responses to comments must not be conclusory statements but must be supported by empirical or experimental data, scientific authority or explanatory information of any kind. The court further said that the responses must be a good faith, reasoned analysis.

Section 15002(f) of the CEQA Guidelines requires that a governmental agency take certain actions if an EIR shows substantial adverse environmental impacts could result from a project. These actions include changing the project, imposing conditions on the project, adopting plans or ordinances to avoid the problem, selecting an alternative to the project, or disapproving the project. In the event that the project is approved without adequate mitigation of significant effects, the lead agency must make written findings for each significant effect (Section 15088) and it must support its actions with a written statement of overriding considerations for each unmitigated significant effect (Section 15089).

If the project requires discretionary approval from any state agency, the Notice of Determination must be filed with the Secretary for Resources, as well as with the County Clerk.

Please contact Anna Polvos at (916) 445-0613 if you have any questions.

Sincerely,

for Stephen W. Williamson
State Clearinghouse

Anna Polvos
State Clearinghouse

SW/dm
attachments

cc; Ken Fellows, DWR.

m o r a n d u m

Jim Burns, Project Coordinator
Resources Agency

Date : September 18, 1981

Subject: Comments on the Occidental
Draft Environmental Impact
Report (SCH#81082501)

From : Air Resources Board

Introduction

Occidental Geothermal, Inc., is proposing to build an 80 megawatt power plant at the Geysers Known Geothermal Resource Area. The power plant, Oxy Geothermal Plant No. 1, would be located in Lake County near the Sonoma County line. Since Occidental is both the steam supplier and the steam user, the operation of the steam field and power plant will be coordinated to minimize impacts to the environment.

General Comments

Our primary concern with the Draft Environmental Impact Report (DEIR) is the lack of detailed information that would substantiate the estimated air emissions presented in the report. It is impossible to verify these estimates without knowledge of the assumptions used.

Specific Comments

1. In Table 3 on page 89 the concentration of hydrogen sulfide (percent by weight) is given as $0.0090 + 30$, but should be $0.0090 \pm .0030\%$. The more common unit of expressing H_2S in terms of part per million by weight should be used rather than expressing the H_2S concentration as a percent.
2. The following comments refer to page 102 of the DEIR.
 - A - In paragraph 1 the emissions from particulate collectors, well bleed lines and leaky gaskets are discussed. The DEIR indicates that emissions from these sources are insignificant. However, no data or information were supplied to support these assertions.
 - B - Total Dissolved Solids (TSD) and Total Suspended Solids (TSS) are estimated at 300 ppm_w and 100 ppm_w, respectively. These estimates are based on a concentration factor of 3.94. It is uncertain how the concentration factor is used in this context. Further information is required to verify these estimates.
 - C - The DEIR states that the circulating water contribution to particulate emissions is 0.6 pounds per hour. This emission rate is based upon a circulating water rate of 80 million pounds per hour, cooling tower drift rate of .001%, TDS of 300 ppm_w, and TSS of 100 ppm_w. Therefore:

September 18, 1981

$$\left(\frac{300 \text{ lb TDS}}{1 \times 10^6 \text{ lb H}_2\text{O}} + \frac{100 \text{ lb TSS}}{1 \times 10^6 \text{ lb H}_2\text{O}} \right) \left(\frac{.001}{100} \right) \left(\frac{80 \times 10^6 \text{ lb H}_2\text{O}}{\text{hr}} \right) = \frac{0.32 \text{ lb particulates}}{\text{hr}}$$

This is approximately half of the stated emission rate.

- D - Paragraph 4 indicates that 15.1 pounds of particulates per hour will be emitted if an oxidizer and evaporator are used. The DEIR should have provided information showing how this emission rate was derived.
 - E - The DEIR estimates that carry-over from the stretford evaporative cooler and oxidizer to be 22.6 lb/hr. Of this total, 7 lb/hr will be particulates. The DEIR should have indicated the composition and emission rates of the other 15.6 lb/hr.
3. The DEIR should have discussed the particulate emissions that would occur during construction, drilling, and vehicular activities. Additionally, estimated emission rates and possible mitigating measures should have been included.

We appreciate this opportunity to comment on the DEIR. If you have any questions, please call George Lew at (916) 322-2886 or Kelly Birkinshaw at (916) 322-0252.

Ronald A. Friesen, Chief
Industrial Project Support Branch

cc: Bob Reynolds, LCAPCD
State Clearinghouse

Memorandum

Steve Williamson
STATE CLEARINGHOUSE
1400 Tenth Street, Rm 121

Date : September 4, 1981

Subject: Oxy Geothermal
Plant No. 1 - SCH #81082501

From : ENVIRONMENTAL HEALTH BRANCH

The Office of Noise Control has reviewed the above Draft Environmental Impact Report and offers the following comments.

1. Although personnel in this office understand that the L_{eq} values shown in Table 3, page 121, are meant to indicate what numbers might be obtained if such measurements were physically possible, and to show that the probable levels are well below existing (L_{99}) levels, inclusion of L_{eq} 's on the order of 3, 10, 15, etc. is misleading to a layman.
2. With respect to Table 5 it seems advisable, for the benefit of the nearest receptor, to indicate the durations (minutes or hours/day/week) of the expected operations and their associated noise levels.

If you have any questions, please contact Dr. Jerome S. Lukas, Office of Noise Control, 2151 Berkeley Way, Rm 516, Berkeley, Ca 94704, 415/540-2665.

for Harvey F. Collins, Ph.D., Chief

m o r a n d u m

State Clearinghouse
1400 Tenth Street
Sacramento, CA 95814

Date: 14 September 1981

RECEIVED
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OFFICE OF PLANNING
& RESEARCH

from : California Regional Water Quality Control Board
Central Valley Region
3201 S Street, Sacramento, California 95816
Phone: 445:0270

subject: OCCIDENTAL GEOTHERMAL, INC., PLANT NO. 1, LAKE COUNTY SCH#81082501

We reviewed the Draft EIR for the subject development and essentially concur with the presentation.

1. However, the comments on page 19 should contain a specification that any road watering for dust control will be regulated to prevent runoff to natural surface drainage courses.
2. There needs to be further discussion and review by all interested agencies as to whether or not the sedimentation pond below the plant site and/or an access road for maintenance should be constructed.
3. The Regional Board Basin Plan has no absolute standards for settleable and suspended materials. Objectives for inland surface waters are as follows:

"Sediment

- A) The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.

B) "Settleable Material

Waters shall not contain substances in concentrations that result in the deposition of material that causes nuisance or adversely affects beneficial uses.

C) "Suspended Material

Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.

D) "Turbidity

Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses.

14 September 1981

"Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits:

3D.1 • Where natural turbidity is between 0 and 50 Jackson Turbidity Units (JTU), increases shall not exceed 20 percent.

3D.2 • Where natural turbidity is between 50 and 100 JTU, increases shall not exceed 10 JTU.

3D.3 • Where natural turbidity is greater than 100 JTU, increases shall not exceed 10 percent.

"Exceptions to the above limits will be considered when a dredging operation can cause an increase in turbidity. In this case, an allowable zone of dilution within which turbidity in excess of limits can be tolerated will be defined for the operation and prescribed in a discharge permit."

4. Drinking water health standards for turbidity are directed to the finished product and not to the raw supply.

Please contact me at (916) 322-1594, if you have any questions.

EDWIN E. CRAWFORD
Area Engineer
Sacramento Watershed

EEC/gs

cc: Energy Commission

Lake County Office of Education

1152 SOUTH MAIN STREET
LAKEPORT, CALIFORNIA 95453
Telephone 707/263-3080

JUDITH E. LUCHSINGER
County Superintendent of Schools
GEORGE CHAPMAN
Assistant Superintendent
WILLIAM WOOD MERRILL
Schools Attorney

RUSSELL E. PULLMANN, SR.
Director, Business Services
DON F. HENTHORN
Director, Pupil Personnel
RICHARD B. GAGE
Director, Special Education

September 3, 1981

Ms. Valerie Campbell
California Energy Commission
1111 Howe Ave.
Sacramento, California 95825

RE: COMMENTS ON BEHALF OF
SCHOOLS RE: DRAFT
ENVIRONMENTAL IMPACT
REPORT/OXY GEOTHERMAL
PLANT NO. 1

Dear Ms. Campbell:

This letter is written on behalf of the school districts of Lake County as commentary on the Draft Environmental Impact Report regarding the proposed OXY Geothermal Plant No. 1, insofar as the report relates to potential impact of the project on schools.

The following comments are offered:

1. The Report finds that there will be a significant adverse impact on school facilities resulting from this project, at least insofar as it is part of the general geothermal activity that is causing and will cause a cumulative impact on schools (EIR, P. 209-211). However, in spite of this finding, the Report recommends that there be "no mitigation measures" required of Occidental. This anomaly is apparently due to the fact that CEC staff expects the impact to be mitigated through use of funds distributed to the County of Lake pursuant to AB 1905 of 1980, a bill regulating the disbursement of state revenues from the lease of federally-owned geothermal land.

The major defect in this analysis is that disbursement of funds under AB 1905 is entirely

Ms. Valerie Campbell
September 3, 1981
Page # 2

within the discretion of the Board of Supervisors of the County of Lake. The distribution of the remainder of AB 1905 money is entirely within the discretion of the California Energy Commission and the State Legislature. Although expenditure of those moneys on school capital outlay costs is authorized under the law, it is certainly not required. The Board of Supervisors of the County of Lake is already on record as indicating that there are many areas in which it plans to spend the money and that schools cannot expect to receive whatever money is necessary to meet all of their needs as a result of geothermal development. In any event, neither the Energy Commission nor the school districts have any authority to confiscate the money for school capital outlay purposes.

Moreover, this "mitigation measure" does not meet the requirements of the California Environmental Quality Act in that this is simply an unfounded assumption that money may come from some source entirely outside of the project. If in fact the money had been received or if there were a statutory or contractual right to the money, it certainly could be considered by way of mitigation of an impact from geothermal development; however, there is no such right. Nevertheless CEC staff, having made the questionable assumption that the money is available in sufficient quantity, is now contending that the impact is mitigated, regardless of whether the school districts ever in fact receive any of that money. One could argue with equal logic that state income or sales tax revenues, because the Legislature could lawfully allocate those funds to mitigation of this impact, are also available and should be considered a "mitigation measure". Before a source of funds may be counted on for mitigation, it must be under the direction and control of one of the parties to the CEC proceeding; with the exception of the funds under the control of the Energy Commission itself, that is not the case with AB 1905 monies.

The net result may be that school districts will receive no significant funds from AB 1905 and, the geothermal power plant applicants having been relieved of their responsibility under CEC staff's

rationale, the impact will remain unmitigated as geothermal development goes forward. This is not only an undesirable result from a public policy standpoint, it is clearly contrary to the express terms of the California Environmental Quality Act.

Finally, it should not be forgotten that the State Legislature is free to amend AB 1905 at any time and/or reduce the revenues available for distribution under the bill. Therefore, it is not prudent to rely on such a source of funds as the sole method of mitigating the public service impacts of geothermal development.

2. The facts appear to bear out staff's conclusion that a progressively greater proportion of geothermal development will occur in Lake County (P. 206). However, inconsistent with that conclusion are several of staff's assumptions, which form the basis for its ultimate conclusions. For example, staff assumes that geothermal workers will not move and will continue to commute, even though the general locus of geothermal activity changes (P. 209). Staff also assumes that population distribution among the four counties will remain the same, even though geothermal development sites are changing. There is no basis for making these assumptions with respect to this proposed project, at least none set forth in the Report. The final report should analyze and allow for the effect of the shift in geothermal activity on the location of geothermal worker residence (P. 209).
3. The report estimates the "cumulative labor demand for 1983" (the projected peak period of activity) as 948 workers (P. 209). The source of this figure is unclear. Moreover, present school enrollment data and the pattern of steady growth over the past several years, as well as the fact that more and more geothermal activity will be located in Lake County, indicate that the Report's estimate of two hundred additional students (P. 209) in all of the four counties due to additional geothermal development is a substantial underestimation.

If the geothermal peak in 1978 was 502 (P. 209) and if it will be 948 in 1983 (P. 209), that labor

force will be doubling in that five year period. Looking at school enrollment data, the December, 1980, Middletown census (P. 211) shows that as of 1980 in that district alone there were already nearly 200 pupils living in families with at least one geothermal worker. Assuming that only 25-50% of geothermal workers living in Lake County reside in the Middletown district (P. 211), there are at least 400 geothermal-related students in Lake County now. Assuming this is a lower figure than the enrollment in the peak year of 1978, and that the 1983 enrollment will be double the 1978 enrollment, it would appear that there will be more than 800 Lake County geothermal-related students by 1983, a drastic increase in Lake County alone over current enrollment. This analysis uses only known data and the assumptions recited in the Report, but it clearly calls into question the conclusion that there will be only two hundred more children in all four counties together.

4. The analysis of the impact of the project on the labor market and housing contains some basic assumptions that seem to have been arrived at in the absence of hard data. For example, at Page 210, the report states that

"the level of new, direct, and induced employment represents only a small addition to each county's labor supply; therefore, further geothermal development, including the OXY Project, will not have an adverse significant impact on the labor supply in the four county area. However, geothermal development may provide increased employment to the local labor force."

Implicit in this statement is the assumption that a large pool exists in the four counties of individuals both willing and able to work in geothermal steam fields and on power plant construction. While this may be true, another possibility is that these individuals would not be attracted to such highly skilled and/or laborious work, and/or that they would be found to be unsuitable employees by the employers. Apparently there is no data to support either the assumptions made by staff or

assumptions to the contrary. There certainly is none set forth in the Report.

With respect to housing, the report makes the conclusion that

"based upon the nature of transient workers' housing demand and the large distance which workers commute (for example, Ukiah, a round trip of seventy miles each day), the housing requirements resulting from geothermal development will disburse over a large area and reduce the significance of this impact. Because of existing bus transportation new residents will have a large area to chose from within the housing market. P.210)"

The problem is that there is no data set forth in the report to substantiate any of the assumptions implicit in this conclusion. For example, one hasn't any idea how many workers commute from Ukiah, what constitutes "existing bus transportation", or what the basis is for assuming that a geothermal worker likes to commute over a "large distance". It may well be that new workers will want to locate very close to a new power plant because of the cost of gas and vehicle maintenance, regardless of their aesthetic preferences; it may well be that bus transportation patterns will change. It may well be that bus transportation will tend to concentrate workers along the bus lines rather than disperse them. Anyone familiar with the condition of the roads and the topographical characteristics of the geothermal steam fields and of the four counties in general must question whether, as a practical matter, new geothermal workers are free to chose casually among any of the communities in the four-county area.

In conclusion, it appears to the school districts that major assumptions and conclusions are made in the draft environmental impact report without revealing the data on which they are based. While logical analysis plays an important role in any projection, it must be supplemented by data. The most serious defect in the report with respect to the school impact issue is a basic misunderstanding of the California Environmental Quality Act. This is revealed in the conclusion

Ms. Valerie Campbell
September 3, 1981
Page # 6

that, because the County of Lake receives AB 1905 funds, Occidental Petroleum is not required to address the impact of its project on the school districts of Lake County. Also revealed is a misunderstanding of the relationship between the County of Lake and the entirely separate and independent school districts, which have absolutely no control, legal or practical, over what the County of Lake chooses to do with its money. It is strongly urged that CEC staff carefully review its recommendation regarding mitigation of this impact. For example, staff should refer to the recommendations it made in the environmental impact report on P.G. & E. Unit 16, which are entirely inconsistent with its recommendations in the above proceeding. Staff should also look to its conclusions in the DWR South Geysers Project, which are also inconsistent with the recommendations in the OXY Plant No. 1 proceeding.

Thank you for your consideration and cooperation.

Very truly yours

WILLIAM WOOD MERRILL
Schools Attorney

WWM/da

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ROBERT L. REYNOLDS
Air Pollution Control Director

September 16, 1981

To: Valerie Campbell
Regulatory Analysis Office
California Energy Commission

From: Robert L. Reynolds, APCO *Bob Reynolds*

Re: Comments on Draft Environmental Impact Report on Oxy
Geothermal Power Plant No. 1 81-AFC-1

GENERAL COMMENT

(1) The document is well prepared and has attempted to present a fair picture of the environmental issues, mitigation, etc. However, the one definite and continued fault of the document is the reliance upon standards to determine if an environmental impact is likely to occur and be significant. Air quality standards and guidelines in particular are used to reach conclusions when addressing the issue of cumulative effects. Degradation to just under standards, MEGS or extremely permissive occupational standards may be legal; but it certainly does not occur without significant negative impact on the environment. The DEIR insinuates that the contrary is the case. The realization of a more than average sensitive population (because of age), present superior environmental quality in adjacent receptor areas, and the need to use best possible efforts to conserve and preserve such a state of the environment should be integrated into the document.

(2) A most appropriate mitigation step relative to air quality, noise and health was taken in choosing twin generating units equipped with steam by-passes of the turbine. This mitigation step voluntarily taken by Oxy is significant since the very high potential impacts resulting from uncontrolled release of large volumes of steam unabated of H₂S and non criteria pollutants far outweighs most other concerns. It is a reasonable mitigation measure that should be considered by all applicants and deserves more rigorous comment.

SPECIFIC COMMENTS

- (3) Pg. 79, Paragraph 1 - Monitoring was continued into 1978.
- (4) Pg. 79, Paragraph 6 - Heat energy is gained by the plume when water vapor condenses, and the plume rise is greater. This is the opposite to what is stated.
- (5) Pg 79-83 This section is well prepared but lacks discussion of the site specific met-data collected and the actual wind trajectory anomalies noted by measurements at 30 ft and 100 ft. In particular the opposing wind directions at significant wind speeds noted during one tracer test should be reported.
- (6) Pg. 87 Given met observations at the site, mention of the lee-side eddy should be included.
- (7) Pg. 88, Paragraph 3 - Variability of steam does depend upon location, but constituents other than H₂S are important and should be addressed. The inclusion of all test results from the two completed wells on the leasehold should also be reported.
- (8) Pg. 88, Paragraph 6 - A significant effort was made by the ARB and LCAPCD to establish existing levels of criteria pollutants in the Lake County Air Basin during the past 1½ years. A years worth of data was collected at the city of Clearlake and monitoring continues at Lakeport for O₃, Vis and COH. At Clearlake NO_x, COH, CO, O₃, and Vis was measured. Particulate (total/Hi-Vol) continues to be measured at Upperlake, Lakeport and Kelseyville.
- (9) Pg. 88, Paragraph 7 - Of special concern to the LCAPCD are respirable particulates As, Hg and visibility in addition to those pollutants mentioned. Of course, those mentioned have established standards and a more obvious legal mandate for notice.
- (10) Pg. 90, Paragraph 1 - The reported 1.74 µg/m³ (TSP) measured on Socrates Mine Rd. merely reflects the severe deterioration of the road since 1977. Dust complaints occur on occasion in regards to the road, and even the untrained eye can detect a serious dust problem existing on Socrates and other dirt roads in the Geysers area.

- (11) Pg. 98, Paragraph 1 - Monitoring by the LCAPCD showed two violations one of 36 ppb and one of 33 ppb since beginning monitoring in October of 1979 at the Anderson Springs Recreation Center, however the hours are not clock hours.
- (12) Pg. 98, Paragraph 5 - The reported SO₂ standard should be 0.05 ppm not 0.06 ppm.
- (13) Pg. 99, Paragraph 3 - All of the LCAPCD rules and regulations apply to operations and construction at Oxy Geo #1. The NSR rules are merely more relevant to making an AC/DOC determination.
- (14) Pg. 100, Paragraph 6 - A half mile prescriptive limitation also applies to well pads.
- (15) Pg. 103, Paragraph 2 - A number of factors in addition to steam quality affect partitioning. An improved partitioning over a period of time in excess of 90% at Unit #13 may be due to (in part) inleakage in the condenser, etc. The partitioning is dependent on the boric acid content apparently could explain the improved partitioning at Unit #14. It would be beneficial to mention the preliminary results of methods to improve partitioning. Also, PG & E presently claims in excess of 90%.
- (16) Pg. 103 Change the several references of 7.5 pounds to 8.0 pounds of H₂S per hour.
- (17) Pg. 104, Paragraph 5 - The tail gas of the Stretford unit would be the applicable point at which rule 412 B is to be met. Oxy, according to stipulations, will specify this requirement in their bid.
- (18) Pg. 104-114 A brief discussion of the utility of models and tracer tests should be incorporated. The discussion of modeling if possible would explain the wind field generation technique, model grid-cell size relative to transport distances, uncertainties of plume rise inputs, uncertainties of emission inventories and future sources, and any smoothing or averaging assumptions utilized in the model.

The LCAPCD does agree with the validity of the conclusion on pg. 112, paragraph five. Note should also be made of the fact that the two tracer tests only marginally fitted the criteria for downwash and limited mixing.

- (19) Pg. 114 The corrosion problem can be worsened by chemical mismanagement and avoided to a great extent the use of the necessary material to ensure compatibility or abatement techniques.
- (20) Pg. 116, Paragraph 2- The final noise ordinance is awaiting the adoption of a general plan by the County.
- (21) Pg. 117, Paragraph 2- Note should be made of the Toscher Cabin.
- (22) Pg. 117, Paragraph 5 & 6 The service traffic especially of large trucks utilizing the engine compression brake are the more likely significant source. This is especially true for periods of time when nearby residents are attempting to sleep.
- (23) Pg. 124, Paragraph 1- The noise will be noticed primarily because of the existing serenity, and the fact that it will be within legal limits does not mean it is not an environmental affect.
- (24) Pg. 124, Paragraph 4- The data for Unit #17 represents an operating unit and is not representative of upsets or construction noise.
- (25) Pg. 128, Paragraph 4- Mitigation steps should be made consistant with the joint stipulations and compliance plan filed for the subject project. Also, except for accidents or safety considerations unmuffled venting of steam or compressed air is not necessary. A necessary mitigation is to avoid doing such unmuffled venting.
- (26) Pg. 135, Paragraph 4- The federal standard for Rn 222 in equilibrium with its daughters should be reported.
- (27) Pg. 135, Paragraph 5- Has any testing of human hair been performed to see if mercury levels in residences or workers in the Geysers area is abnormally high? If not, is any planned?

- (28) Pg. 135, Paragraph 6- It should be noted that presently PG& E posts cooling towers as off limits because of inorganic arsenic. Was this decision to post based upon new information or the information quoted?
- (29) Pg. 136, Paragraph 1- It should be stated that the serpentine rock will be drilled while constructing wells. Also, Oxy did measure the existing wells condensate steam to identify chrysotile asbestos levels and they can be reported.
- (30) Pg. 135, Paragraph 4- See comment on mercury above.
- (31) Pg. 140, Table 3 The inclusion of occupation standards in any table for suggested levels for non regulated pollutants, even with an explanation, is in poor judgement. Occupational exposures are compensated if later found in error; and it is not uncommon to rotate persons being exposed or remove sensitive individuals. Table three should be split into two tables - one applicable to power plant workers and the other to ambient air levels resulting in exposure to the general public.
- (32) Pg. 146, Paragraph 3- The need for Oxy to monitor for all constituents given their design and more remote location should be evaluated carefully. Benzene appears to be of questionable importance as a potential problem.
- (33) Pg. 146 Suggested mitigation should take note of DOC conditions and attempt to avoid unnecessary redundancy.
- (34) Pg. 147, Paragraph 2- What Study? Can more information be provided? It should if at all possible be mentioned in detail.
- (35) Pg. 196 - Mitigation- This section leads to the wrong conclusion. The reason that cumulative noise from the power plant will not be a problem is that mitigation steps will be taken. For example specifying equipment and steamline designs to avoid resonance, utilizing steam vent mufflers and turbine by-passes, using noise insulation, etc., are all mitigation steps which are planned. Each of the individual impacts are potentially very significant and perhaps CEC staff meant to state that no additional requirements

on the power plant are necessary to avoid a cumulative noise impact which would be unacceptable or illegal. The issue of the cumulative noise from traffic should be addressed in order to present an accurate EIR. The construction traffic is mentioned as an unavoidable noise impact on pg. 217.

(36) Pg. 198

The cumulative health section should also reference the Gennis and Associates' Robin-Perrini Hill or Northeast Geysers (Lake County) EIR's. There is a very good health section referencing a number of publications included in these EIR's. Also included is a section on odor and thresholds for H₂S which could prove of interest to readers.

(37) Pg. 202, Paragraph 2-

Non criteria pollutants which condense or are removed in the stretford scrubber are significantly abated if a turbine by-pass is incorporated to avoid stacking. During stacking the total steam content is vented into the air.

(38) Pg. 318-321

A reference to the appropriate EPA document or more recent compilations of information on several of these pollutants could be helpful and prove helpful to parties wanting additional information.

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Ms. Valerie Campbell
Project Manager
California Energy Commission
1111 Howe Avenue
Sacramento CA, 95825

September 30, 1981

J.O. No. 13876
WP 40B4
SW/OXY-87

RE: DRAFT ENVIRONMENTAL IMPACT REPORT
OXY GEOTHERMAL PLANT NO. 1

Dear Ms. Campbell:

Attached are comments on the Draft Environmental Impact Report. They are organized into General Comments and Specific Comments. General Comments are those that are either referred to more than once in the text or are too lengthy to incorporate in the Specific Comments. Specific Comments are identified by page and paragraph. Where suggested rewording is provided the comment is in quotes. Additions or changes are underlined. Deletions are identified by an underlined blank.

We trust that these comments will assist you in presenting a balanced assessment of the project.

These have been reviewed by Occidental Geothermal, Inc, and are being submitted on their behalf.

Very truly yours,

V. R. Fesmire
Project Engineer

VRF/ka

Enclosure

CC: R. Ward (Oxy)
T. Hamilton (Oxy)

SPECIFIC COMMENTS ON
DRAFT ENVIRONMENTAL IMPACT REPORT

	<u>Page</u>	<u>Paragraph</u>	<u>Comment</u>
1.	ii	second	"Basically all of the environmental documentation indicates the sensitivity of placing a geothermal development <u>high in a relatively fragile watershed, parts of which provide</u> both potable and recreational waters..."
2.	ii	fifth	16.7 acres should be 18.5 acres
3.	iii	Steam Supply	"The Oxy power plant will require approximately <u>1,600,000</u> pounds per hour and will <u>probably</u> require 7 to 12 wells <u>initially</u> to furnish this supply."
4.	iii	Twin Units	"...each of which could independently produce <u>80MW</u> of net electrical output..." <u>However the remainder of the plant is capable of removing only the waste heat produced by 80 MW net of power, so the system design includes governors...</u> "
5.	iii	Condensers	"Hydrogen sulfide contained in the noncondensable gas stream <u>can be treated more economically</u> than the hydrogen sulfide contained in the liquid condensate stream."
6.	iii	Cooling Towers	"The proposed power plant will use two <u>4 or 5</u> cell cooling towers."
7.	iv	Geology	"Oxy's development as a part of geothermal development of the entire KGRA, will add to the overall <u>development</u> of the steam reservoir."
8.	iv	sixth	..."however, the Oxy leasehold is located on highly erodable soils <u>high in a watershed, which ordinarily</u> supplies both recreational and domestic water for <u>about 120 households</u> downstream..."

9. iv sixth Distinctions should be made between Anderson and Gunning Creeks when discussing water sources.
10. v first "o Pave the internal access road from drill site C to B prior to construction of well pad C." (Pad B has been constructed.)
11. v first "Oxy will participate in a water quality monitoring program which will help identify whether further mitigation measures are necessary."
12. v Hydrology para. 1 16.7 should be 18.5
- Hydrology para. 2 "The Oxy leasehold is located high in a watershed parts of which supply agricultural, recreational and domestic waters to downstream residents. The total development of this project (power plant, access roads, and steamfield) could place an additional sediment load in these waters and thereby alter the water quality. However, the conclusion that "high" sediment load is possible cannot be drawn without quantification. Degradation to local creeks could impact recreational and domestic use as well as alter the aquatic ecosystems which affect fish and other aquatic organisms."
- Hydrology para. 4 Gunning Creek is not presently pristine. Recent water quality sampling upstream of Socrates Mine Road indicates total coliform counts exceed 800 most probable number (MPN) per 100 milliliters (ml), while fecal coliform concentrations exceed 16 MPN 100 ml (Supplemental Separate Stipulations of Applicant, filed Sept. 3, 1981).
13. vi Vegetation "Oxy has _____ completed adequate studies on the occurrence of rare species including a followup survey in the spring of 1981.
14. 21 acres should be 18.5; 59 should be 51
15. vi Wildlife, second Add after the first sentence on the ringtail: "A fully protected species cannot be hunted or taken. There is no prohibition, however, against development in the general habitat area."

16. vi Wildlife, third Add: "However due to the lack of suitable drill sites on the lease, the Bureau of Land Management has made an exception and approved both Well Pad B and the road from B to C."
17. vi Air Quality "The Oxy project might contribute HDE, GD marginally to an existing air quality problem...The LCAPCO has issued a Determination of Compliance which indicates that Oxy will use best available control technology (BACT) to limit H₂S emissions to 8.0 pounds per hour."
17. vii second In place of last sentence: "Oxy's design of the cooling towers and other facilities will reduce rates and amounts of such emissions."
18. vii fifth "...around the entire plant site and around individual H₂S abatement and chemical handling areas."
19. vii sixth "Oxy will contract for disposal of wastes at approved disposal sites in Martinez, Middletown or Kelseyville."
20. viii fifth "Oxy and other geothermal developers will share the costs of improving Socrates Mine Road. County improvement of Butts Canyon Road has already been funded."
21. viii sixth "The Oxy plant will consume approximately 1,600,000 lbs/hr of geothermal steam."
22. ix second "Staff recognizes the potential for the Oxy development to cause a significant public service impact on the recreational water system for Anderson Springs. However, there will not be a significant impact on domestic supplies taken from Gunning Creek. Cautious engineering and adequate mitigation measures may dispel this concern."
23. ix sixth "Although cumulative geothermal development (Oxy #1 and others) in this watershed may degrade the water quality of Anderson Creek, Oxy's contribution to such impact will not be large".

24. x second "The federal government holds mineral rights on the property and Oxy has a 40-year lease from the U.S. Bureau of Land Management to develop the geothermal resources. Oxy has the right to use the surface as necessary to develop the steam resource."
25. 2 third "The surface land itself is privately owned and has been homesteaded for stock-grazing purposes. Permission of the surface owner to build the power plant is not necessary, but compensation is required for surface damage."
26. 5 third "Two four or five-cell wet..."
27. 5 third The sedimentation basin has been deleted due to the environmental impact of its construction and maintenance. Additional mitigation measures will be used on the toe of the fill slope.
28. 6 first The access road from Pad C to Pad B will be paved.
29. 13 fourth There is no support for the statement that subsidence induced by reservoir depletion may focus along such faults.
30. 14 second "...should a peak bedrock acceleration of 0.15 g in the horizontal direction occur at the site."
31. 18 second "The prime use of the area is to support wildlife and in part to serve as a watershed for the community of Anderson Springs."
32. 18 third The sedimentation pond has been eliminated in favor of increased mitigation measures for the toe of the fill slope.
33. 18 sixth "o Except at road crossings, a buffer zone of 250 feet (76 m) on each side of the stream will be established in which no ground disturbance will be allowed."
34. 20 second Sediment pond has been eliminated in favor of enhanced mitigation measures for the toe of the fill slope. Oxy has agreed to pave the road from Pads B to C.

35. 23 second

90 should be 85

36. 27 fourth

"...while Drill Pads B and D are south of Cobb Mountain, all four sites are..."

37. 27 fifth

Replace present paragraph with: "Site C is also located on a topographic ridge. Presently, runoff from upper slopes finds its way to the drainage arroyo where the sump fill is to be placed. However, the ditches of the access road (now under construction), and the drainage diversion ditch planned above Site C, will intercept and redirect the runoff from the slopes away from the site of construction. The only runoff remaining is that generated from the drill site slopes and nearby natural slopes. Such runoff is directed through paved or rock-lined ditches to culverts that discharge into natural drainage channels below the construction. Energy dissipators are employed in all culvert outlets."

The ephemeral seeps located in areas to be covered by the sump fill will be drained by underdrains, keyway drains, and drain blankets. The underdrains will discharge into the natural drainage channel below the fill. It is anticipated that the quantity of water from these ephemeral seeps will be substantially diminished due to the redirection of surface drainage from the slopes above."

38. 29 second

45 should be 48

39. 29 fourth

"Taken together, intense rainfall and erodible soils (neither due to the Oxy plant) could lead to accelerated erosion on the leasehold even under natural conditions."

40. 29 fifth, sixth

In analyzing the runoff induced erosion and sediment, the quantity stated should be qualified as representing erosion induced by the 100 year recurrence storm. The probability of such a storm taking place prior to partial revegetation of the slopes should also be pointed out. Revegetation will begin before the first rainy season.

A comparative tabulation should be presented relating the impact of Occidental's development to the impacts of other developments in the same watershed. For instance, it is probable that the Socrates Mine Road project may have much greater impact, as far as siltation is concerned, than Occidental's development.

Not all sediment from the leasehold gets as far as Lake Berryessa.

41.	30	first	The present high sediment condition is a natural occurrence. There is only one geothermal unit operating in the Putah Creek watershed; Unit 13. All other operating units (including the only two operating in 1965, Units 1 and 2) are in the Big Sulphur Creek drainage. In addition, California has no standard for suspended or settleable solids for human consumptions. This is cited in the Cumulative Impacts - Water Quality section of this EIR, p. 175.
42.	30	sixth	"Further downstream, the <u>better</u> quality inflow...."
43.	40	second	See General Comments - Water Quality No. 2
44.	40	third	"No regional groundwater aquifers _____ have been reported in the rock formations of the Mayacmas Mountains."
45.	48	third	"...contributed dissolved but particularly suspended solids during runoff periods (Station A2.7).
<u>Improvements to Socrates Mine Road may reduce these levels.</u> "
46.	49	second	See General Comments - Water Quality, No. 3.
46A.	49	fifth	The CEC staff discussion of present turbidity levels in Gunning Creek seems to discount the importance of storm timing and intensity. The spot sampling for suspended solids in Gunning Creek during 1980-1981 did not include any values from the largest storm of the

season. Furthermore, the CEC staff admits that the suspended solids level would probably be higher for larger storm events. Thus, the comparison of Gunning Creek data to that for pristine, undisturbed watersheds is inappropriate at best.

47.	50	fifth	The EIR indicates that Gunning Creek supplies 70 percent of the potable water for the approximate 700 residents of the Anderson Springs community. The origin of this estimate (70%) is unknown. In addition, the system serves approximately 185 hook-ups and less than 700 residents.
48.	51	second	16.7 should be 18.0
49.	51	third and fourth	The sediment pond has been deleted in favor of enhanced mitigation measures for the toe of the fill slope.
50.	51	fifth	The initial slug of water from the plant site will be diverted to the cooling tower basin. The remaining water will be clear rain water and will not be similar to that from an "urban or industrial" area.
51.	51	sixth	The eariler accidents listed in this paragraph should be distinguished generally from those which happened in recent times and under modern control methods.
52.	53	second	13 acres should be 1.0 acre
53.	53	fifth	The sediment pond has been eliminated. However, this paragraph also assumed that earth moving activities would take place during the rainy season. This is not the case. In addition, revegetation will begin before the first rainy season.
54.	53	seventh	"The purpose of the berm is to contain spills from the cooling <u>water system</u> ."
55.	64	sixth	Rare plant studies have now been completed.
56.	72	third	It is possible that ringtail occur on the lease. However, no ringtail has been spotted or detected.

- 56A. 73 second The 21 should be 19. Revised response submitted April 22, 1981.
57. 73 fourth See comment No. 53.
- 57A. 74 second "The potential loss of vegetation to cooling tower drift..."
58. 75 fourth A fully protected species cannot be hunted or taken, but development is allowed in the general habitat area. As staff notes, project development "will not eliminate habitat types which staff considers to be ideal for ringtail."
59. 76 third "...a program of habitat management and enhancement. Once the landowners permission has been granted, this will include a regular prescriptive burning program..."
60. 76 fifth "In addition to burning, Oxy will provide protection to existing snags from fire by establishing a no-burn zone in the area of the snags."
61. 76 sixth "In the event on-site mitigation cannot be implemented Occidental is willing to pay a fee equal to the cost of the full mitigation measure. This money will be used..."
62. 77 second Replace paragraph two with the following: "Through the ARM program, monitoring for impacts which have not been clearly determined, due to a current lack of data, will be conducted. This program may be modified by mutual agreement between CEC and the geothermal developers participating in the program."
63. 77 third Oxy does not see the need to conduct such a study and does not plan to do so.
64. 77 fourth "Reports on short-lived items (e.g., the Aquatic Resource Monitoring Program for the first two years) will cease one year after completion."
65. 81 Table 1 Air Quality - Table 1 should have information in °F for public review, rather than °C

66.	82	fifth	"At elevations above 2,000 feet (610M), the predominant wind..."
67.	100	second	"o The power plant <u>is located such that not more than one permitted power plant is closer than 0.6 miles</u> and is not located within 1.0 miles of a populated area..."
68.	103	third	90 plus or minus 30;"...based on an expected incoming steam flow of 1.6×10^6 pounds per hour, would range from approximately <u>96</u> to <u>192</u> pounds per hour."
69.	103	fourth	"For the Oxy #1 project, Rule 608 limits the H ₂ S emission rate to <u>8.0</u> pounds per hour, based on 1.6×10^6 pounds per hour steam input."
70.	103	fifth	"...(based on the highest input rate of H ₂ S of <u>193</u> pounds per hour)..."
71.	106	Air Quality Table 6	The peak concentration for H ₂ S emission by Oxy #1 in limited mixing for the 1984 simulation should be <u>1.6 ppb</u> , rather than 1.8 ppb.
72.	112	fourth	"The peak value predicted is 1.6 ppb H ₂ S in the Ford Flat/Anderson Springs area."
73.	117	third	"Ambient noise levels at <u>receptor locations near roads</u> ranged from 70 dBA to 29 dBA.*"
74.	124	first	"...construction noise levels range between 75 dBA and <u>94</u> dBA at 50 feet...to range from 30- <u>38</u> dBA Leq..."
75.	124	second	"Construction traffic should be limited to daylight hours, <u>to the extent practicable.</u> "
76.	131	first	"The hydrogen peroxide will oxidize the dissolved hydrogen sulfates to <u>soluble sulfates</u> . Side reactions may result in the production of <u>elemental sulfur and iron sulfide precipitates</u> . The elemental sulfur and iron sulfide solids from the secondary abatement system are expected to amount to less than 3.5 cubic yards of sludge per year. <u>These wastes will accumulate in the cooling tower basins, along with sludge formed by particulates scrubbed from the atmosphere.</u> "

77. 136 fifth
A paragraph should be added between paragraphs four and five quantifying the present substandard condition of the water and the Anderson Springs Water Company. This should include a discussion of public programs to fund improvements to the system and the current status of the Anderson Springs Community Services District. See also General Comments Water Quality 1 and 2.
78. 147 fourth
"o Mass balance measurements (operational) for arsenic and mercury, if agreed to be warranted and methods are available that yield meaningful results.
79. 147 fifth
Oxy will perform monitoring as required by the lead agency, the Regional Water Quality Control Board.
80. 147 sixth
The ARM program is being established, and Oxy is participating.
81. 147 seventh
On September 22, 1981 Oxy and the staff agreed that the expected levels of asbestos in the water were so low and measurement techniques at the expected levels so inaccurate that these measurements do not need to be taken.
82. 149 first
"Socrates Mine Road is presently being upgraded and paved.
- 82A. 149 third
The Union Oil road is paved. However, all Union roads are private and not open to the public or Oxy.
83. 149 fifth
This paragraph should be revised to indicate its present condition and to show the source of the improvements. In addition, it should state that Socrates Mine Road can only impact Gunning Creek at the bridge crossing.
84. 152 third
"...aggravate the existing impaired conditions. Lake County has arranged for over \$186,000 of 1981 AB 1905 funds to repair this road."

85. 153 second Add the following paragraph between the second and third: "Oxy does not plan to use any access roads from Sonoma County and will not use the Healdsburg-Geyzers Road, the Cloverdale Geyzers Road or Pine Flat Road. In addition, Ford Flat Road in Lake County will not be used."
86. 153 four "...from the project area per day. All truck and light traffic will use Socrates Mine Road. To further decrease the light traffic..."
87. 155 second Oxy has agreed to preclude truck traffic during school bus hours to the extent feasible.
88. 155 three "...the road through Birdsong Meadow and the balance of the fire road have now been completed and paved. Oxy has participated in the costs of these improvements. Paving the road will alleviate..."
89. 156 first PGandE and Union Oil did not participate in the Socrates Mine Road improvement.
90. 157 first "...Requires approximately 1,600,000 lb/hr. CEC staff experts..."
91. 157 fourth "...contribute incrementally (1,600,000 lbs/hr) to the overall..."
92. 158 fourth The governors are not a steam conservation technique since their use results in less power being produced, not less steam used per kilowatt-hour. However, Oxy has incorporated two measures to make more efficient use of steam. Suggest replacing the paragraph with: "Oxy has taken several measures to make more efficient use of steam. The dual turbines will allow one turbine to operate when the other trips, reducing the amount of steam that is stacked, unutilized to the atmosphere compared to a plant with a single turbine. It is planned to operate at 165 psia during single turbine operation. Raising the inlet pressure from the 115 psia used in all presently operating plants increases the plant efficiency. This inlet pressure is a "first" for The Geysers.

The plant will also use turbines with longer last stage blades than any currently in use in The Geysers, again resulting in increased efficiency. There are other measures that potentially could be taken to increase efficiency even further, but the Applicant feels that enough innovative measures have ben taken in this plant for the "next step" in increasing plant efficiency."

93. 158 sixth Oxy will recycle any material that has a net salvage value.
94. 161 first "...CEC the BLM's Ukiah office, and Occidental will meet with the specialist within one working day after the initial notification to discuss mitigation measures.*"
95. 161 third "...to evaluate the find. Any construction in the immediate area will remain stopped until the specialist can evaluate the extent and significance of the resources. In consultation with CEC and interested agencies, Oxy will develop the necessary mitigation plan. If agreement between Oxy and CEC cannot be reached regarding a mitigation plan, the matter will be considered under the provisions of the CEC Dispute Resolution Procedure."
96. 163 fourth "To the east, the site is visible from points within Collayomi and Long valleys, including locations in _____ Middletown and along Highway 29 and 175. However..."
97. 164 third Oxy does not believe that this development will degrade the aesthetics of Gunning Creek in any fashion, and any impacts on Anderson Creek will be nondetectable compared to naturally occuring impacts and impacts from other developments.
- 97A. 168 second It is true that the steam resource is depletable. However, so are all fossil energy sources. The depletion of this resource results in a product, electricity, that is of beneficial use to man.

- 97B. 170 third
There is no evidence in the record that the Oxy roads have increased erosion from 2 to 360 times, as implied by the paragraph wording.
- 97C. 170 fourth
What is the density of roads in the Klamath, Trinity, and Smith basins? Have they used mitigation measures to the extent that Oxy will?
- 97D. 171 first
Oxy does not plan to convert 40 percent of the lease to grassland.
98. 171 second, third
The sedimentation impact of the development is limited to Anderson Creek. Gunning Creek, the domestic water supply for residences in the area, is not impacted by the development. The 1/4 acre of fill slope at Site B still draining into the 770 acre Gunning Creek watershed will have no impact as a result of the proposed extensive mitigating measures. Such measures include placing topsoil and hydroseeding the slope, placing an effective erosion protection matting over the seeded slope, placing a ten foot wide rock rip-rap at the base of the slope, and placing a siltation screen of hay bales downslope of the fill.
99. 172 second
Oxy has employed greater mitigation measures for the fill slope in Gunning Creek than will be employed for the other drill pads and plant site. The sediment pond has been eliminated in favor of enhanced measures for the toe of the fill slope.
100. 173 sixth
"...public water supply. Oxy has taken extraordinary measures on the fill slope in the Gunning Creek watershed which should preclude degradation of the Creek from development of the Oxy lease."
101. 174 first
See General Comment Water Quality No. 3
102. 174 second
Add a new final sentence: "All federal and local agencies having jurisdiction have approved the construction of Well Pad B and the access road to it."

103. 174 third There are no barrow pits. There are side drainage ditches. The road will be paved before the first rainy season.
104. 175 first The reference to the State of California requirement for an average monthly turbidity of less than 1.0 NTU should note that this standard applies to treated waters, not raw waters. The ASWC does not provide the turbidity removing treatment systems required for water from surface sources.
105. 176 second "When Oxy implements the mitigation measures, the potential for impact to local water resources should be lessened, and the impact on domestic water sources should be less than under pre-development conditions."
106. 177 Lake County, 1. "Sewage" should be "seepage".
107. 177 CEC Mitigation, first "...there is a strong likelihood that soils will be eroded from the leasehold and deposited in Anderson Creek. Deposition of soils in local creeks has the potential to physically and chemically degrade the recreational water supply of the community of Anderson Springs. The water in Gunning Creek will not be degraded by Oxy development."
108. 177 last "1. Institute a network of continuous monitoring stations to demonstrate the effectiveness of on-site mitigation as ordered by the CVRWQCB, as lead agency."
109. 178 entire page This discussion of monitoring/mitigation measures is unclear. The focus of the program and its relation to mitigation of adverse impacts may be protecting downstream water quality, estimating incremental soil losses or erosion rates resulting from Oxy's developments, or perhaps both these objectives. Monitoring by itself only documents events; it provides no protection other than perhaps to deter capricious behavior. Oxy's development may increase sediment loads in Anderson Creek. It will not increase the sediment load in Gunning Creek. The proposed

monitoring program ignores the contribution of the other geothermal and nongeothermal activities within the watershed, and as such does not assess the overall existing and potential problem. For example, both the construction of Unit 16 and the upgrading of Socrates Mine Road will impact Anderson Creek.

The Central Valley Regional Water Quality Control Board (RWQCB) has primary jurisdiction over water quality control. No acknowledgement of this is made on pages 177 and 178. Oxy has agreed to establish the continuous flow and quality monitoring station as requested by J. Lawrence Pearson of RWQCB in his letter of August 5, 1981, to R. F. Ward of Oxy.

110.	178	tenth	A continuous turbidity monitoring device may not be available that can provide reliable results.
111.	178	thirteenth	Should be specific about "other physical and chemical parameters" that are being suggested for monitoring.
112.	181	Second	59 should be 50.3. Biology Table 1 should be replaced by General Comment, Acreage. The General Comment contains the current values.
113.	182	first	Well Pad B will improve water quality in Gunning Creek.
114.	182	second	"...its access road. <u>All agencies with jurisdiction have, however, approved the construction of Well Pad B, and its construction is now complete.</u> "
115.	183	fourth	"o Enhance wildlife habitat through vegetation management, including prescribed burns _____ where necessary."
116.	183	fifth	"o Monitoring of aquatic biological resources shall be conducted on Anderson Creek and Gunning Creek <u>through the ARM program.</u> "
117.	183	sixth	Oxy does not consider that a persuasive case has been made for monitoring the ringtail.

118. 188 second "...shown in Cumulative Air Quality Table 4). At sensitive receptor locations, the SAI simulation shows approximately a 10-20 ppb contribution from the NCPA units..."
119. 188 third "...background concentrations in 1985-1986 would be about 10 ppb near Anderson Springs..."
120. 188 fourth "...a change of less than 1°F in wet-bulb temperature readings."
121. 194 third "...the worst-case predicted 1984 background H₂S concentration at sensitive receptor areas...it is unlikely that a violation or near-violation will occur in the Anderson Springs area when Oxy #1 comes on line. The maximum incremental impact expected..."
122. 194 fourth "By 1985-86, the CEC staff expects the background levels in the receptor areas to be even less (about 10 ppb)..."
123. 194 seventh "The projected impact from Oxy #1 is insignificant..."
124. 195 first "...referred to as stacking. If unabated, Oxy would emit during stacking as much as 193 lbs H₂S/hr..."
125. 195 second "The results of modeling and tracer analyses indicate that Oxy #1 H₂S emissions will result in a maximum of two ppb at Anderson Springs..."
126. 195 second "...20 times (193 lbs/9.7 lbs = 19.9). If unabated, this would constitute a violation..."
127. 195 third "...the estimated particulate emission rate of approximately 8.0 lbs/hr..."
128. 199 second The emission rates used to project values for arsenic, boron and mercury assume they are completely emitted. They are particulates, and a large fraction of these contaminants end up in the sludge in the cooling tower basin as is demonstrated by analysis of the sludge.

129. 199 third "...CEC staff believes that monitoring of emissions and ambient air nonregulated pollutant concentrations is needed to determine steam concentrations and existing ambient levels of these pollutants."
130. 200 Health Table 1 The emission rate assumption used as a basis for estimate is not correct for arsenic, boron and mercury.
131. 201 Footnote g. "to occur simultaneously. Therefore these values overestimate the cumulative impact."
132. 203 second The requirement for operational ambient monitoring should be based on preoperational results and measured constituents in the steam.
133. 203 second "Mass balance measurements (operational) for arsenic and mercury will be performed if warranted and if measurement techniques will yield meaningful results".
134. 203 third "...and recreational waters. In addition, Oxy will monitor potentially toxic constituents in Gunning Creek, which supplies drinking water for Anderson Springs, through the ARM program."
- 134A. 203 fifth It has been agreed by staff and Oxy that there is no need to monitor asbestos in water.
135. 211 sixth The total amount of AB 1905 awarded to the Middletown and Konocti School Districts should be updated. This amount is all that has been requested by the school districts. No applications have been made for AB 1905 funds administered by the CEC.
- 136 212 third The CEC presents a discussion of project specific impacts on public services. The conclusion drawn is the degradation of Gunning Creek would require improvements to the Anderson Springs Water Company's supply system and result in fiscal impacts on the community. This discussion fails to recognize that the Anderson Springs Water Company

(ASWC) water supply system requires updating regardless of whether or not the geothermal development takes place. The ASWC water supply system does not satisfy requirements for using surface water as per Title 22 of the California Administrative Code.

137.	212	fifth	"The Lake County Board of Supervisors and the CEC separately administer monies provided under AB 1905..."
138.	215	first	50-60 should be 50.3. Thirty-seven should be fifty. 8 percent should be 10 percent.
139.	215	third	Excavation and fill placement for the sediment basin will disrupt and alter the flow from <u>an ephemeral seep</u> on the 3,400 contour."
140.	216	second	All disturbance to the ringtail riparian habitat zone has already taken place.
141.	216	fourth	"The main point, in terms of environmental consequences, is that recent monitoring shows that the number of air quality violations is decreasing. Oxy #1 <u>may</u> contribute incrementally to this violation, but on a very "
142.	217	third	See Comment 133.
143.	217	fourth	See General Comments - Water Quality.
144.	217	fifth,
sixth	These two paragraphs should be updated to indicate the completed improvements on Socrates Mine Road and planned improvements.
145.	218	Socio-
economics	See Comment 136.
146.	220	fourth	"More importantly, soil erosion from the full development has the potential to degrade the quality of <u>recreational</u> sources of water."
147.	220	sixth	"...Oxy will need less than one acre-foot of water per year to operate the power plant. <u>This make-up water will be taken from the condensate.</u> "

148.	221	first	There will be a beneficial impact on Gunning Creek.
149.			deleted
150.	221	sixth	It has not been demonstrated that a ringtail study is warranted.
151.	222	second	"The Oxy geothermal plant will irreversibly consume <u>1,600,000</u> lbs/hr of geothermal steam."
152.	223	first	There will be no degradation of Gunning Creek.
153.	223	fifth	The conclusion of this paragraph should be that if upgrading the ASWC is required, it is in the best interest of the federal, state, and county to do it so that the revenues of \$2,104,487/yr will not be lost as would happen if Oxy were to abandon the project.
154.	231	second	"This gas stream passes through the primary abatement system which employs the Stretford chemical scrubbing process to <u>remove</u> the H ₂ S.
155.	231	Metal catalyst system	This section on the Metal Catalyst system is irrelevant to a present day discussion of alternative H ₂ S Abatement Systems and should be replaced by a discussion of <u>"o Carbon Dioxide pH Control --</u> Injection of carbon dioxide (CO ₂ into condensate to displace the H ₂ S dissolved in the condensate is an attractive method for reducing the amount of H ₂ S in the condensate. CO ₂ obtained from the Stretford process <u>vent gases would</u> provide a readily available source of CO ₂ ."
156.	238	Alternative location	This paragraph is superfluous. Pad B is completed.
157.	280	1. Roads	There is no road in the Gunning Creek watershed.
158.	281	Pipeline Corridors	No pipelines will be located in the Gunning Creek watershed".
159.	282	Power Plant	Topsoil will be stockpiled for revegetation.

160.	283	Increased Erosion	Run-off from cut and fill areas will be discharged to the natural drainage. Runoff from the paved power plant area will be reinjected except for the largest storms.
161.	285	Water Quality	See General Comments - Hydrology.
162.	286	Flood Hazard	See Comment 27.
163.	287	Water Supply	Water will be purchased by contractors only from those who have a legal right to sell it.
164.	296	third and seventh	Rare plant surveys are complete. It has not been demonstrated that further wildlife studies are necessary.
165.	297	second, fifth	These conclusions support Oxy's stand on the proposed ringtail study.
166.	304	No. 2,A	"The Lake County Air Pollution Control Officer <u>has</u> made a determination of compliance (DOC). Few studies..."
167.	312	third	See General Comments - Water Quality.
168.	316	fifth	"The Canadian Ambient Air Quality objectives include a proposed maximum desirable level for H ₂ S of <u>0.66 ppb</u> (1 hour average).." This value looks inconsistent with the other data.
169.	49	Table 5	Limited Access to Non-Essential Trails. Will be done in the summer.
170.	350	Table 6	Use table from August Mitigation Plan.
171.	350	Table 6	Anderson and Gunning Creek water quality sampling will be conducted as part of the ARM Program.

General Comments - Hydrology

There is a pervasive tone throughout the DEIR that development of the Oxy lease will do immeasurable harm to the water quality of Anderson and Gunning Creeks. Oxy recognizes that development in the upper reaches of a watershed potentially can impact downstream users. The potential impact depends on the type of use; Anderson and Gunning Creeks are often combined in the same sentence or paragraph in the DEIR, as if they are a single entity. They are not. The primary use of Anderson Creek water is recreational. Gunning Creek is the primary water source for the Anderson Springs Water Company. As a domestic water source it should be protected to a greater degree than Anderson Creek. Oxy is taking great care in the design of measures to preclude impacts to either creek. These measures are specific for each creek and are discussed separately.

The vast majority of the development will occur in the Anderson Creek watershed. This includes the power plant site, all roads, the entirety of three of four well pads, and the majority of the fourth pad, Well Pad B. All cut and fill slopes will be revegetated. Benches with lined ditches will be placed on long slopes to break up the flow of water. The major road crossing of Anderson Creek will be paved from Well Pad B to Well Pad C. Spills on a well pad will be contained in a sump. Spills at the plant site will be contained by curbs around tanks and a berm around the entire plant site.

The only development in the Gunning Creek watershed is a portion of Well Pad B. The pad was designed so that the runoff from most of the disturbed area in the watershed is diverted through a culvert to Anderson Creek. Only one-fourth of an acre drains to Gunning Creek. This small area has been fertilized and seeded, then covered with fine mesh jute netting or excelsior matting.. The toe of the slope is faced with rip-rap (small rocks). Hay bales have been placed below the rip-rap. An old logging trail leading from the well pad area toward the creek has been highly eroded over the years. Hay bales have been placed on the road as water breaks to reduce this source of sediment. Bureau of Land Management personnel who have reviewed the site concur that extraordinary mitigation measures have been taken and there should be minimal sediment lost from this slope to Gunning Creek.

The watershed area of the Gunning Creek tributary nearest Well Pad B is 111 acres. The one-quarter acre of B Pad fill slope represents only 0.23 percent of this watershed. In view of the mitigation measures taken on this fill slope, the hay bales on the old logging road, and the fact that about half of the 1.9 acres in the watershed that are part of Well Pad B previously consisted of abandoned logging trails that were heavily eroding, it is Oxy's position that there will be less sediment in Gunning Creek originating from the Oxy lease now than there was before the pad was constructed. Interested parties are invited to view the development in the Gunning Creek watershed and discuss with Oxy the measures taken to protect Gunning Creek.

General Comments - Water Quality

1. One area not mentioned in the EIR which requires additional clarification is the present condition of the Anderson Springs Water Company (ASWC) and the interaction between the quality of water sources, the water treatment system, and the quality of water ultimately delivered to water users. The tone throughout the EIR is that there is nothing really wrong in Gunning Creek watershed nor with the ASWC. This is not the case. Prior to any development on the Oxy leasehold, the ASWC has routinely disconnected its diversion from Gunning Creek if weather forecasts indicated an approaching storm front. This action was and is necessary because of increased turbidity in runoff resulting from either natural processes, recreational activities, or development within the watershed.

The ASWC draws the majority of its water from Gunning Creek, which is an unprotected stream above the ASWC intake. The ASWC chlorinates for disinfection but provides no other form of water treatment. The Lake County Department of Health and the California Department of Health Services (DHS) have examined the facilities of the ASWC and found them to be seriously deficient with respect to water treatment. According to the California Administrative Code water drawn from a surface source such as Gunning Creek should be pretreated and filtered, as well as disinfected, for it to be safe for human consumption. Disinfection alone does not provide adequate protection. If the ASWC provided the mandatory treatment required by law, concerns over suspended solids or turbidity in runoff would be greatly diminished or eliminated. The reader should note that the problems with the ASWC treatment system are documented in the files of the Lake County Health Department prior to any geothermal development in the watershed of Anderson Creek and would exist today regardless of the geothermal development.

2. The CEC staff highlights (p. 40) the low average turbidity levels in Gunning Creek and points out that the values in question are below the maximum contaminant level (MCL) for turbidity in drinking water. The staff fails to note, however, that Title 22 of the California Administrative Code requires that surface waters "exposed to significant sewage hazards or significant recreational use shall receive as a minimum, pretreatment, filtration, and disinfection." The implication of the draft EIR is that Gunning Creek is an acceptable drinking water in its present state, when used by the Anderson Springs Water Company (ASWC). The reality is that Gunning Creek water is acceptable only after proper treatment and that the Lake County Department of Health and the State of California Department of Health Services have concluded that treatment now provided by the ASWC (only chlorination) is significantly deficient. The ASWC system should be upgraded with pretreatment and filtration to ensure public health.
3. The CEC staff states (p. 49), "Standard disinfection kills coliform organisms. Therefore, coliform counts do not indicate a significant water quality problem for raw water." While it is true that disinfection does kill coliform organisms, the conclusion drawn regarding raw water quality is patently false. Standard disinfection does not provide adequate

protection from other biological agents in raw water, particularly viruses and the cysts or ova of parasitic organisms such as Ascaris lumbricoides and Giardia lamblia. Viruses and cysts may be more resistant to disinfection than bacteria, particularly if water treatment processes do not reduce turbidity levels in the treated waters. In the past decade enteric viruses such as Rotavirus and Norwalk agent have proved to be significant causes of gastrointestinal illness for residents of the continental United States. In fact, Rotavirus is apparently endemic worldwide. The intestinal parasites mentioned above are also endemic within the United States. Giardia lamblia cysts which caused outbreaks of giardiasis in the users of several small water systems have been traced to nondomestic animal sources in rural watersheds. Ova or cysts of parasites can also be introduced from poorly functioning septic tanks and poor sanitation practices of hunters or other recreational users.

Recent spot water quality sampling in Gunning Creek by Brown and Caldwell, just upstream of Socrates Mine Road showed total coliform counts exceeding 800 most probable number (MPN) per 100 milliliters (ml) and over 500 MPN/100 at Ford Flat Road. Fecal coliform concentrations were found to exceed 16 MPN/100 ml. These data suggest that Gunning Creek water quality is far from pristine.

4. The CEC staff discussion of present turbidity levels in Gunning Creek (p. 49, 50) seems to discount the importance of storm timing and intensity. The spot sampling for suspended solids in Gunning Creek during 1980-1981 did not include any values from the largest storm of the season. Furthermore, the CEC staff admits that the suspended solids level would probably be higher for larger storm events. Thus, the comparison of Gunning Creek data to that from pristine, undisturbed watersheds is inappropriate at best.

General Comment - Acreages

Areas involved in various presently identified phases of the project are as follows:

	<u>Total Area (Acres)</u>	<u>Revegetated Area (Acres)</u>
Well Pads	20.1	9.4
Internal Access Roads	11.7	6.2
Power Plant Site	18.0	9.6
Transmission Line - on site	0.5	0.5
Transmission Line - off site	<u>0.5</u>	<u>0.5</u>
Total Lease	50.3	25.7
Total Project	50.8	26.2

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

SEP 30 1981

Ms. Valerie Campbell
California Energy Commission
1111 Howe Ave., MS-39
Sacramento, California 95825

Dear Ms. Campbell:

Enclosed for your consideration are our comments on the Draft EIR for
Occidental's Geothermal Plant No. 1.

Sincerely,

William F. Isherwood
Acting Deputy Conservation Manager,
Geothermal

Enclosure

USGS Comments on Draft EIR
Oxy Geothermal No. 1

- (1) Pg. v, line 4 - Although this reference to paving conforms to lay useage, it would be more accurate to note that Oxy will chip-seal the road. Also, it will be done prior to the rainy season of 1981.
- (2) Pg. v, ¶ 5 - The upper reaches of Gunning Creek have been scarcely affected by geothermal development, but the lower portion has been heavily impacted. Socrates Mine Road, a main access road to the steam field, and Ford Flat Road are both unpaved roads that cross Gunning Creek. Socrates Mine Road has been a major source of siltation to the lower portions of both Gunning and Anderson Creeks, especially during the rainy season.
- (3) Pg. vi, Wildlife, line 2 - There was no explanation in the other sections of this summary of the potential for serious impacts. In view of the emphasis, in the EIR, on cummulative impacts of associated activities (including steam field operations), it should be noted that Oxy is contributing to the upgrading and paving of the Socrates Mine Road. This will substantially reduce sedimentation in the portions of Anderson Creek which have fish and will also greatly reduce the probability of a toxic spill.
- (4) Pg. vi, ¶ 4 - Will the impacts to the ringtail be assessed before the power plant is permitted, or are studies of the ringtails in the area to be a part of the recommended approval conditions?
- (5) Pg. 1, ¶ 5 - USGS has permitting authority for well drilling and surface use. However, because of a stipulation in Occidental's Federal lease, Occidental must also obtain a land-use permit from Lake County. From our perspective, the role of the County is otherwise unclear, excepting the requirement for a permit from the Lake County Air Pollution Control District Officer. We are unaware of legislation or litigation which clearly identifies local and Federal responsibility on these 1916 Homestead Act lands.
- (6) Pg. 2 - Mention close proximity of SMUD to Oxy.
- (7) Pg. 2, ¶ 3 - A third well, on Oxy's Pad D, is now being drilled (September, 1981).
- (8) Pg. 2, ¶ 6 - Federal leases CA-5636 and CA-5637 have been consolidated into one lease: CA-5636.
- (9) Pg. 15, ¶ 3, line 3 (elsewhere) - We suggest saying parent bedrock rather than geologic parent material.
- (10) Pg. 20, line 1 - It is not clear what this monitoring program is for. Is it for soil, water, biota, or something else?

- (11) Pg. 20, Please make it clear that Tables 5 & 6 are in the last appendix.
- (12) Pg. 20, last ¶ - The phrase, ". . . soils water resource" is unclear. Presumably you mean "adjacent streams." If so, this seems best handled under water quality.
- (13) Pg. 20, ¶ 1, sentence 2 - Suggest that this read "data . . . have . . . are . . ." not "data . . . has . . . is . . ." The singular form is "datum."
- (14) Pg. 23 - It would be useful to note that Anderson Creek originates on this leasehold and that Gunning begins slightly above the northernmost lease boundary, and flows southward across the lease.
- (15) Pg. 23, ¶ 4 - We think it would be informative to also give the drainage area of Anderson Creek upstream of its confluence with Gunning Creek.
- (16) Pg. 27, Runoff - Sentences 3 and 4 are unclear. Did you mean "upslope" rather than "upstream?"
- (17) Pg. 27, Runoff, ¶ 4 - What is the 470 acre area? It is not in Water Table 1.
- (18) Pg. 29, ¶ 1 - The significance of the second sentence would be clearer if it read, ". . . runoff from 63 of the 5,632 acres in the Anderson Creek drainage."
- (19) Pg. 29, ¶ 2 - Why 45 rather than 63 acres? Where are the other 18 acres of disturbance cited in paragraph 1 occur if not in Anderson Creek's watershed?
- (20) Pg. 29, Erosion, first sentence - Rainfall, slopes, and soil characteristics result in high erosion potential.
- (21) Pg. 29, Sediment Yield - It would help if these erosion rates were converted to express the total expected yield before, during, and after construction. Also, where did the "recommended" 3 ton/acre/year come from?
- (22) Pg. 29, ¶ 2 - The last sentence is true, but it is not clear why these impacts are mentioned here. The power plant, which is the subject of this EIR, is the last phase of geothermal development on this lease, not the trigger for subsequent development.
- (23) Pg. 29, ¶ 5 - Does the 6 tons/acre value apply to the construction period, first three years after construction, or after revegetation?
- (24) Pg. 30, line 1 - Should read "March 1965."
- (25) Pg. 30, last line - This sentence doesn't agree with the table. For turbidity alone, there were 80 samples and 24 of these exceeded MCL's. The sentence would be accurate if it said, "As many as nine samples per station exceeded . . ."
- (26) Pg. 40, ¶ 5, line 5 - Is this reference correct? The statement may be accurate but Jim Knott doesn't seem likely as a source of this infor-

mation. Chuck Wassinger, the geologist in the District Geothermal Supervisor's office, is a more likely source.

- (27) Pg. 42, 188 - How will Oxy dispose of sediment accumulated in the sediment basin?
- (28) Pg. 49, line 13 - What two stations are they? It is unclear which of at least six locations you mean. Moreover, one of the stations (open triangle) on Figure 3 is shown as being on a ridge top.
- (29) Pg. 49, last line - Do you mean to say "less than 20 mg/l?" The highest value in Table 7 is 8.2 mg/l.
- (30) Pg. 51, ¶ 5 - The first two sentences are unclear and, perhaps, contradictory. The first implies no storm runoff will be injected. The second implies that some will.
- (31) Pg. 51, last ¶ - We doubt that the reference for pollution incidents is correct. If we counted correctly, reference 34 is a paper published in 1967, whereas we presume you meant to cite a more recent reference, perhaps reference 43.
- (32) Pg. 52 - Is a road planned for access to the sediment pond for clean-out? How far is the toe of the sediment pond fill from Anderson Creek?
- (33) Pg. 53, ¶ 1 - Recolonization of the headwaters is probable once siltation lessens. Consequently, a time period might be placed on the estimate of impacts on amphibians.
- (34) Pg. 53, ¶ 5 - The third and fourth sentences are unclear. In the sixth sentence, the figure "4.2 tons/acre appears to conflict with the 6 tons/acre mentioned elsewhere in the report. Also, should this be 4.2 tons/acre/year? Sentence three states that erosion from 55 to 200 tons/acre (per year?) could occur during construction, while on Page 29, paragraph 5, that erosion could be more than 200 tons/acre (per year?) Is this also a conflict?
- (35) Pg. 55 - Existing access roads to pads D and B are not shown.
- (36) Pg. 63, last line - Probably should read ". . . in canyons, or . . ." not ". . . canyon or . . ."
- (37) Pg. 72, ¶ 2, last sentence - We suggest you change ". . . on site" to ". . . within the leasehold."
- (38) Pg. 72, Species of Special Concern - These two paragraphs do not discuss the leasehold or the power plant site. We think they should so they will be relevant to the project in question.
- (39) Pg. 74, ¶ 1 - The fourth sentence is ambiguous and perhaps erroneous.

"Loss of vegetation" can be interpreted to mean "denudation" which probably was not the intent, and "far exceeds" is an unduly alarming statement unless there is evidence to indicate that severe effects

are to be expected over several hundred acres. The pattern characteristic of damage along a gradient of increasing stress is elimination of the more sensitive species followed by the loss of the larger growth forms. Whether one is examining the H_2SO_4 - caused impacts of copper smelters, or natural gradients of stress, one sees a shift from trees to shrubs, and from shrubs to grasslands, before one sees denudation. It would be defensible at this time to say "... mild damage to vegetation over an area which far exceeds ... construction, and severe damage to sensitive species on an area equivalent to the area impacted during construction."

- (40) Pg. 74, ¶ 2 - The assessment of effects on rare plants is surely conjectured. It is plausible, but probably unprovable since it is unlikely that the physiological responses of these species to boron, etc., have been measured. Indeed, there is evidence that many of the rare plants restricted to serpentine are found there because they can tolerate those rather toxic soils, whereas their biological competitors cannot. It is even possible, though unquestionably conjectural, that some rare plants might benefit from damage to vegetation on non-serpentine sites.
- (41) Pg. 74, ¶ 5 - The deer densities seem high by at least a factor of 5, using state-wide data for mule deer as given in USFS, 1980 California Wildlife and Their Habitats: Western Sierra Nevada, General Technical Report PSW-37. Unless you have data that are more appropriate than these, it is more accurate to predict that the loss will be 1-2, not 8-15 deer.
- (42) Pg. 77, line 4 - Is this the ARMS Program, or a yet to be proposed monitoring program for upland animals.
- (43) Pg. 129 - The reference at end of the paragraph (Gennis is misspelled) is not in the waste bibliography.
- (44) Pg. 129 - 100 gals/day of sewage produced per person? Is there a reference for this?
- (45) Pg. 147, ¶ 3 - Suggest rewording to "... monitoring program for the following reasons:"
- (46) Pg. 147, ¶ 4 - Is this air or water monitoring (or both)?
- (47) Pg. 151 - The legend contains a typo ("ro" for road) and Ford Flat is shown as a community. There are a couple of residences there, but no community.
- (48) Pg. 155, ¶ 3, line 9 - Why isn't the road paving to be completed before the rainy season or by the start of construction when the road will receive the heaviest use?
- (49) Pg. 168, ¶ 7 - "by DOG or USGS" should be "by DOG and USGS."
- (50) Pg. 170, ¶ 3, line 3 - Explanation is needed to interpret the phrase, "one to three tons/acre/year these soils can sustain."

- (51) Pg. 170, ¶ 4 - Add ". . . drainage area in the Mad and Eel River basins." Delete "e.g. those proposed by Oxy," unless you can state that the construction of Oxy's roads will be substantially like those in the Mad and Eel River Basins. If they differ, then comment on how this affects the comparison of impacts.
- (52) Pg. 170, Footnote - The statements regarding road construction are true, but should be placed in perspective. The referenced roads probably are unpaved logging roads and, one suspects, less carefully constructed and more prone to be aligned parallel to streams than are the roads on Occidental's leasehold. It is probable that these percents are upper limits of what is to be expected on this leasehold. Also, what are the similar conditions that exist on Occidental's lease and in the Eel and Mad River Basins?
- (53) Pg. 171, ¶ 1 - This rationale for high sediment yields from the Dry Creek Basin is not convincing. The vegetation of the Dry Creek Basin looks much like the Russian River Valley except it is much narrower. It would seem that geometry might play a major role in the difference in sediment yields per acre. Moreover, it should be noted that this is the Dry Creek in Sonoma County, not the Dry Creek found in Lake County, familiar to local residents.
- (54) Pg. 171, ¶ 5, line 6 - A comma should follow "nitrogen."
- (55) Pg. 172, ¶ 2, line 3 - It is not clear whether you are allowing chip-sealing as an alternative to paving. Chip-sealing and paving are not the same. We and the BLM are requiring Occidental to chip-seal the C to B access road.
- (56) Pg. 174, ¶ 1 - Has Aminoil developed sites within the Gunning Creek watershed other than the PDC No. 1 pad as this paragraph implies?
- (57) Pg. 174, ¶ 2 - The wording of this paragraph implies a lack of concern for environmental resources in the road siting decision. This was not the case. We suggest that the clause at the end of line three be dropped.

It is true that broad buffers were recommended by various agencies, but these recommendations seem to have been based on the intuition of individual biologists, and a desire to allow a generous margin for error, rather than quantitative data. There are some reports, which we plan to examine, which indicate that the buffers recommended to date may be substantially larger than necessary. Haupt and Kidd in the J. Forestry 63 (9); 644-670 reported that buffers greater than 30 feet wide were effective in Central Idaho, and Johnson in the J. Forestry 51 (8); 551-554 reports that 20-30 feet was effective in the Rockies. We have not examined the original reports yet and view the applicability of these numbers to The Geysers as tentative, yet they suggest recommendations in The Geysers have been strongly biased toward protection. We agree that there is, as paragraph 3 states, good reason for riparian nonencroachment zones, but the zones proposed may be excessive for steam protection.

- (58) Pg. 174, ¶ 5 - Such precautions were specified by the BLM/GS and Lake County approvals for drill site B.

- (59) Pg. 177, last ¶, and Pg. 178 - As a combination of local and Federal stipulations, Occidental is applying all feasible mitigation measures to pad B and to the access road to pad B. Consequently, the use of continuous sediment sampling is not clear to us. That is, we do not see how these data would lead to actions, to prevent siltation, that are not now being applied.
- (60) Nor, upon further consideration of the problem, are we convinced that the "zero discharge principle" which the second option implies is equitable to all parties. We agree that Occidental should be prepared to replace immediately water degraded by spills or large landslides caused by their operations, but the provision of a permanent water supply seems to be as much an unjust taking of Occidental's resource rights, as a total failure of Occidental to mitigate would be a taking of the downstream user's rights. We do not see a good answer within the jurisdiction of the USGS or the CEC.
- (61) Consequently, we urge very careful consideration of these recommended options.
- (62) Pg. 181, Impacts, line 5 - There is no Biology Table 3 in the EIR.
- (63) Pg. 181, bottom line - The statements, "serious threat" and "serious impacts to aquatic biota" is not supported by the text of Sediment Yield (especially the first paragraph), page 29, or the first paragraph (especially the last sentence) on page 75. If there are parts of the text to support the statement, it would help to clearly reference them immediately after the statements.
- (64) Pg. 181, bottom line - We feel the text of the Draft EIR does not support the statement ". . . will likely result in serious impacts . . . to the Anderson Springs domestic water source . . ." Also, note that the end of that sentence should read ". . . 70% of which is supplied by . . ."
- (65) Pg. 182, line 5 - We suggest using the actual distances from other power plants, well pads, and roads, instead of the word "distant."
- (66) Pg. 182, line 7 - We suggest changing "will remove" to "has removed" since the road has already been cleared and graded, and will probably be finished by mid-October. Also, the use of the word "will" is generally inappropriate in this paragraph. These roads and pads have been built.
- (67) Pg. 182, line 13 - Change "will" to "has" since pad B has also been cleared and graded and will probably also be completed by mid-October.
- (68) Pg. 183, Mitigation Measures, #3 - Is this by participating in ARMS?
- (69) Pg. 209, ¶ 3 - What is the time frame for these figures? Is it over a 10-year period? Over the life of the steam field or, by 1983? Also, the 605 new people is an increase, but it is not clear from what. In paragraph one it was stated by 1983 there will be an increase of 446 workers. The two conclusions seem to conflict.
- (70) Pg. 215, ¶ 7, line 1 - Change "will" to "kill."

- (71) Pg. 221, § 6, line 2 - Change "160°" to "160 ft."
- (72) Pg. 277, Under significance - No geologic resources, other than the geothermal resource itself, should be depleted.

ENERGY COMMISSION
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OCT 02 1981

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STATE OF CALIFORNIA ENERGY RESOURCES CONSERVATION
AND DEVELOPMENT COMMITTEE

IN THE MATTER OF	)	Docket No. 81-AFC-1
	)	
OXY GEOTHERMAL PLANT NO. 1	)	INTERVENOR'S COMMENTS
	)	<u>TO DRAFT EIR</u>
<hr/>		

Intervenor County of Sonoma submits the following comments to the draft Environmental Impact Report (hereinafter DEIR) dated August, 1981:

1. Transportation

The DEIR accurately describes the Healdsburg-Geysers Road as having poor alignment, sharp curves and short sight distances, all of which contribute to making this road below county standard; CEC staff agrees that sections are inadequate and unsafe with respect to heavy loads and multi-axle vehicles. However, it is the position of Intervenor County of Sonoma that the DEIR is inadequate in that:

- a. The DEIR assumes all construction traffic will reach the power plant site from the Lake County side and does not allow for changed conditions during con-

struction or operation which would involve use of the Healdsburg-Geysers Road which road is admitted to be inadequate to handle heavy traffic.

b. Although the DEIR acknowledges that the proposed transportation program is designed to provide workers with incentives to locate in Sonoma County, the DEIR states without supporting data that the majority of light trucks serving the project will use Socrates Mine Road while light traffic is expected to be equally divided between Socrates Mine Road and Healdsburg-Geysers Road.

c. The DEIR summarily states that the extent of deterioration of County roads due to this project is likely to be insignificant based upon the assumption that those roads are and will continue to be properly managed and maintained. However, the DEIR fails to analyze the ability of the County to properly maintain and manage the affected roads.

d. The DEIR recognizes that in order to assure safe traveling the upgrading and improvement of the Healdsburg-Geysers Road is necessary, but fails to provide for appropriate mitigation measures: the DEIR merely notes that the County may request the involved developers to participate in improvement

and maintenance cost (emphasis added).

e. With respect to cumulative impacts the DEIR points out that the potential number of vehicles which may travel in the Geysers is quite high and as development and traffic in the Geysers area increases, so do traffic hazards on the roads in this area. The DEIR claims that it is unable to accurately assess the extent or significance of road deterioration resulting from heavy equipment traffic due to the project but admits that the traffic results in a significant cumulative effect of accelerated deterioration of the private and public roads in Lake and Sonoma Counties which serve the geothermal area. The DEIR is inadequate in that once recognizing adverse cumulative effects, it fails to prescribe measures (other than encouraging ride sharing/busing) to mitigate these impacts.

The provisions of the California Environmental Quality Act require that the DEIR, having identified a mitigatable impact, must propose mandatory solutions especially since reasonable measures to mitigate the adverse impacts of this project, both individually and cumulatively on the transportation network of Sonoma County, exist. For example, if the DEIR is based on the assumption that no construction traffic will use Sonoma County roads, the permit should be so conditioned. Regarding the light truck and vehicle traffic,

the Commission should require Occidental to mitigate for project specific impacts by contributing its fair share at such time as the County of Sonoma by special assessment proceedings, or otherwise, determines that the Healdsburg-Geysers Road shall be improved.

Lastly, a reasonable mitigation for the substantial, but currently indeterminate, cumulative adverse impact on the transportation network of the County of Sonoma would be the retention of jurisdiction by the CEC by appropriate conditioning of this permit so at the time the study of cumulative impacts at the Geysers is completed (or at such time when the CEC is presented with specific evidence regarding cumulative adverse transportation impacts), appropriate mitigation can be required of Occidental and other permittees. Should the Commission fail to retain jurisdiction by appropriate conditioning, the DEIR would clearly be an inadequate document for failure to presently require full mitigation of cumulative impacts.

2. Safety

The DEIR is inadequate as it fails to raise the issue or resolve the question of the industrial safety of Occidental's workers or of Occidental's contract workers with respect to emergency medical and evacuation services.

3. Socio-Economic

The DEIR does not adequately examine the socio-economic impact of this project and future similar projects at the Geysers for purposes of mitigation. Examples of such inadequacies include:

a. The DEIR fails to provide support data for its statements concerning the continued availability of labor willing and able to work in geothermal steam fields and power plant construction. Yet it is based on this assumption that the DEIR concludes that further geothermal development, including this project, will not have an adverse significant impact on the labor supply and so fails to prescribe mitigation measures.

b. The DEIR allows that in an impacted housing market such as Healdsburg, additional demand for housing must be considered a significant adverse impact. However, the DEIR without supporting data summarily concludes that the housing requirements from geothermal development will be disbursed over a large area thus negating the need for geographically specific mitigation measures.

c. The DEIR is inadequate in that while allowing that countywide housing impacts will be significant, the document fails to discuss, much less provide, any countywide mitigation measures. The County of Sonoma will suggest that the Commission retain jurisdiction of

certification of this project, so that at the time the cumulative impact study is completed, appropriate mitigation measures can be imposed upon Occidental (and other permittees).

d. The DEIR states that Sonoma County's school districts have reported declining enrollments since 1977. However, while some Sonoma County school districts may be experiencing declining enrollments, the DEIR fails to address the enrollments of those school districts which will, in fact, be impacted most severely by Geyser related development, e.g., Geyserville, Cloverdale, Healdsburg.

e. The DEIR fails to address the financial impact on Sonoma County due to the fact that as the OXY 1 plant is located in Lake County, the County of Sonoma and its school districts will be servicing workers and their families without benefit of property tax revenue or AB 1905 funds attributable to OXY Plant No. 1.

4. The County of Sonoma joins in the analysis submitted by the Lake County Office of Education with respect to the apparent position of staff that mitigation of significant adverse socio-economic impacts no longer need be required by the Commission because of the availability of AB 1905 funds. If AB 1905 funds are thought to mitigate all socio-economic and public service impacts regardless of questions of adequacy or actual appropriation,

will these same funds mitigate other types of impacts? Perhaps even environmental impact reports will be rendered unnecessary, for what could be their practical purpose if no new mitigation measures can be identified and required to be implemented? These results are clearly contrary to the express terms of the California Environmental Quality Act: the Commission itself must require identified adverse impacts to be mitigated.

Dated: September 30, 1981.

JAMES P. BOTZ, County Counsel

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October 2, 1981

California Energy Commission
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Attn: Ms. Valerie Campbell

Dear Ms. Campbell:

The Lake County Planning Department has reviewed the Draft EIR for Oxy Geothermal Plant No. 1. While a more detailed analysis of is not practical at this time, the following comments address several key issues:

1. Water Quality

Critical unresolved issues remain regarding accidental and/or long term cumulative impacts to the Anderson Springs domestic water supply. While Occidental's proposed project would be only one of several geothermal projects which conceivably could impact recreational and domestic water supplies, additional measures are nevertheless needed to safeguard local water users and equitably distribute costs for necessary water system improvements and monitoring.

2. Land Use

Land Use Map(s) should be included indicating the scale, and proposed location of the power plant and related facilities in relation to existing land uses including residences, other sensitive receptors, and recorded land subdivisions. Zoning and General Plan information for the general project area (including Anderson Springs) would also be appropriate. In addition to demonstrating spatial relationships, this type of land use information would be very useful in evaluating the associated field development in regards to the requirements of Lake County Code (Article XXV General Performance Standards, Sec. 21-73.6) which states that: "No geothermal well shall be drilled within one-half mile of any populated area (defined as more than 10 dwelling units established within a quarter mile diameter area) or within one-half mile of any recorded subdivision, without the written consent of at least 75% of the owners having been obtained."

It should be further noted that while Occidental has received Lake County permits for Site "A", "E" and "D" pads and wells, these use permits were

for exploratory purposes only. No action has been taken yet regarding Occidental's proposed Plan of Development for field production. Lake County Use Permit 80-11 was amended to allow 1/2 + acre of Drill Pad "B" to potentially drain into the Gunning Creek watershed. While a single exploratory project may or may not present significant water quality impacts, overall geothermal production within the Gunning Creek watershed raises serious land use compatibility concerns. Consequently, the Occidental project, which is the first production project within the Gunning Creek watershed, could establish important land use precedents.

Finally, a brief description of the land use conflicts that have generally characterized this area should also be mentioned, including the court decision that geothermal resources are "minerals", and the distinction between privately owned surface areas and federally reserved subsurface mineral rights.

We appreciate the opportunity to comment on all projects of mutual concern.

Sincerely,

LAKE COUNTY PLANNING DEPARTMENT

Alex Hinds

Alex Hinds
Senior Planner

AH:bw

81-AFC-1

WORKSHOP
CALIFORNIA ENERGY COMMISSION
SEP 21 1981

In the Matter of)
APPLICATION FOR CERTIFICATION)
OF OCCIDENTAL GEOTHERMAL, INC.)
FOR OXY GEOTHERMAL PLANT NO. 1.)

Docket No. 81-AFC-1

COPY

MIDDLETOWN UNIFIED SCHOOLS
CALISTOGA AVENUE
MULTI-PURPOSE ROOM
MIDDLETOWN, CALIFORNIA

WEDNESDAY, SEPTEMBER 16, 1981

7:00 P.M.

Kileen Jennings, C.S.R.
License No. 5122

11

STAFF PRESENT

Ms. Valerie Campbell, Project Manager
Mr. Zane Bohrer, Staff Hydrologist
Mr. Gary Heath, Public Adviser's Office
Ms. Arlene Ichien, Counsel
Ms. Kathy Onley, Secretary

APPEARANCES

FOR THE APPLICANT:

THOMAS I. HAMILTON, Esq.
Occidental Exploration & Production Company
3000 Stockdale Highway
Sakersfield, California 93309

INTERVENORS

Ms. Mary Jadhav, Geysers 1916 Act Landowners
Mr. Bob Reynolds, Air Pollution Control District

INTERESTED PARTIES

Mr. Dave Fach, U.S. Geological Survey (Menlo Park)
Mr. Norm Ritchy, Bureau of Land Management
Mr. Alex Hinds, Lake County Planning Department
Mr. Pleser Crosby, Lake County Health Department

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PROCEEDINGS

--oOo--

MS. CAMPBELL: I'd like to introduce myself first.
My name is Valerie Campbell. I'm the Project Manager
for the Energy Commission for the Occidental proceeding.

This is Arlene Ichien, the Project Attorney for
the Energy Commission. At the end of the table is Zane
Bohrer, the Project Hydrologist for the Energy Commission.
I anticipated that many of you would be concerned with
water quality, so I brought Zane with me today.

Before we actually get into talking about the
EIR, I would first just like to give you a brief overview
of what the different agencies do in this area so we don't
get confused in the proceeding.

First of all, I would like you to understand
that the Energy Commission itself only has jurisdiction
we only have authority, over the power plant site itself,
over the transmission lines, and over the access road to
the power plant itself.

Another part or another connection with the power
plant is the steamfield. Obviously, we're talking about a
geothermal power plant that is run by steam out of the
ground.

The power plant itself will sit here (indicating).

leasehold.

Now, the steamfield is under the jurisdiction
and authority of the federal government. We have here
tonight some representatives from the federal agencies,
that's from the Bureau of Land Management and from the
United States Geological Survey. They have permitting
power over the steamfield as does Lake County. We also
have representatives here from Lake County.

If I could, may I ask Norm Ritchy from BLM, could
you raise your hand? With Bureau of Land Management.
Norm is their hydrologist. Dave, could I ask you to raise
your hand? Dave Fach from U.S.G.S. Alex Hinds and Bob
Reynolds, could you raise your hands? They're with Lake
County. Bob Reynolds is the Air Pollution Control Officer.

Alex Hinds is a planner familiar with geothermal development.
We also have here tonight the attorney for
Occidental, Tom Hamilton. And I see in the audience various
people I recognize, but I think you may all know each other,
so I won't go on with introductions.

I wanted to clarify where the jurisdiction lies,
because what you'll see is a good amount of what is in
the steamfields has already happened. There is existing
development in the steamfields. There are existing roads
out there, et cetera. And to some extent, we may be talking

are existing developments for the most part.

I would also like to explain that the Energy
Commission has only been in existence since 1975. We have
the authority to certify power plants. What happens is
an applicant like Occidental will come to the Energy
Commission and propose -- give us an application for
certification, which is a great, big, thick document. And
that says what they're proposing.

They're proposing in this case an 80 megawatt
power plant in your county right up there on the hills.
They come to us with the proposal. And then we examine
it over the course of a year. And we try to determine
whether or not we think it's a good proposal, how it could
be improved, et cetera.

In the course of things, we write an Environmental
Impact Report like these. And if you need one, feel free
to help yourself from this box.

The purpose of an Environmental Impact Report
is to document what the proposal would do to the environment.
It's not to say whether the proposal is good, bad, or
indifferent, it's simply to say what will happen in the
opinion of experts if this power plant is built as proposed.

So, what you may see here is a very thorough
document that discusses air quality, noise, et cetera.

can take action.

The document itself represents no action. It's simply a disclosure document. It should be telling you what will happen.

Now, the way it works with an Environmental Impact Report is it's issued twice. The first time it's a draft. What you have now is a draft.

When the draft is issued to the public, it goes through a 45-day review period. Then we, the agency that has written the document, must receive your comments formally and we must respond to them. That is the purpose of this meeting here tonight. We would like to hear your comments. You're also invited, as Gary said, to call him on the phone to give him your comments or to send them in writing to either Gary Heath or myself at the Energy Commission.

The closing date for comments is October 1st. I must have your comments by then or I may not be able to respond to them. I will certainly try if you get them to me after that.

What we're interested in hearing is if you feel we have inaccuracies in the documents, or if you have concern over what you see in the document, et cetera.

So, with that, I would like to open the comment period. I would suggest that we go simply by the order of things in the Table of Contents; although first I would

transmission corridor. That's their preferred transmission route.

The second transmission route would go southwest down the ridge. It would be more visible. It would connect with power lines from Unit 13, PG&E's Unit 13. Then it would enter the PG&E network.

The Energy Commission staff feels that the preferred route is straight over the mountain over to SHUD would be the most desirable.

Do we have any questions about the transmission line corridor or comments?

MR. REYNOLDS: I'd like to make one comment.

MR. CAMPBELL: Would you please state your name, please.

MR. REYNOLDS: My name is Bob Reynolds, and I'm speaking as a citizen of Lake County.

I think there was two options. And I think one of them was reasonably unobtrusive, that is below the ridge line. I think the transmission line on the ridge line itself would be highly visible. I think most citizens of the county do appreciate the visual aesthetics of the county. And as Air Pollution Control Officer, I would suggest that the Energy Commission consider the alternative mitigating --

MR. CAMPBELL: How can we get it over the hill

like to ask the question: Does anyone have any comments about the overall organization of the document itself?

If not, then I'd just like to go right through the Table of Contents and see if you have any comments on the subject areas.

I'd like to remind you that the reporter has asked if you have comments to please step forward and make your comments clearly. Will you first identify yourself by name so that the reporter will get it correctly.

The summary of the document basically says what all is going on. If I were to summarize in overview, I would say that the proposal by Occidental has received review by your local Air Pollution Control Officer, who has a great deal of authority in this area. He has given it a determination of compliance, which means that in his opinion, provided that they do all the things that they have said they will do in terms of air emissions, that it will be an acceptable plant and the county will permit it.

Similarly, the Energy Commission agrees with the Air Pollution Control District Officer in the matters of air quality.

In the matter of water quality, which is of some concern, the summary in the EIR states that nearly all of the environmental documentation that has gone on in

to the transmission corridor?

MR. REYNOLDS: That's your problem. One of the first routes to the SHUDCO power plant was unchanged. You know, versus going all the way down the ridge.

MR. CAMPBELL: And that is the preferred route over across to the SHUDCO corridor. We concur that that's the preferred route.

MR. REYNOLDS: I'm just concurring with your concurrence. At one time it was an issue.

MR. CAMPBELL: Okay. Do we have any questions or comments concerning the geology of the region?

Gary, were there any questions about seismicity or anything like that?

MR. HEATH: Yes, I believe we have someone that wants to talk on seismicity, or microseismicity.

Yes, can you just stand up and state your name, please?

MR. WHITE: Beaver White and I'm a resident of Anderson Springs.

I have a report here from Dr. Oppenheimer.

MR. HEATH: Could you spell that, please?

MR. WHITE: Oppenheimer?

MR. HEATH: Yes, could you spell that.

MR. WHITE: O-p-p-e-n-h-e-i-m-e-r. It's from the Department of Interior, Menlo Park.

the past has indicated the sensitivity of this location in that it is at the top of a watershed which supplies both domestic and recreational water to the people below.

In the water quality sections of the EIR, we go on to identify the sensitivity of this subject area. The Energy Commission staff feels that a cumulative impact, that is an impact of both the power plant and the steamfield, may be an adverse impact to Gunning Creek, which is the primary source of domestic water for the people in Anderson Springs Community.

I think that that maybe summarizes the major areas of concern. I understand this is the power plant located the closest to a community to be proposed yet. That's going to come out very funny. This power plant is proposed very close to a community. And that perhaps noise may be a concern and so forth. The document deals with all of these concerns.

Are there any comments in terms of the project description? Are there any questions about the project itself? About what is being proposed?

You all have a fairly good understanding. It's an 80-megawatt power plant. They have proposed two routes for transmission lines, one of which would go straight back over the mountain over to connect with the SHUDCO power plant and then down the backside onto the PG&E power

I have been rather interested so far as earthquake is concerned in Lake County. A year back, a year and a half back, I checked with Mr. Miller of the University of California with verification on the Richter Scale. We had as high as a 4.3.

According to Mr. Oppenheimer, it's rather contradictory, a lot of his statements. I appreciate as a scientist, but I don't appreciate what he has to offer here in this field for the simple reason that a letter which I have received from Mr. Oppenheimer dated June the 22nd:

"In appreciation of your situation in Anderson Springs and understand the impact on your community from development of the steam reservoir. However, ground shaking in your area is probably not due to induced seismicity near the production region. More likely, you have felt some regional earthquakes which are unrelated to any manmade activity. It is also possible that you may be feeling ground movement associated with nearby blasting. Such explosions are too small to be located by our network."

I have studies here that was made. But it's going to take

10

1 a qualified person to read them.

2 Our magnitude, which they call microquakes,
3 anywhere from 1.2, 1.7, up to 3.1, is a microquake.

4 He will not lay his reputation on the line nor
5 will any geologist lay his reputation on the line to say --
6 to predict what is going to happen. They can't. It would
7 be impossible.

8 If this plant is located six-tenths of a mile
9 from Anderson Springs, what are we going to foresee in
10 the future? What's going to happen to us?

11 MS. CAMPBELL: Okay, I understand your question
12 to be dealing with the predictability of earthquakes as
13 relates to the presence of a geothermal power plant nearby.

14 Maybe I could ask for some help from U.S.G.S.
15 My understanding of the studies in seismicity as relates
16 to geothermal is that they do tend to induce microseismic
17 activity. However, the overall prediction about big quakes
18 resulting from it seems to be that the microseismic activity
19 will actually relieve pressure, and that you may not be
20 inducing the big quake that so many of us are afraid of.

21 However, there are five instruments in your vicinity
22 U.S.G.S., I think, has one at Castle Rock? I think there
23 is a unit within a mile of your community, which does record
24 the size of quakes.

25 So, that certainly is something that we could

13

1 is. But it seems to me just like the effects of a blast.
2 And, of course, I understand it's against the law to be
3 slant drilling if they're on your property. But sometimes
4 you just wonder.

5 MS. CAMPBELL: Okay.

6 MR. BROWN: This is just an idea. But we do
7 have pretty good shakeups. And it really shakes your place
8 up. There's no doubt about it. Why, I don't know.

9 MS. CAMPBELL: All right. I think we understand
10 the public comment to be, again, concerned with seismic
11 activity in the area. You'd like to know what's going
12 on, what is causing it. And, if possible, predictions
13 about it.

14 I would remind you that from the perspective
15 of the Energy Commission and within the scope of this EIR,
16 we have to limit ourselves to the effects of the geothermal
17 power plant. And to the extent that we can do that, we
18 will respond to your questions. Thank you.

19 The lady in the back. Will you identify yourself,
20 please.

21 MS. SHEAT: Merial Sheat from Arthcaw, Anderson
22 Springs Homeowners Association.

23 I just have one comment on the earthquake. I
24 have a propane gas pipe rig in my home. It had only been
25 in the ground for six years. And we lost approximately

11

1 identify and find out what the readings are on it for you.

2 MR. WHITE: How do we get a feedback on this?

3 MS. CAMPBELL: On what is happening?

4 MR. WHITE: What is happening.

5 Also, suggestion has been made that there should
6 be a monitoring station set up in Anderson Springs alongside
7 the air pollution controlling vehicle at Anderson Springs.

8 Now, if somebody tells me it's a blast, sure

9 it's a blast. It could be an explosion. But when my house
10 shakes, I want to know why it's shaking.

11 MS. CAMPBELL: I understand your comment. I'm
12 not too sure of the sophistication of the machines. I
13 don't know if the seismic monitors are sophisticated enough
14 to detect the difference between a blast and a slight rumble.
15 I'm not sure of that. But we can certainly look into that
16 for you.

17 And we'll also look into the proximity of the
18 nearest seismic monitors. I believe there's one within
19 one mile of your community which would probably take care
20 of your concern with having one right in the community
21 itself. A mile away is close enough to read a quake.

22 But we'll look into that for you and we'll give
23 you feedback on it in the final EIR.

24 Do we have any other questions or comments on
25 seismicity?

14

1 3400 worth of propane in the ground. And I do believe
2 it was caused from these microearthquakes, which is a problem
3 that should be considered. Thank you.

4 MS. CAMPBELL: Okay, are there any more comments

5 on geology? Seismicity, geology? Yes.

6 MS. ANDERSON: My name is Gertrude Anderson.
7 I'm part of the Homeowners of Anderson Springs.

8 I would just like to say I do live in San
9 Francisco, and I do have my home part-time up here. But
10 I have felt many quakes. And they don't compare to what
11 I felt up here. These are more like Mr. Brown said, a
12 sharp drilling jolt of this kind. They are not quite --
13 as far as I'm concerned.

14 MS. CAMPBELL: Are there any other comments on
15 geology?

16 All right, then let's move on to soils. Do we
17 have any comments about the soils section of the EIR?

18 In the soils section, now Iene Bohrer, who is
19 our hydrologist, also wrote the soils section.

20 Iene, if you will, could you generally summarize
21 what the soils sections says in the EIR?

22 MR. BOHRER: The soils section basically says
23 that the terrain is quite steep. The soils are moderately
24 to very highly erodible. And tying in with the hydrology
25 section, rainfall is quite erosive in that area. And that

12

1 Yes, and will you identify yourself?

2 MR. BROWN: I'm Carl Brown. I'm from Anderson
3 Springs.

4 What Mr. White has said I would go along with
5 100 percent. Because I would say that on an average, probably
6 two or three good rattlings of our house a month would
7 be an average that we get. And when it first happens,
8 it scares us. Maybe we're getting acclimated. Maybe you
9 see a guy get shot -- somebody shot every day, maybe you
10 can acclimate yourself to it. So, I'd like to describe
11 it that way. And Mr. White will verify it.

12 I've called him up and every time I do, he says,
13 "Carl, that's already been recorded by the professor at
14 the University of California." In other words, it seems
15 like I call up and he's taken care of it.

16 So, a lot of us have listened to Mr. White. You
17 can get all kinds of people in the Springs that are getting
18 these.

19 And I have a somewhat different theory. I think
20 they're slant drilling.

21 MS. CAMPBELL: Is causing it.

22 MR. BROWN: That's one idea. And I have
23 acquaintances there that do the slant drilling and know
24 something about that. I'm no scientist. But it's some
25 way -- I know anybody that could qualify what an earthquake

15

1 the disturbance of the soils and the removal of the
2 vegetative cover and the deterioration of the root structure
3 will in the end, in spite of mitigation measures, lead
4 to increased erosion due to road development to power plant
5 site development and the development of other accessory
6 facilities such as the transmission line.

7 Under CEQA, although we do not have licensing
8 authority, we have a responsibility to address the entire
9 threshold under the California Environmental Quality Act.
10 So, we've addressed drill pads and steam lines which
11 are not under our jurisdiction in that. That's basically
12 what the soils section says.

13 It describes the various soils series, the apparent
14 material on which they were formed, and what we can expect
15 in the way of erodibility.

16 MS. CAMPBELL: Okay. Do we have any comments
17 at all on the soils section, per se?

18 Okay, then I'd like to discuss water resources,
19 if we could.

20 Obviously, the soils and the soils' erodibility
21 is related to the potential problem that we see in water
22 quality. Again, I'm going to ask Iene to summarize what
23 the water quality section says. And then we'll field comments
24 on it. Iene.

25 MR. BOHRER: The water quality section basically

1 says under the uses in Anderson Creek are, with the exception
2 of four users who are domestic users, predominantly
3 recreation.

4 The water use from Gunning Creek is approximately
5 70 percent of the water supply of Anderson Community and
6 Anderson Springs via Anderson Springs Water Company.

7 And it's also used for irrigation. And to a
8 lesser extent, for industrial purposes. Industrial purposes
9 meaning geothermal development.

10 Studies done on behalf of various scamfield
11 developers by different consultants seem to point out the
12 fact that Anderson Creek has been subject to degradation,
13 particularly from sediment, and probably because of the
14 development and the extensive use of the Socrates Mine
15 Road.

16 Therefore, the record showed degradation in quality
17 due to sediment and other heavy metals and other materials
18 in that creek.

19 Gunning Creek, on the other hand, in the same
20 studies, indicates a limited degradation, if at all, about
21 seven to nine milligrams per liter of sediment in the creek.
22 It indicates that there also has been some degradation
23 in bacteriological quality of Gunning Creek due to coliform
24 bodies, which indicates fecal contamination, human excrement
25 in the creek.

1 So, there's a lot of fish in there. And there's
2 still quite a few fish. And I'm concerned about the quality
3 of the fish from arsenic.

4 Another thing that I feel is maybe a little
5 misleading has to do with the flood runoff of the sites,
6 the cumulative effects of the pads and the site itself
7 on extra flood runoff into Anderson Creek.

8 They indicate that it's only one percent of the
9 total drainage. But at this level we're looking at a high
10 drainage level that we're involved in. I don't know what
11 it is, but it's probably closer to 60 to 70 percent of that
12 area that I'm interested in. And when you add that, say,
13 20 percent figure extra runoff into that creek, it could
14 have some real impacts. I know it will have impacts on
15 our property. And I'm sure it will have an impact down
16 in Anderson Spring itself.

17 And I'd like those addressed a little closer.
18 And I'm afraid that all the things that are discussed in
19 the Environment Impact are maybe broader -- and they have
20 to be to some extent -- than they're downstream. But there
21 are some major impacts being an adjoining property owner
22 where we have a home right within 2000 feet of the proposed
23 power plant site.

24 MS. CAMPBELL: Okay, I understood your comments
25 to be that you're concerned with the arsenic in the water

1 But, basically, what the water quality section
2 shows is that the water quality is reasonably good to
3 excellent in Gunning Creek, degraded in Anderson Creek,
4 due to various activities, but certainly to a great extent
5 by geothermal activity and the use of the Socrates Mine
6 Road for said activities.

7 It expresses a basic concern for the quality
8 of both Anderson Creek and Gunning Creek, particularly
9 the latter, that activities on the Occidental leasehold,
10 the soil disturbance described earlier, will very likely,
11 in spite of mitigation measures, result in erosion on the
12 site, transport of the sediment offsite, and deposition
13 of the sediment in the water of Anderson and Gunning Creeks,
14 which we also pointed out would lead to additional
15 degradation and would lead to extra efforts having to be
16 expended by the water purveyor in the area for maintaining
17 their system.

18 Particularly, if there is large amounts of sediment
19 deposition at their intake to Gunning Creek.

20 MS. CAMPBELL: Okay, that's Iona's summary of
21 what the section says.

22 Now, may I hear comments? The gentleman in the
23 back. Will you identify yourself please.

24 MR. TOCHER: Yes, my name is Craig Tocher.

25 I want to preface my comments that I'm an adjoining

1 and the fish. And you're also concerned with the potential
2 for flood runoff from the Occidental development impacting
3 the downstream users; in particular, your property.

4 MR. TOCHER: Right.

5 MS. CAMPBELL: Okay, Mary Jadhikar.

6 MS. JADHIKAR: My name is Mary Jadhikar.

7 And I have a question that you may ask Mr. Tocher.
8 Was it arsenic or mercury? As the Clear Lake studies were
9 mercury.

10 I would comment also that there is no mention
11 in this document of a residence 2000 feet from the power
12 plant. And if, in fact, it's there, it should certainly
13 be included in the document and the appropriate noise
14 mitigations and other references made to it.

15 MS. CAMPBELL: Okay, Mr. Tocher --

16 MR. TOCHER: Yeah, it is mercury.

17 MS. CAMPBELL: Okay. Yes, I found out that mercury
18 is a substance that is found locally. There used to be
19 historic mercury mines in the vicinity. Not on this
20 particular --

21 MR. TOCHER: There are none in this upper level,
22 though.

23 MS. CAMPBELL: No, not in this -- not specifically
24 here, but in this region, yes.

25 We can look into -- we can address those more

1 property owner of Gny. And I'm concerned that most of
2 their reports kind of relate downstream and the impacts
3 downstream.

4 And where Anderson Creek flows through the middle
5 of our property, it is of a high quality at the present
6 time. I'm sure with the pads they're putting in there
7 now has had some detrimental effect on the water quality.

8 But it's hard for me to pick out in this report
9 real specific things. One, is the fish, the arsenic and
10 fish. Apparently, some studies were made earlier, maybe
11 in Clear Lake or something, and gave some indication of
12 arsenic in the fish and some that exceeded safe limits.

13 I doubt if there's much arsenic in Anderson Creek
14 at the level that we're looking at at their site. But
15 I can't find anything in the draft that indicates what
16 it might be in the future. And I think that has to be
17 addressed a little closer.

18 I'm sure they could have taken a sample of the
19 fish in Anderson Creek. That property has been in my family.
20 My grandfather homesteaded it. And I know that there's
21 been thousands of fish caught in there. My older brother,
22 before they had real strict limits on it, used to come
23 out of junior college and he and his friends would catch
24 around three or four hundred fish in about a mile and a
25 half stretch of Anderson Creek.

1 thoroughly.

2 Also a question for you, Mr. Tocher, is have
3 you been receiving notices of workshops, or cessals?

4 MR. TOCHER: No. In fact, I just stumbled onto
5 this, because I live in Sacramento, and I happened to stumble
6 onto the draft the day before yesterday. So, I really
7 haven't had time to review it like I would like to.

8 MS. CAMPBELL: What I would like to ask you to
9 do right now, if I could -- Kathy, will you go get his
10 address and phone number. And we have to make sure that
11 he's on our EIR list and let's put him on the proof of
12 service list as well.

13 MR. HEATH: Yes.

14 MR. BOHRER: I have a question of Mr. Tocher.
15 What use do you make of the water in Anderson
16 Creek?

17 MR. TOCHER: Right now we get our domestic water
18 supply out of Anderson Creek. I don't know how long that
19 can go on.

20 MR. BOHRER: How long have you used the water
21 from Anderson Creek?

22 MR. TOCHER: Since about 1922.

23 MR. BOHRER: Do you have a water right or are
24 you just a riparian user?

25 MR. TOCHER: Riparian user.

MR. BOHRER: So, you have no filing on that?

MR. TOCHER: I don't know. I think that when my grandfather homesteaded it, he filed.

MR. BOHRER: Would he be the same name?

MR. TOCHER: Right, uh-huh.

MR. BOHRER: T-o-c-h-e-r?

MR. TOCHER: T-o-c-h-e-r.

MR. BOHRER: Thank you.

MS. CAMPBELL: Do we have any other comments or concerns or questions regarding water quality in this EIR? Mr. White.

MR. WHITE: Yes. I looked at the Environmental Impact Report on page 223.

MS. CAMPBELL: Wait a minute, let me find 223.

Got it.

MR. WHITE: Now, I don't know; I might be implying something. But that second paragraph seems to me very, very broad to me.

"With respect to water quality, trade-offs exist..."

That's a question mark there.

"...exist between the long-term benefit of 88 megawatts of preferred..."

I underlined that.

"...geothermal energy versus the immediate

may be part of the bottom line here. The bottom line may be, yes, we're going to allow geothermal development; but in allowing geothermal development, we're going to ask for certain guarantees, so to speak. That's what the staff may be saying. Now, the Commissioners make the decision in the end.

But there will be trade-offs. For arguments sake, you may end up with a power plant and that may not be good. But you may end up with certain guarantees that protect your water system or change the water system and that may not be all bad. That's what we mean in this type of a paragraph.

MS. CAMPBELL: And what the document really says is to build this geothermal power plant may wind up impacting the waters locally. That is what this document says.

MR. WHITE: That's what it says.

MS. CAMPBELL: Yes.

MR. JACOBSEN: Eric Jacobsen, Anderson Springs. I've lived there since 1962. And talking about the creek, for instance, now -- when we come up there, my boys and my daughter were young. They used to go there and fish and have a beautiful summer. You know, what I mean? They'd come out there on weekends and they lived it up.

Okay, today this is the overall picture as far

impairment of beneficial uses and potential degradation of the waters in Anderson and Gunning Creeks."

I'd like to have an explanation of that, if I may.

MS. CAMPBELL: Okay. I see, do you want to offer an explanation now, or should we handle it in our response to the comments in the final EIR itself?

MR. BOHRER: Well, I think the word "preferred", the Biennial Reports of the California Energy Commission lists geothermal as one of the preferred technologies that we see as supplying a portion of the electrical energy in the State of California.

MR. WHITE: Versus?

MR. BOHRER: -- versus nuclear, versus coal.

MR. WHITE: Versus the water in Anderson Springs.

MR. BOHRER: All right, with respect to water quality, trade-offs exist. That I think is true in almost anything. It's true whether you build a truck dock or whether you build a subdivision or whether you build a power plant. That there's certain trade-offs. Open space trade-offs, for instance.

I may prefer that the area in which I live in Sacramento stays open, but I don't want to buy the land. So, they build houses on it. That's a trade-off. The advantage to society as a whole -- or at least the people

as I'm concerned. Today you can go down to that creek, you've got dirty water, you can't even hear a frog croaking down there.

Now, this is what they're doing to us in our environment. I can't but help think that there's got to be some type of compensation for the people in that general area. This is their homes.

And you people -- not you, but the whole government people -- are taking this away from us. When you take that away, we have to have some compensation for our -- what we have built our homes for in that particular area.

I know we need electricity. I'm not saying that we don't. I understand that. And like this gentleman says, maybe there has to be a trade-off. But let's trade something off to us, the people of Anderson Springs. We're the ones that are suffering for it. I thank you.

MS. CAMPBELL: Okay, thank you, Mr. Jacobsen. I understand your comment to be addressing the overall degradation of water quality in this area due to geothermal development.

MR. JACOBSEN: That's right.

MS. CAMPBELL: And your concern is that the people have not been adequately compensated for their loss.

MR. JACOBSEN: That's right.

that own the land -- is more for developing that land for housing than it is to leave it open for open space enjoyment by others.

What we're saying here is that in building a power plant -- and not only geothermal, we face it in all power plant proceedings -- there's certain trade-offs. One trade-off is, obviously, I don't want to look out my upstairs window and see those stacks. That's an aesthetic trade-off. The other may be I don't want any more air pollution in this desert basin in which I live. I moved out here to get away from it.

The trade-off may be -- or what we mean by the trade-off is we have the enabling legislation in this community that we are to see that the energy needs of the State of California are met while protecting the environment.

Well, those are not usually self-exclusive. But one may infringe upon the other. For instance, we may say that because of electricity needs of the state, we need to build a coal-fired power plant. And we have said if you build it this place in the desert, because we don't want it in agricultural zones, but we do need the electricity; so we put it in the desert.

That doesn't make everybody happy. The Indians talk about the spiritual eminence of the desert -- don't like that. But that may be the bottom line. And that

MS. CAMPBELL: Thank you. Yes?

MR. BROWN: Carl Brown, from Anderson Springs. I'd like to emphasize one thing. Lots of times we go along and omit or forget something. I'll explain it by some fellow may be a little bit backward and forgot to insure his house for fire insurance. Your house isn't much good today -- nobody would think of building a home today without insurance.

And here, two or three months ago when we had a meeting with Brown, Caldwell, Occidental, in regards to our water system, I addressed the California Energy Council (sic) here that I admit that paving this road up here, the \$5 million job, has got to be helpful. There's no doubt about it. And they won't need so much water to put the dust down.

But we're not guessing or making any deals and suggesting -- like Mr. White says, he doesn't know when the earthquake's going to come. But I'm putting facts that has happened. They have polluted our water. They've done it. They've admitted it. They could have been fined. We're not complaining about it because we didn't get \$10,000 or \$50,000. That isn't the deal. It's tomorrow.

Now, I asked Occidental when they were here at our meeting a month or two ago, what happens, these holding tanks, when they start drilling or take a chance, the weather

1 looks pretty good, the rain's about an inch an hour. You
2 think that water isn't going to get back into Anderson
3 Creek and poison us like it did before? It's already did
4 it.

5 So, my question addressed to Aminoll was when
6 that happens, who furnishes Anderson Springs drinking water?
7 Who furnishes the tank and the truck? Until that time
8 comes, everybody runs around with their head out off,
9 blaming somebody else.

10 This is what's going to happen. And what's the
11 answer? Lake Berryessa, when they flooded it, Monticello,
12 they paid those farmers so much for their land.

13 There's no difference between drowned out or
14 poisoned out. And they don't want to talk about compensation.
15 They say there's ways of doing it. Do they want to get
16 a form and write it like a contract and say, okay, if that
17 happens, we'll do it. When you prove we've poisoned it,
18 we'll take care of it. They haven't come up with it.

19 Aminoll spoke right here. They have no answer.
20 But they want to put the water system in. But who's changing
21 the water system? It isn't us. We have a dilapidated
22 system that went for years, but the water is still good.
23 Who causes this pollution?

24 Can we go through and write up these rules and
25 regulations and when they get through this winter, get

1 And, as you say, the paper came out and the county
2 has done wonderful the last few weeks backing us up. But
3 never how they're going to do these things.

4 But the real gut feeling is when we're poisoned --
5 just like when your house burns down, it's got to be spelled
6 out. Maybe you'd only get 90 percent of it or whatever
7 it is.

8 And we have been poisoned, a couple or three
9 times. I want that one specific deal, no matter what they're
10 doing, who's going to bring the water into us when there's
11 none to drink.

12 MS. CAMPBELL: Okay. Another development which
13 is occurring is -- and I'll ask Dave Fach to correct me
14 if I'm wrong.

15 As I understand it, one of the permit conditions
16 which the United States Geological Survey is requiring
17 is that Occidental have ready an alternative interim source
18 of water in case something does happen to your drinking
19 water supply. Is that correct, Dave?

20 MR. FACH: Well, I don't remember that as being
21 a condition.

22 MS. CAMPBELL: Oh, it's not a condition of the
23 permit?

24 MR. FACH: Not that I know of.

25 MS. CAMPBELL: Oh. Yes?

1 poisoned again? Can't drink the water? Sure, they're
2 going to meter it, but who is paying the bill to get water
3 up to our house?

4 That hasn't been addressed or maybe I missed
5 it somewhere. I don't read those fine points. Maybe I
6 have. But that's the question I put. That's the deals
7 we're going to be in trouble with.

8 MS. CAMPBELL: As I understand, your concern
9 is that if the water delivery system has to be upgraded
10 in order to avoid the possibility of geothermal pollutants
11 getting in it, you're concerned that the people here may
12 have to foot the bill?

13 MR. BROWN: Yeah, right. That's what we're after.
14 And I'm saying we got good water. Just like the gentleman
15 back here, his grandfather, Mr. Tacher, and all of these
16 people. There's nothing wrong with it. But it's been
17 good up until they started drilling.

18 MS. CAMPBELL: I understand.

19 MR. BROWN: Maybe they're not. Maybe there's
20 somebody else we don't know about.

21 MS. CAMPBELL: Okay.

22 MR. BROWN: But who does it? Are they going
23 to be responsible?

24 MS. CAMPBELL: What I'd like to do right now
25 is to give you a brief rundown on what I understand has

1 MR. CROSBY: I'm Pieter Crosby from the Lake
2 County Health Department.

3 MS. CAMPBELL: Yes.

4 MR. CROSBY: Now, I haven't heard of any
5 alternative plans for the water supply, which we're very
6 concerned about on Anderson Springs.

7 MS. CAMPBELL: You haven't heard anything about
8 the plans at all?

9 MR. CROSBY: No.

10 MS. CAMPBELL: Okay.

11 MR. REYNOLDS: I would just make a comment --
12 and this is just my understanding. It's secondhand
13 information. But my information was that they had committed
14 to the study of those three alternatives you talked about,
15 but they had not yet committed funds to do the job.

16 MS. CAMPBELL: That's my understanding also.
17 The study is underway now. Once the study is completed
18 and a winning scenario is chosen, Occidental and Lake County
19 will -- that is Aminoll and Lake County will discuss those
20 plans with the people in the community, seek your
21 concurrence. And if you agree, then they will go and seek
22 the monies from the county to actually implement the new
23 system.

24 MR. BROWN: I read that in the Lake County paper
25 this week.

1 happened between Aminoll and Lake County right now.

2 Aminoll has undertaken with the help of Lake
3 County to do a feasibility study on an alternative supply
4 of water for the community. The plan is that the study
5 is supposed to be completed sometime in October, hopefully.

6 There will be three possibilities that they're
7 studying, tank sources, well sources, and an earthen dam
8 impoundment as a source of water.

9 The winning scenario of those three will then
10 be brought to the people of Anderson Springs to see what
11 they think about the possibility. If the people give the
12 nod to one of those three possibilities, then Aminoll intends
13 to seek help from Lake County to try to get all 1983 monies
14 to actually implement that system. That is the plan as
15 I now understand it.

16 If anyone from the county or anyone else here
17 is more knowledgeable than I am in the status of that,
18 please add to it if you know anything about it.

19 MR. BROWN: Well, what you said was in the Lake
20 County paper. And our supervisor asked for more specific
21 understanding with our county road supervisor, going to
22 put the road in, he says he wants this spelled out more
23 how they're going to pay.

24 And they have agreed to pay -- I don't know whether
25 it was 15,000 -- something towards their share.

1 MS. CAMPBELL: And, sir, what was your name in
2 the back?

3 MR. CROSBY: My name is Pieter Crosby.

4 MS. CAMPBELL: Pieter Crosby?

5 MR. CROSBY: Crosby, C-r-o-s-b-y.

6 MS. CAMPBELL: Okay, let's talk afterwards and
7 I can give you some names of the people at Aminoll who
8 are doing the study, et cetera.

9 Yes?

10 MS. JADIKER: Yes, my name is Mary Jadiker.

11 I think the point that Mr. Brown and other people
12 who are residents of Anderson Springs and consumers of
13 these waters are trying to make is that the EIR, and possibly
14 any subsequent permit conditions on the power plant, do
15 not contain adequate mitigation measures for the possibility
16 of water pollution.

17 The suggestion is not simply that somebody has
18 to pay to upgrade the water system -- although that has
19 to happen -- the suggestion is that there should be a clear
20 liability somehow, an insurance, a bond or something, so
21 that whoever is responsible for any instance of pollution,
22 must have the mechanism to provide water to replace that
23 which is no longer potable and, possibly, the mechanism
24 to pay damages.

25 That is not discussed or suggested as a mitigation

34

1 in the EIR.

2 MS. CAMPBELL: Okay. Let me just write that
3 one down. Your concern is over the actual liability of
4 Occidental for a toxic spill into the water system?

5 MS. JADIKER: A toxic spill and sedimentation
6 to the point where the water exceeds the potable drinking
7 water standards.

8 MS. CAMPBELL: Okay, concern over liability of
9 Occidental -- I'll just put for degradation of domestic
10 water.

11 There is a \$150,000 bond which is being posted
12 by Occidental, posted to U.S.G.S., for those sorts of purposes.

13 However, the actual release mechanism for the
14 bond might be clarified further.

15 MS. JADIKER: I suspect when it's clarified,
16 the residents will find it's really not applicable to their
17 needs.

18 MS. CAMPBELL: Okay. The lady in the back.

19 MS. SWEAT: Maribel Sweet. A \$150,000 bond, isn't
20 that nationwide that they have a bond to cover all of their
21 projects? \$150,000 could hardly buy my house.

22 MS. CAMPBELL: I'll have to ask Tom Hamilton
23 from Oxy, can you explain what all the \$150,000 bond covers?

24 MR. HAMILTON: No, I'm not that familiar with
25 the bond.

37

1 and, particularly, the Well Pad 8 that may impact Gunning
2 Creek -- we want them to do a whole lot of mitigation
3 measures on the surface, which they're agreeing to do.

4 They're putting in the jute matting, they're
5 reseeded their fill slope, they're trying very hard to
6 eliminate any possible erosion. Nevertheless, we're afraid
7 that some erosion may occur.

8 Therefore, we think that they ought to monitor
9 what happens to that stream to assure us and you that there
10 is nothing going wrong with your stream.

11 Now, we have it down to an either/or. Either
12 they can monitor that stream scrupulously or they could
13 chip in towards the project that Aminoll and Lake County,
14 I understand, are working towards in trying to fix up a
15 source of drinking water which could not be polluted by
16 geothermal development.

17 In other words, box it in up at the head springs
18 and supply the people below with unpollutable water. That's
19 another possibility. We are presenting both to Occidental
20 and to the Commissioners as our proposal of what they
21 ought to do.

22 Now, whether we succeed in getting this or not,
23 we don't know. Occidental's position -- Tom, would you
24 like to tell the group what Occidental's position is on
25 the either/or at the moment?

35

1 MS. SWEAT: Well, this is what I have been told.
2 They have an overall bond that covers all their projects.
3 It's entirely unacceptable.

4 MR. BOHNER: It is a nationwide bond; isn't that
5 correct, Dave? Initially taken out by --

6 MR. FACH: That's what I understand. I don't
7 know everything about the bonds and Prop. 13, though. In
8 fact, what I did hear from our lawyer in Riverside recently
9 was that I asked for a little clarification on the bond
10 to see what it could be used for. And he said the purpose
11 for the bond is for onsite repairs. The problems seen
12 downstream, the bond could be used to repair the source
13 of the problem, but not necessarily -- the way I understand
14 his explanation -- to repair the damage downstream. That
15 would come through different mechanisms.

16 MS. CAMPBELL: And Mary Jadhav's point was that
17 mechanism needs to be addressed in the EIR.

18 Do we have any other comments on water quality?
19 In the back.

20 MR. MALFONTE: I'm Joe Malfonte, a resident of
21 Anderson Springs.

22 In your summary of this notice of availability,
23 you say:

24 "Because Gunning Creek is the main
25 water supply of the village of Anderson

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1 Springs, staff believes that Occidental
2 should provide mitigation to preserve
3 the high quality of this water."

4 What does staff intend to do when Oxy is not providing?
5 This is my question.

6 MS. CAMPBELL: Okay, for that, I would like to
7 explain the difference between the CEQA -- CEQA is the
8 California Environmental Quality Act -- which requires
9 us to produce EIRs. There is a difference between that
10 process and the Energy Commission's regulatory process.

11 The regulatory process is the one where our staff
12 sits down and says, okay, here are the things that we think
13 Occidental ought to do. And we present our thinking to
14 the Commissioners.

15 They reach a decision based not only on what
16 we do in the regulatory process, but also on the EIR.

17 Now, in the regulatory process, we are now attempting
18 to require of Occidental something like an either/or
19 condition. We are attempting to require of them either
20 they monitor scrupulously for the kinds of problems which
21 we anticipate may occur to Gunning Creek -- which is basically
22 mud in the water, that is what we think may occur. The
23 fancier name for it is "suspended solids" and you'll hear
24 that a lot tonight.

25 We're saying if they build their power plant --

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1 MR. HAMILTON: We believe that the mitigation
2 measures that Oxy -- when Val explained it to
3 you, she said that there was a -- the staff had a belief
4 that there would be an impact on the -- that there could
5 be an impact on the water quality, that the mitigation
6 measures might not be enough.

7 Oxy's position right now -- and we are discussing
8 these in workshops -- is that the mitigation measures will
9 be adequate. We don't understand exactly the either/or
10 approach. If you do this -- if you monitor, then the water
11 quality will be okay. We are not really in agreement with
12 an either/or approach.

13 MS. CAMPBELL: Are you willing to go with either
14 fixing up the source of drinking water or monitoring the
15 creek as we want you to monitor it?

16 MR. HAMILTON: No. Actually, the monitoring
17 that's required -- we're in the position that the Regional
18 Water Quality Control Board, which is the lead agency in
19 the water quality and has the state responsibility for
20 protecting water supplies -- does have the authority to
21 impose monitoring requirements. And we have stated that
22 we will abide by any water monitoring requirements that
23 are ordered by the Regional Water Quality Control Board.

24 We think that that's adequate. And we don't
25 know why the Energy Commission believes that more is necessary

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1 then the Regional Water Quality Control Board believes
2 is necessary. And, again, that's in the process of being
3 determined as well.

4 MS. CAMPBELL: Okay, so much for the monitoring
5 possibility. What about the other possibility? What is
6 Occidental's position on that one?

7 MR. HAMILTON: We're not in favor of paying for
8 something that should be paid for by what we think should
9 be paid for by public funds.

10 MS. CAMPBELL: Okay, that translates as you are
11 not willing to contribute money towards fixing up the source
12 of water for the community of Anderson Springs, correct?

13 MR. HAMILTON: Yes.

14 MS. CAMPBELL: All right, the lady in back here.

15 MS. LANG: I'm Karen Lang from Anderson Springs.

16 In reference to what he just said, why should
17 county or state or anybody else or even the private individuals
18 pay for what they are spoiling? In other words, 1903 funds
19 should go into it? It's up to Aminoll, PG&E, and Occidental
20 to take care of everything.

21 MR. HAMILTON: Val, it may be appropriate for
22 you to explain --

23 MS. LANG: While I'm on the same subject --

24 MS. CAMPBELL: Let her finish.

25 MS. LANG: Maribel Sweet mentioned the \$150,000

1 bond. Their bond doesn't even cover the \$10 million that
2 they have in lawsuits for damage they've done in other
3 dwelling areas.

4 MS. CAMPBELL: Mary?

5 MS. JADIKER: Mary Jadiker.

6 I was just going to suggest if we really do have
7 suggestions for the Regional Water Quality Control Board.
8 Mr. Crawford is standing right outside the door.

9 MS. CAMPBELL: She's referring to Ed Crawford
10 from the Regional Water Quality Control Board.

11 MS. ICHIM: If I might interject -- Arlene Ichim,
12 attorney for the Commission staff -- I would like to point
13 out that while the Regional Water Quality Control Board
14 is, in fact, the state agency responsible for protecting
15 the quality of the state's water; nevertheless, the Energy
16 Commission is the lead agency with respect to the Occidental
17 project.

18 As the lead agency, it has the responsibility
19 of preparing an Environmental Impact Report which evaluates
20 which environmental effects are likely to occur as a result
21 of this proposed project.

22 As the lead agency, the Commission is also,
23 therefore, placed with the responsibility of ensuring that
24 significant effects are reduced to an acceptable level.
25 In other words, mitigated.

1 as I understand it, of assuring the quality of water; is
2 that correct?

3 MR. CRAWFORD: To a point.

4 MS. CAMPBELL: Okay. Can you tell us what the
5 concerns are of the Regional Board in this particular
6 watershed? And what are they doing about it?

7 MR. CRAWFORD: Edwin Crawford, Regional Water
8 Quality Control Board. They have my address.

9 Concerns are protection of water quality for
10 indicated beneficial uses enumerated in the Water Code,
11 recreation, domestic supply, aesthetics, and a few others.
12 And it's to be protected from damage to beneficial uses
13 from an unreasonable waste disposal practice.

14 And I'm sure every attorney in this room realizes
15 we have a hard time with "reasonable". But that's the
16 way the Water Code is written.

17 MS. CAMPBELL: Now does the Board interpret
18 "unreasonable"? I mean, what does that mean to us here?

19 MR. CRAWFORD: Do you want a candid answer? It
20 means you try as hard as you can to keep it as clean as
21 you can and stay out of court.

22 MS. CAMPBELL: Okay, how do we do it here with --
23 we're looking at another geothermal plant. What is being
24 proposed from the Board about how to keep it clean?

25 MR. CRAWFORD: Oh, waste discharge requirements.

1 As the lead agency, the Commission is also
2 responsible for taking into consideration this environmental
3 document when it tries to arrive at a decision with respect
4 to permitting the Occidental plant and with respect to
5 what conditions would be appropriate to putting on that
6 permit.

7 So, I want to clarify the two positions of the
8 two different state agencies.

9 MS. SWEAT: Mariel Sweat.

10 I'd like to ask the Commission if you have been
11 up to the Oxy facility in the last two weeks, three weeks.
12 Have any of you been up there and looked at the soil and
13 seen what's going on there now?

14 MR. BOHRER: I personally have not been up there
15 in the last two weeks. I was up there when they started
16 from Drill Pad C to Drill Pad D. I did observe before
17 the culverts were in place and I have been on the site
18 since the culverts were in place. And we have had staff
19 biologists up there within the last week and they are
20 concerned by what they see.

21 MS. SWEAT: Well, we've had some pretty bad results
22 And the other thing, this discussion of 1903
23 funds. Aminoil is so graciously going to use for the people
24 of Anderson Springs. In the beginning, Aminoil promised
25 the people of Anderson Springs that they would put up tanks

1 for us and take care of our water supply, because they
2 felt an obligation to the people. They've been drilling
3 there since 1969. And we have spent thousands and thousands
4 of hours going to meetings like this and getting nowhere.

5 Everything is addressed, everything goes down
6 in the report. But nothing ever gets done, frankly.

7 Anyway, they promised us the tank, the water
8 supply, everything. Now, they back down and they want
9 to use 1903 funds.

10 So, you must realize that, too. We have been
11 promised and promised and nothing ever happens, frankly.

12 MS. CAMPBELL: Okay, I understood that comment.

13 The lady here.

14 MS. MUDD: I'm Virginia Mudd, a homeowner in
15 Anderson Springs.

16 We wouldn't have this problem if it weren't for
17 the geothermal plants. The water was perfect. And all
18 of us know this. We're all aware of it.

19 So, how come we're having polluted water now?

20 MS. CAMPBELL: Okay, I think this may be the
21 time for a few words from Ed Crawford from the Regional
22 Water Quality Control Board.

23 As Arlene was explaining, the authorities of
24 the different agencies are complicated. The Regional Water
25 Quality Control Board has the statewide responsibility.

1 thou shalt not discharge anything into the creek; several
2 monitoring stations.

3 MS. CAMPBELL: Is the Board requiring any
4 monitoring stations on Gunning Creek?

5 MR. CRAWFORD: Yes -- well, wait a second. I
6 don't have the darned things with me.

7 MS. CAMPBELL: They're not, as far as I know.

8 MR. CRAWFORD: No, Anderson Creek, no. And the
9 reason for that is the county is requiring that along the
10 creek.

11 MR. BOHRER: The court reporter simply cannot
12 get the record. And if you want us to do as good a job
13 as we can, it's very important that we get a good, clear
14 record. So, please --

15 UNIDENTIFIED VOICE: We can't hear him.

16 MR. BOHRER: Okay, speak up, Ed.

17 MR. CRAWFORD: It's been a long, hard day and
18 I guess my voice is running down. Where was I?

19 MS. CAMPBELL: You were in the process of telling
20 us what monitoring is being required by the Board of
21 Occidental.

22 MR. CRAWFORD: Oh, okay. We didn't require
23 Occidental to monitor Gunning, because the county is requiring
24 that. And we thought it would be a duplication of effort.

25 MS. CAMPBELL: Okay, hang on for a second.

1 County, what are you requiring on Gunning Creek
2 in the way of monitoring?

3 MR. CROSBY: Pieter Crosby, Health Department
4 again.

5 We do not have any monitoring going on at this
6 time. We are requesting that either a monitoring takes
7 place so we will have ample advance warning if there's
8 any spillage or any contamination to the water supply of
9 the people that will be drinking downstream. We either
10 would like to see that or something done so that you will
11 not get any accidental spillage or other problems.

12 MS. CAMPBELL: One further question. What about
13 suspended solids, or mud in the water? You're with the --

14 MR. CROSBY: With the local Health Department.

15 MS. CAMPBELL: -- with the Health Department.

16 Is the Health Department at all concerned with that?

17 MR. CROSBY: We would be concerned about that
18 in the water. Right now we're more concerned about spillages
19 that would have immediate significant health problems to
20 the people who would be drinking it. They would not have
21 ample warning ahead of time if there was any kind of a
22 spill from, say, a truck accident tipping over into the
23 water or something along those lines.

24 But we'd also like to see provisions that the
25 staff is making for downstream problems. Or some kind

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1 of mitigating circumstances so you wouldn't have a problem
2 in that regard. We go for that either/or that you discussed
3 in that area.

4 MS. CAMPBELL: The gentleman in the back. I'll
5 get back to you.

6 MR. TOCHER: Craig Tocher.

7 It relates to the same question by Mr. Crawford.
8 Whereabouts on Anderson Creek is the monitoring? Will
9 it be high enough so that our property will get some
10 indication of when it's coming and when it will pass?

11 MS. CAMPBELL: Could you let us --

12 MR. CRAWFORD: It sure will. We've got Union
13 Oil -- I take that back. You mean, on your Union Oil lease?
14 I don't know where you live.

15 MR. TOCHER: We live on the southeast corner
16 of that map up there. We have 160 acres that adjoin the
17 Occidental site.

18 MR. BOHRER: In here (indicating)?

19 MR. TOCHER: That and the next quarter up.

20 MR. BOHRER: This quarter here?

21 MR. TOCHER: Yeah, and it still extends out beyond
22 that.

23 MR. CRAWFORD: And you're not speaking to that
24 piece of property you have leased to Union Oil?

25 MR. BOHRER: Well, that's where the Union Oil

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1 lease is.

2 MR. TOCHER: Union Oil has leased from us, but
3 they've offset. That doesn't have anything to do with
4 this. I just want to know where the monitoring of Anderson
5 Creek will come to the middle of our property.

6 MS. CAMPBELL: Okay, Ed, can you answer that
7 one? Is there any monitoring being required?

8 MR. CRAWFORD: By us? No.

9 MR. TOCHER: He already answered that.

10 MS. CAMPBELL: The answer is none is being required

11 MR. TOCHER: It looks like to me it might be
12 logical right at the edge of their property to set up a
13 monitoring point.

14 MR. CRAWFORD: That, again, has been required
15 by the county. Correct me if I'm wrong.

16 MR. HAMILTON: I don't know.

17 MR. CRAWFORD: You don't remember?

18 MR. HAMILTON: I don't know.

19 MR. CRAWFORD: It's not the Health Department,
20 it's the Planning Department.

21 MS. CAMPBELL: Okay, Alex, can you do it again,
22 please?

23 MR. HINDS: Alex Hinds with the Lake County
24 Planning Department.

25 I'm begging off. I've only been here a little

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1 over a month, so I'm not sure what the permit says.

2 But I would like to say that the production permit
3 that is proposed by Occidental in relation to this project
4 has not been considered yet by the Planning Commission.
5 There has been a permit approved for an exploratory project
6 of which some of the well sites are the same. And that
7 may or may not have the monitoring Mr. Crawford is referring
8 to.

9 And to sum it up, I'd like to yield to Mary Jadiker
10 who's patiently looking like she has something to say.

11 MS. JADIKER: Mary Jadiker.

12 I was Chairman of the Planning Commission and
13 Dave Fach was in his present position with the U.S.G.S.
14 when the exploratory well permits were issued for Occidental
15 geothermal on this site.

16 However, I don't remember the specific water
17 monitoring requirements in the permit. Therefore, as part
18 of this draft document hearing, I will ask the Commission
19 staff to obtain copies of the Occidental well drilling
20 permits and any other possible monitoring requirements
21 laid down by any other regulatory authority and put those
22 into the final document.

23 I'd also like to emphasize, as Mr. Crawford is
24 saying, he's not concerned with sedimentation. He's
25 concerned with waste discharge.

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1 MS. CAMPBELL: Yes, I want to point out that
2 neither Mr. Crawford of the Regional Board nor, as I
3 understand it, the gentleman in the back from the County
4 Health Department, are they concerned with suspended
5 sediment, is that correct?

6 MR. CROSBY: Well, we're concerned, but we're
7 more concerned about other things.

8 MS. CAMPBELL: Right. And I think the upshot
9 of it is that neither the Board nor the County Health
10 Department are requiring monitoring suspended sediment.
11 Is that correct, Ed, from the Board's --

12 MR. CRAWFORD: Val, I've got to state here and
13 now I'm not going to tell anyone at a public hearing how
14 I function, because it's going to reduce my capabilities
15 as a law enforcement officer.

16 MS. CAMPBELL: We want to know what's being
17 monitored.

18 MR. CRAWFORD: What you want to know is being
19 monitored as far as documents, okay. How I plan my
20 activities, no way.

21 MR. BOHRER: That's what we're asking. What
22 do the documents --

23 MR. CRAWFORD: That I keep to myself, because
24 I'm not going to tell --

25 MS. CAMPBELL: Okay, don't reveal your hand.

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1 MR. CRAWFORD: -- every other week of every other
2 month I'm looking at it.

3 MS. CAMPBELL: What I want to know is what
4 officially is being monitored?

5 MR. CRAWFORD: I just want out. It's Anderson
6 Creek, above Anderson Creek, above Anderson Springs, above
7 the last house there; the Unit 13 tributary, that's two.
8 I've got one more on Anderson Creek somewhere. Oh, and
9 above the swimming hole.

10 MS. CAMPBELL: And what elements are being
11 monitored?

12 MR. CRAWFORD: Turbidity.

13 MS. CAMPBELL: Turbidity, which is cloudiness
14 in the water.

15 MR. CRAWFORD: Stage, the height of the water;
16 not the flow, the height of the stream. And if the turbidity
17 exceeds a specified value of 15 units, which is the point
18 at which you start to see cloudiness, a machine takes a
19 sample for possible suspended solids, but mainly for
20 suspended toxic materials.

21 There's a complicated formula if the turbidity
22 goes up without a concomitant increase in stage -- do you
23 understand that?

24 MR. BOHRER: In other words, the water doesn't
25 get --

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1 MR. CRAWFORD: If the water level stays the same
2 and the water gets muddy, you take a sample. If the water
3 goes up and gets muddy, you assume it's due to a rainfall
4 or whatever. And you don't take a sample.

5 MS. CAMPBELL: And you don't take a sample.

6 MR. CRAWFORD: And you don't take a sample.

7 MS. CAMPBELL: I see?

8 MR. BOHRER: Now, the question was asked early
9 on that they couldn't understand or it wasn't understandable
10 why the Commission has a different perspective.

11 The reason we have a different perspective is
12 simply this. Turbidity is listed as part of the things
13 that are checked for water quality. But it is not the
14 pollutant. The pollutant is not turbidity. Not whether
15 the water is clear or opaque, but whether there is sediment
16 in the water.

17 And, furthermore, the sediment not only itself,
18 sediment, according to textbooks, is the number one pollutant
19 in the waters of the United States and costs more money
20 for water systems to remove than any other pollutant.

21 So, the Commission's position -- and has been
22 from the beginning -- that in order to determine what is
23 being lost from the site because of the erodible soil and
24 erosive rainfall is how much sediment is in the water and
25 what is the flow rate.

Now, the importance of that -- which I've explained before -- is if you don't know what the flow rate is and you don't know how much sediment is in that water at different times, you can never calculate how many tons of material were washed off of a given watershed into given waters.

To measure turbidity is the same as doing a comprehensive water quality study for what is in the water by taking pH. In other words, is it acid or is it alkaline? If you took pH and you tasted it, you could say it tastes sour. But you wouldn't know whether it tasted sour because it had lemon juice added or sulfuric acid from a plant.

So, consequently, pH would be just about as much help in determining whether there's sulfuric acid or whether there's arsenic or whether there's lead or mercury -- which are the contaminants that cause the health problems -- as measuring turbidity will be, in effect, telling us what are the pollutants being washed off of the site; how much soil is being lost. And furthermore, some of the soil particles could easily have other contaminants attached to them.

So, that's why we're asking the Applicant -- and have from the very beginning -- to monitor at various sites continuous flow -- that is, cubic feet per second or gallons per minute -- and the amount of sediment actually

in the water.

Now, that isn't that big a problem, because during many periods of the year there isn't any sediment in the water to speak of. And maybe one sample a month would be adequate. But 90 percent of the sediment that comes off this watershed is going to come off in about 10 percent of the time. That is, days during the year.

And if those periods are not sampled, the rest of the data is valueless. It will only say, well, it's not very contaminated. So, that's why we've maintained that.

In answer to Mr. Tocher's question, very early on we met with the various regulatory agencies and discussed three different scenarios of the type of monitoring I'm talking about. And one of those scenarios would have been at this point right here (indicating) where the new road from Drill Site C to Drill Site B goes across Anderson Creek. And that, by the way, is across your property.

Now -- and this is only a personal opinion -- the ability of this type of a network to actually pick up spills is certainly open to debate. Why is that? There are various pollutants and contaminants in the water that have to be sampled in a very prescribed manner, collected in the field in a prescribed manner, and tested in the laboratory in a prescribed manner. Some of them must be

taken in within 14 hours. Others must be taken in in a plastic bottle rather than a glass bottle.

If this sampling is for spills, there's a good chance that the bottles might not be taken off for some period of time. And the value of those samples, depending on what they were testing for, might not be too helpful.

So, that's why the Commission has from the very beginning had a concern about how this monitoring was going to be undertaken.

MS. CAMPBELL: And I just want to add that what we are trying to accomplish in the regulatory case is we're trying to get the help of the other agencies who have greater authority than we. We are seeking the help of the Regional Water Quality Control Board, we are seeking the help of ERM, we are seeking the help of U.S.G.S., and we are seeking the help of the county. All of these in requiring the kind of monitoring which we think will do the job to identify any impacts from this power plant.

Tom Hamilton.

MR. HAMILTON: Val, Tom Hamilton.

Just two comments. First of all, the separate findings, conclusions, and conditions that Occidental proposed did have appended to it an exhibit that indicated all the various monitoring stations that have been imposed that they are agreeable to in a visual format with various

symbols representing them and they were significant as there were a number of ones that were just one or two. If you have that document, it might be -- I recall that there were a couple of stations on Gunning Creek. I am probably should remember that.

MR. BOHRER: There's one at Fork Flat Road.

MR. HAMILTON: My other comment is I'm a little concerned about the ability of the public to comment when we've had you inquiring of Ed and me to explain things to you. We've got a document here to hear public comment on.

MS. CAMPBELL: Okay, I think that's fair. Tom's pointing out that we're getting deflected a little bit in inquiring into what all is going on to resolve these situations rather than dealing with the document before us.

I understood that maybe that's where the public interest was going. But what we could do is -- let's stick to the document and then what we can do is we can take a break and during the break the Public Adviser would be available. You should consult with the Public Adviser about what you can do about the problem.

People like Mrs. Sweet, who have indicated frustration with "we've seen it before, we keep seeing it happening, we have a lot of meetings and we get nowhere,"

I think what you need to do is talk with Gary Hearn about what you can do about it. How can you take action and how can you get action. And I would suggest that you do that at the break.

So, then, let's get back to any specific comments about the Draft EIR itself. We're on the subject of water quality. Are there any other specific comments about water quality in the Draft EIR? Mary.

MS. JADIKER: Mary Jadiker.

Earlier on this sidetrack discussion, the topic of Aminoil and the county and the possible use of AB 1903 funds to mitigate water contamination supplies came up.

I don't recall that being in this Draft EIR. If it is in the Draft EIR and if it is suggested as a possible mitigation measure, I would submit that that's very inappropriate in that there is nothing to assure anyone that the Board of Supervisors of the County of Lake will do anything like that with 1903 funds.

They have, in fact, committed \$15,000 for the study that we spoke of. But at the rate of \$300,000 a year -- which is more or less what comes in at the present rate for the county's share of federal revenues from federal leases -- there simply is no use in suggesting that because the revenues are received by the county, they will be used for any specific purpose.

MS. CAMPBELL: I think your point's well taken.

That is not in the EIR.

However, what the EIR does contain is the suggestion that improving the water system would be an adequate mitigation measure. We don't suggest how. We don't suggest the funding. And we don't suggest where the impetus should come from. And those are subjects which you may wish to discuss with the Public Adviser's Office.

Are there any other comments on the water quality section of the Draft EIR? Mr. Bull.

MR. BULL: Robert Bull, Anderson Springs Water.

If you refer to page 123, the second-to-the-last paragraph, you'll see an amount there in the amount of \$1 million.

Occidental did a study for us to find an alternate source of water, which they never did. That same study, I was informed last week that Occidental and Aminoil through Brown and Caldwell are doing the same study. And I'd like to say that we're being studied to death with absolutely nothing being done.

MS. CAMPBELL: I understand your comment, Mr. Bull. Feasibility studies have been underway for some time. Tom.

MR. HAMILTON: An explanation of what Mr. Bull heard probably. I understand that Aminoil is using known

1 and Caldwell's study that was previously done in their
2 efforts with Lake County.

3 MS. CAMPBELL: Sure.

4 MR. HAMILTON: And that's the extent of it.

5 MS. CAMPBELL: I understand. The bottom line
6 from Mr. Bull's comment is we have feasibility studies
7 and we have feasibility studies and what have we got on
8 the ground? What have we got in the way of implementation
9 of the study? Mr. Brown.

10 MR. BROWN: I'd like to make a suggestion. Where
11 all of us sometimes might be a little wrong, it's procedure
12 that the California Energy Council can't help, maybe no
13 one else. But I can make a short synopsis why we're the
14 most impacted and get the least help for this one reason:
15 LASCOR helped us out, told us what to do, there's only one
16 way of getting 1985 funds was to form a water district.
17 In order to form a water district, it takes a few years
18 to do it.

19 Now, Lake County -- not Lake County, but the
20 lower lake, as I understand it, 25 or 30 thousand dollars,
21 they get up one evening and want to drill another well
22 and they have a very good water system. But they know
23 how much it costs to drill a well. Kelseyville maybe wants
24 a new fire truck. They know the price of that fire truck
25 They can look in Sears and Roebuck and get it in 10 minutes.

1 a fair representation of environmental issues and mitigations
2 However, the one definite and continued fault
3 of the document is the reliance upon standards to determine
4 if any environmental -- any significant impact is occurring.

5 Air quality standards and guidelines are
6 particularly used to make legal decisions. I think you
7 used the term "multiple environmental goals" in several
8 occasions. They're used to decide whether the impacts
9 are significant or not. Well, I would suggest to you that
10 the document needs to address the fact that degradation
11 is just below these standards, while it may be legal, is
12 certainly not desirable. And that the receptor area that
13 you're talking about is a pristine environment in many
14 considerations. The air quality is. And our recreational
15 center there has been improving, in spite of the expansion
16 there.

17 There's good reasons for it. Unit 13 is by far
18 and away the cleanest operating power plant in this area.
19 People like Carl Brown, who intervened a long time ago
20 in the PUC certification, several of the people here did
21 make a difference. And you can do things directly. And
22 I think it's reflected.

23 I think the document that we're referring to
24 tonight, for instance, can help a great deal in really
25 explaining the difference between legal, acceptable standards

1 they qualify right now.

2 We're suggested to have this water study made
3 by Brown and Caldwell -- which there's nothing wrong with
4 the legality of it -- but I'm saying how we're getting
5 hooked, it takes all winter to get it figured out. I don't
6 say it's Aminoff's fault. But you see, it takes a year
7 for us to come up with our figures and everybody else in
8 the county in 10 minutes gets their money, because it's
9 the procedure we have to do. And there we're the guys
10 that's hurt. Everybody gets a piece of the pie but us.
11 That's the whole story right there.

12 MS. CAMPBELL: Okay, Carl, thanks for your comments.

13 I think that maybe in discussing how to resolve
14 some of the problems, we can handle them at the break with
15 advice from Gary Heath.

16 Are there any other comments on the water quality
17 section of the EIR?

18 Okay, what about biology? Do we have any concerns,
19 questions, or comments on the biology portion of the EIR?

20 How about air quality? Bob Reynolds.

21 MR. REYNOLDS: My name is Bob Reynolds. I'm
22 the Air Pollution Control Officer.

23 We have several comments, which we will submit
24 in a letter format as well as a general comment that I'd
25 like to make so the people would be aware of it.

1 and what's going to happen to the environment. It talks
2 about cumulative effects. And what the option and mitigation
3 steps are.

4 For instance, I would like to point out that
5 one of the very desirable features from the air quality
6 standpoint, noise and health considerations, the Occidental
7 power plant has effectively got twin generating units there.
8 They also have turn bypasses on the turbine. Some of you
9 will remember that we tried to get PG&E to put one on Unit
10 14. That still is not resolved. But it's a very important
11 aspect when you start talking about noncriteria pollutants.
12 Because the time at which you have these mass formations,
13 knowing the power plant would be putting out H_2S an hour,
14 if the power plant breaks down, it dumps all of the noncriteria
15 pollutants in the area as well.

16 There's no doubt that the turbine bypasses and
17 the twin generating units are very, very effective mitigation
18 steps, which is kind of just glossed off.

19 The reason I point this out is I actually give
20 Occidental a compliment or two, because I'd like to see
21 other applicants also use this approach. On two occasions,
22 the turbine bypasses and twin generating units were tried
23 unsuccessfully.

24 The CEC itself, I feel, was not aware of the
25 benefits that are derived both from an efficiency standpoint

1 We have permitted both the power plant for our
2 purposes and the steamfield. They're having a very congenial
3 approach with the Air District and Ory. They're addressing
4 most of the issues which came out before our county board
5 with power plant sitings, at cetera. It is a good facility
6 from an air quality standpoint. I want to say that to
7 preface that.

8 But the real purpose tonight is to address a
9 document which you may want to use later in a legal battle.
10 Or you may want to us in getting stipulations which it
11 turns out the CEC has kind of gotten backwards. We argue
12 about these stipulations. The permit is issued and now
13 we're preparing an EIR. And the EIR we want to make certain
14 is consistent with the conclusions we've reached in other
15 proceedings, which are really the binding proceedings upon
16 the Applicant.

17 What happens in the EIR is only supposed to guide
18 those regulatory bodies in making those binding decisions
19 which have already to a large part been made. So, this
20 document should at least reflect those decisions.

21 I would avoid making specific comments tonight.
22 But I would like to make a couple points relative to the
23 cumulative effects which do appear in this document. In
24 other words, you have to address this document.

25 I do think this document is well prepared and is

1 -- you waste less steam -- and from an environmental
2 standpoint. And noise, specifically, because the stacking
3 is the biggest noise source and the noncriteria pollutants,
4 which are not abated at all and are removed in the process
5 treatment of the power plant. When they're stacked, they
6 are not removed.

7 The Occidental power plant is really, as far
8 as I'm concerned, adequately addressed in both those issues.
9 You cannot ask them to do more in those areas. On a positive
10 note, I'd like to see this document reflect that.

11 As far as little, picky comments, I will note
12 that the document also talks about the particulate loading
13 on Socrates Mine Road. It talks about 1.74 micrograms
14 per cubic meter, which is about the cleanest air you're
15 going to find anywhere in the state. And it's talking
16 about 1976. The document should talk about how that road
17 is at the present time, how the particulate load is going
18 at this time.

19 The document should also take notice of the fact
20 that we have, the district, had a workshop in Anderson
21 Springs. And we filed it. It should also take notice
22 of the DOC conditions.

23 MS. CAMPBELL: It does.

24 MR. REYNOLDS: And incorporate it as mitigation
25 steps. This makes it legally more binding on the Applicant.

MS. CAMPBELL: Yes.

MR. REYNOLDS: The other thing I would like to explain in regards to water quality and particulate load. We have had a requirement placed upon them, primarily as a result of our workshop and comments made by Mr. Bull, Eric Jacobson and several other people, that they monitor what is falling out of the sky as well. Several people mentioned that they're worried about things coming down from the twin towers, et cetera. And those will be measured. And it really is the district's position that those are not serious concerns at this time.

I'd like to tell you that if I thought it really was a serious concern, I wouldn't permit the facility. And as an Air Pollution Control Officer, I have that right; as part of the PUC staff, we could control that and the Applicant would have to take it before the CEC and couldn't ignore it. It will also tell you at the same time, they will be monitored. And if there are things that are at issue, there is certainly steps that can be taken. And you can have a very positive effect. It doesn't have to be as Martial Sweet mentioned, on and on and on.

And she is aware, I think, the air quality has markedly improved. And if there are problems, there's ways of removing them.

Occidental, I think, again deserves a compliment.

I think they've taken the options at the power plant to avoid a major issue. That issue was stacking. And they have essentially addressed it in a manner which no one should have a complaint and they should be complimented for that, too, and there should be more of that.

I imagine, as in all issues, there's always an answer if you can define the problem. But you must understand that part of the reason for this document is not to actually be binding on anyone, but it simply forces decisionmakers to look at it, what's contained in the document, and their decision has to be consistent with this document. And you, as people in the public, should realize it's an opportunity that has to have a follow-through. You may not be so frustrated if you follow it all the way through.

MS. CAMPBELL: I think Bob's made several points. I think his main one was that they're in good shape; this proposal, in his opinion, is in good shape in terms of air quality and in terms of noise. Energy Commission staff agree and appreciate his expertise in the area.

He also made the point that there is quite a difference between what is legally allowable and to just below what is legally allowable when you start adding them up. That that may make a difference on a cumulative level. In other words, the individual parts may add up to quite a bit. But, individually, they may be just below what

is legally allowable. Therefore, are allowable on cumulative impacts.

MR. REYNOLDS: Bob Reynolds again.

I'd like to clarify a little further. I'd like to state that a standard may not be acceptable to you as people. I'm telling you that most of the people who live in Lake County, I think a large number of people in that county, moved up here to get away from what they considered to be a less-desirable situation.

Those less-desirable situations may very well be legal themselves. I'll take the example of the H_2S standard. There's no intent to keep you from ever smelling H_2S . There's no intent to even approach that. The H_2S standard is at a level -- is at what we call a nuisance level. In other words, you smell it too long, too frequently. You're always going to smell it once in awhile and there's always going to be a little question about, perhaps, some health effects, et cetera.

But it's a borderline thing. It's a reasonable number. And that's what those standards are based upon, some reasonable number. And you don't necessarily let things get up to that number. And that's my point. That may not be acceptable to you, but it still is an environmental impact that occurs. That document should still address them in those terms.

MR. HEATH: We're going to go off the record now. Our reporter needs a little break. So, we'll go back in about five minutes.

MS. CAMPBELL: And I would just like to suggest if you want to discuss possible resolutions to some of your frustrations and courses of action that you can take, do confer with Gary Heath, the Public Adviser.

Let's reconvene at 10 minutes to 9:00. (Thereupon a brief recess was taken.)

MS. CAMPBELL: Could we reconvene, please.

MR. HEATH: Ladies and gentlemen, we're ready to start again. So, if you could take your seats.

MS. CAMPBELL: Okay, we'd like to take up where we left off, which, I think, we had completed comments on air quality.

Yes, in the back, Mr. Tocher.

MR. TOCHER: I saw a few hands raised. Craig Tocher.

One of the problems I have is a little hard to relate to. I guess a lot of reports talk about parts per million, a lot of documents. And then I come across other items, pounds per hour. And it's hard to relate items like this to the report.

I've got some documents here that relate parts per million to toxicity and the things that are dangerous

to you. And it's hard for me -- even though Bob over here is very confident everything has been fine -- living within a few thousand-foot radius of that power plant out there and H_2S being emitted.

I know that H_2S in certain amounts is very harmful to people that have alcohol problems, it's very harmful to people that have some other respiratory illness, and infections, anemia, things like that.

What I'd like to see in this report is some relationship to either parts per -- some way you can relate to the illnesses that might be affected.

MS. CAMPBELL: I think you may want to look into the appendices. Appendix 8, as I recall, in the very back, that discusses the potential health effects of geothermal pollutants.

It goes into the water pollutants as well as the air pollutants. That's in the vicinity of page 322 and on. And I think that gives a pretty clear description.

It also talks, by the way, about mercury and some of those other concerns which you raised earlier. You might want to review the appendices. I think it clarifies some of the points.

MR. HEATH: If you have any specific questions on any of those items, we can put you in contact with our health staff at the Commission and they will answer, hopefully.

your questions that you may have.

MR. TOCHER: Okay.

MS. CAMPBELL: Are there any questions or comments on air?

MR. REYNOLDS: I'd like to first respond to Mr. Tocher's comments.

I'd like to first state that I was unaware that we had a resident in that area. And that we certainly have no intent to site the facility in that area considering your proximity there and to protect you. I mean, I don't know how to say this to you, but essentially you weren't considered. When I was speaking, I was speaking primarily in terms of, you know, the immediate Anderson Springs area.

So, you'll be clarified. In fact, I know the Tocher well is just across the line of the county in Sonoma County and has a very high blood rate. That would probably be a much larger source close to your home.

I will honestly tell you that I wasn't aware of your proximity.

MR. TOCHER: The unfortunate part, I think, our house is right on Anderson Creek itself and everything is going to be draining right down that funnel.

MR. REYNOLDS: You're right.

MR. TOCHER: And it's going to be a major concentration within the air pollutants.

MS. CAMPBELL: Okay.

MS. SWEAT: Maribel Sweat.

Could I make one comment on water quality?

MS. CAMPBELL: Sure.

MS. SWEAT: Sorry to go back to it.

Our recreational waters were not distressed at all. Even if we do get storage tanks for drinking water, there still is the problem of the recreational waters. And we would like to keep those as clean and pure as possible. Because without the recreational waters, well, the place, it wouldn't be the same. I mean, many people they say, well, I bought the creek and they threw in the house. I mean, that's how important that creek is.

MS. CAMPBELL: Yeah, it's a comment on the quality of life.

MS. SWEAT: Yes.

MS. CAMPBELL: Any other comments on air quality? Noise, I think we already asked if there were comments and there were none.

MR. REYNOLDS: No, I don't think so.

MS. CAMPBELL: Any comments on noise?

MR. REYNOLDS: The section is totally inadequate.

MS. CAMPBELL: Oh, you don't like it.

MR. REYNOLDS: It doesn't even reflect the Joint Findings and the Stipulations. It's going to have to be

rewritten. It's just totally irreparable.

MR. HEATH: Mr. Reynolds, you will put those comments in writing on that?

MR. REYNOLDS: Right. I think my comments tonight would be just look at the Joint Findings and Stipulations and put them in the EIR, because there's nothing there.

MR. HEATH: Okay.

MR. REYNOLDS: Especially your remarks on the cumulative effects where you conclude that there's so much noise already that any additional noise won't have a cumulative effect, which is rather ridiculous.

Under mitigation, that's the CEC staff's conclusion.

MS. CAMPBELL: That must be a typo.

MR. REYNOLDS: Read it.

MS. CAMPBELL: I will.

MR. REYNOLDS: It's on page 194, last sentence, I believe.

MS. CAMPBELL: Because this is an incremental impact.

MR. HEATH: Okay.

MS. CAMPBELL: Okay.

MR. REYNOLDS: And one of the mitigative measures that probably would be relevant is limiting the hours at which materials are delivered to the construction site.

The trucks headed back down the hill are a common

source of noise; especially, the use of air brakes. And I believe after that road is paved, they will probably be coming down the hill faster.

MS. CAMPBELL: And you're saying that they should be restricted from nighttime usage?

MR. REYNOLDS: I think the Joint Findings and the Stipulations specifies -- except under emergency conditions -- that they will limit their hours of delivery to the power plant site, which is consistent with good sense.

MS. CAMPBELL: Right, that's correct.

Something that I'd like the people to understand is that these documents, the Findings and Conclusions of the Joint Stipulations that he's referring to has a tendency to come out simultaneously.

They do wind up being linked in the end in the decisionmakers' view. They have to consider both the EIR and the Findings and Conclusions. So, sometimes early in the game it's pretty difficult. For instance, the EIR doesn't give thorough coverage to all the Findings and Conclusions. It couldn't because many of them weren't written in time.

It should, however, not have any inconsistencies in it. And if it does, we've got to clean those up.

MR. HEATH: For the purpose of clarification, the Joint Findings and Conclusions that everyone is talking

about are where the staff and the Applicant find agreement on certain issues in the case such as in the area of air quality, where the staff, the Applicant and, say, the various intervenors have agreed that basically the project will conform to the state standards. Those are what we're talking about.

There are other areas such as water quality where there's a disagreement between what's staff's findings and Conclusions and that of Applicant's. So, those are just as an example.

MS. CAMPBELL: And you, the public, can request any of these documents through the Public Adviser's Office. In fact, if you're concerned with this case at all, I suggest you ask Gary frequently what kind of documents you should be getting and how to get them. And he should be advising you on that.

So, if you're confused what are these Findings and Conclusions on all this stuff and what does it mean and can I have input in it or should I even care, talk to Gary about it.

MR. HEATH: Which brings us to another point. Our office has a toll-free number. I know long distance to Sacramento can be expensive, especially some of the calls have been half-hour-plus. If you want to come up after the meeting and pick up one of my cards, it has our toll-free

number and our direct line number. So, you're welcome to do that.

Mary Jadiker.

MS. JADIKER: I have a legal procedural question for Arlene, I guess.

Those of us who are more involved with this project do know what Findings and Conclusions are. We are always perplexed because the timing and the content of those conflict with the Draft EIR.

It is not unknown for a Final EIR on an energy Commission project not to reflect the Findings and Conclusions.

What effect does that have on the legal validity of a Final EIR? What assurance do those of us who may be disaffected with a project, what assurance do we have that the final EIR is, in fact, a sound legal document?

It's gone through the hearing process. It fulfilled all of its footsteps; but the content -- and there are no hearings on a Final -- the content may be far different from the actual permit conditions or certification conditions or Findings and Conclusions.

I know we're not going to have this problem much longer, but we do have it with this document.

MS. ICHIN: Well, the document, the Environmental Impact Report, is one document that is entered into the

record that the decisionmakers, the Committee in this case, have to take into consideration when they're making their final decision on permitting the plant and deciding what conditions to place on the permit.

The record, the evidentiary record, in addition to the Environmental Impact Report, have to substantiate or give reasons for their final decision and the conditions they end up placing on the permit.

In other words, the EIR in and of itself is not the only document that the decisionmakers will look to in arriving at their final decision. They look at the entire evidentiary hearing. This is one part of the evidentiary hearing.

MS. JADIKER: But is it consistent with the rest of the record?

MS. ICHIN: Well, it will be consistent in that any decision, any final decision, made that is seemingly inconsistent with identified significant environmental impacts have to be explained in the final decision. And that is the responsibility of the lead agency under CEQA.

But this is supposed to be a significant document giving guidance to the decisionmakers. They cannot ignore significant environmental impacts that are identified in this document. That should not occur.

MS. JADIKER: That should not. And, subsequently,

the mitigation suggestions put forth in the EIR may or may not be followed. If they're not, they have to explain why.

MS. ICHIEU: Exactly.

MS. JADIKER: Therein lies, frequently, inconsistencies.

MS. ICHIEU: Not only do they have to explain why, but their reasons for not adopting mitigation measures identified in this document have to be supported by the evidentiary record. Which means that there should be other evidence in the record to explain, to give support, to their explanation.

In other words, they can't just arbitrarily or unilaterally decide without taking into consideration the entire evidentiary record what conditions would be appropriate on the permit or whether or not to even grant the permit. Their decision has to be based on the evidentiary record. This is an important part of the evidentiary record. It is not the only part of the evidentiary record.

MS. JADIKER: Thank you.

MS. ICHIEU: Does that answer your question?

MS. JADIKER: Yes, but I am still not convinced that this document will not be consistent with the Findings and Conclusions. It just can't be. The timing is off.

MS. ICHIEU: Those subject areas that are discussed in the Environmental Impact Report, the Findings and

Conclusions -- well, the Joint Findings and Conclusions, in addition to the Separate Findings and Conclusions -- especially the staff's Separate Findings and Conclusions -- should be supported by this document. I mean, this should be the basis of the staff's analyses in those different subject areas in which there are either joint or separate staff findings and conclusions.

MS. JADIKER: Should be.

MS. ICHIEU: Yes.

MR. BOKNER: Well, furthermore, the various technical advisers -- and I can say this for sure in my case -- will be relying on the information in this Environmental Impact Report to prepare testimony in the area where there is a difference of opinion.

MS. CAMPBELL: I'd like to point out, too, that one of the reasons why we have review periods on the Draft and the Final EIR is as a safeguard against errors.

And if you have a concern with a project, you really ought to be pouring through the thing. I know it's a chore, but you really ought to be. If you've got concerns, you ought to be looking here, take a look at what it says on, say, the roads or, you know, randomly anything and see if that's so. See if that's so.

Now, this is your comment period on the Draft EIR. There is a shorter comment period on the Final EIR. But there

still is a comment period. There's a 15-day comment period on a Final EIR. We will receive comments then and we will incorporate them into the Final.

So, you have two shots at making us clean up our act if we're wrong. We try very hard to get things right in the EIR, but we do make mistakes.

Bob.

MR. REYNOLDS: I would like to reinforce that the EIR does not reflect the stipulations --

MS. CAMPBELL: -- in noise.

MR. REYNOLDS: -- and mitigation steps that have been agreed to by the Applicant and staff and concurred to --

MS. CAMPBELL: You're referring to the subject of noise?

MR. REYNOLDS: The 53 dBA Ldn at the nearest receptor.

MR. HEATH: Alex, did you have a comment?

MR. BOKNER: I was just wondering -- and I think Bob nailed it down, though -- if Mr. Tocher's residence was not included at all in this analysis.

MS. CAMPBELL: I don't think we were aware of his residence being there.

MR. TOCHER: Probably hasn't been there long enough.

MS. CAMPBELL: How long has it been there?

MR. BOKNER: Since 1921.

MR. TOCHER: Well, the residence itself has been there since 1962. But there's been other structures where my grandparents lived since 1921.

MS. CAMPBELL: Okay. Are there any more comments on noise? Yes.

MR. BROWN: I'd like to get a little specific deal. I'm always a little bit away from the subject. But it has a full meaning that we've all learned a lesson from this situation, why we're having lots of trouble now.

Because what we're trying to put over now, to put a real meaning, like when we started out six and seven years ago, I firmly believe that one, two, and three, four, oil wells, are probably doing more pollution than 50 or 100 that's going. Because we couldn't hold them down to things we're trying to put down now.

In other words, I've been told in meeting after meeting -- first in 1978 they promised, more or less, in Santa Rosa, that they were going to keep this pollution down to a certain level. And it would meet that in 1978. Now it's been put off until 1985 or '7, I've lost faith in when they're going to do it.

But here's a lesson to the oil companies, to us people, you people, and everybody else, four wells are doing more damage than the whole caboodle now. And that probably to retrofit them, to them I think they give figures probably

cost a million or a million and a quarter to fix one up, but they're going to do it in '87.

But we're going to stand by and eat this H₂S until they get some more money. This is the crime about this whole thing. Four wells, I really believe, are doing more than the whole caboodle and this is what's caused a lot of the conditions right now.

MS. SWEAT: I think you mean the power plants, Carl.

MR. BROWN: Yeah, I mean the power plants.

MS. CAMPBELL: Well --

MR. BROWN: And this is what we get into because we're not strict enough when we set these deals down. And probably we wouldn't have any air problems if we met what Power Plant 13 is. But they don't want to spend any more money to fix it up. That's the whole story.

MS. CAMPBELL: Okay, Carl, I think we understand your point is that some of the historic geothermal plants in the area are contributing more heavily than some of the more-recently sited power plants. And you have --

MR. BROWN: It seems like we made those points.

MS. CAMPBELL: Well, we definitely agree with you. That is the case.

MR. REYNOLDS: Bob Reynolds. For the record, I will note that PG&E is requesting a variance as of September

the 2nd. And you might want to reflect that in your report.

MS. CAMPBELL: A variance?

MR. REYNOLDS: Yes, to their existing variance. In other words, a modification of the existing variance. It can involve the EIC system which was proposed as the one and only solution for retrofitting the older units.

MS. CAMPBELL: So, what are they going to do?

MR. REYNOLDS: I'd prefer that you talk to PG&E.

MS. CAMPBELL: Okay.

Any other comments on noise?

Moving right along. Waste management. Any

problems, questions?

MR. BULL: Robert Bull, Anderson Springs Water.

I would like some information on reinjection, where it's proposed, the depth of close casings to ensure that the water below the elevations anticipated for reinjection does not come to the surface and does not leach out into the open water sources.

MR. HEATH: Thank you, Mr. Bull.

MR. BULL: And that's not an unreasonable request.

MS. CAMPBELL: Okay, you want the depth of the wells, you want to know whether or not geologically we could expect that that material would come back out on the surface.

MR. BULL: It's either above or below the wells. In other words, breakthroughs through the casings.

MS. JADIKER: Depth of easings is also important and what he did ask for.

MS. CAMPBELL: Are there any other comments on waste management?

Now about health? Public health.

MR. REYNOLDS: I have a comment. I'll repeat it again later.

I think that you're assuming that the standards are being used to determine the significant environmental effect and potential effects. That's not necessarily appropriate. I'd like to address the fact that you're referring to occupational standards as some sort of guidelines in the absence of anything else for general ambient exposure, which is absolutely inappropriate.

MS. CAMPBELL: Now, the problem, of course, is --

MR. REYNOLDS: Yeah, what do you do.

MS. CAMPBELL: Exactly. I think you'll note in the EIR there are two sections in the EIR. There is the Projects Specifics Section where we talk a lot about the laws and rules and regulations. And then there is the Cumulative Section, where we try to deal with the problem of the combined results of all of these plants.

And that is where the situation that Bob brings up really comes to play.

MR. REYNOLDS: Can I suggest one other thing?

In the air quality-related noncriterion or health-concerned pollutants, almost for every one of those you've got books at least this (indicating) thick that the EPA publishes that have all the references. You should at least reference those references. Because people would know that your little paragraph really doesn't tell the complete story. That there is a much more detailed story somewhere else. And maybe you could refer them to those sorts of references. And I would suggest you use the EPA criteria documents or attempts to establish standards that the EPA has, you know, been in like a seven and eight-year process and reference them.

MS. CAMPBELL: Okay.

Are there any other comments on public health?

Questions? Concerns?

How about safety?

How about transportation? In the document we note that there will be impacts to roads. But also we note that mitigation measures are being undertaken by the county and by the Applicant, as well as by other geothermal developers in the area.

Mary.

MS. JADIKER: Val, I've limited my comments.

They're all to the impacts section. But, yet indeed, I have comments about transportation. Would you rather have them

now or would you rather have them when we go through that?

MS. CAMPBELL: Now, please.

MS. JADIKER: Page 204, which is the cumulative impacts to transportation, paragraph 2.

You very correctly point out that in the cumulative phase you must consider the impacts of the steamfield traffic and transportation as well as power plant. And my comment about paragraph 2, under impacts, is that you must include the sump vacuum trucks in your traffic count particularly, during the rainy season.

On page 133, or whatever it is for transportation, there's an anticipated five vehicles per day which would be reduced to ten vehicles a week for the power plant only. And I can assure that if those sumps of the field are still open and collecting rainwater, they're going to have to be vacuum pumped out and the wastewater that collects in them will have to be run down Socrates Mine Road to the dump. And that will certainly exceed ten trucks a week.

MS. CAMPBELL: Okay. So, in other words, your comment really is that our statements on page 133 about the ten reduced to five will probably -- do not include the -- apparently do not include --

MS. JADIKER: -- the vacuum trucks.

MS. CAMPBELL: -- the vacuum trucks which service the steamfield.

MS. JADIKER: Right. It may average out over a year, but we're not talking about average traffic, we're talking about real traffic and traffic times.

The third paragraph under impacts gets more specific.

"The CEC staff estimates an average of 36 to 40 heavy trucks per day traveling The Geysers region."

And my comment is, what's that? What's "The Geysers region"?

MS. CAMPBELL: The EIR.

MS. JADIKER: Then you can take the rest of my comment, which is that's probably a conservative estimate; gravel trucks, water trucks, sump trucks used in construction on the roads, well pads, as well as power plant construction and maintenance couldn't possibly be considered in that kind of a total. At least not during the construction season, which in Lake County is April 10th to October 10th, more or less.

That same paragraph 3 under impacts has again crossed numbers. You have 1979 CALTRANS estimates of traffic averages on 173 at 800 vehicles. Then you have a 1980 traffic count on Socrates Mine Road estimate of 484 vehicles.

MS. CAMPBELL: Uh-huh.

MS. JADIKER: If one were to pretend that all took place in the same year, 800 on 173 and 484 on Socrates Mine

Road, that would only leave 116 nongeothermal working vehicles on Highway 173 a day.

I think that's got to be an inaccurate statement.

MS. CAMPBELL: So, you're questioning the CALTRANS Lake County figures.

MS. JADIKER: I'm saying that they are both potentially correct. But they should not be used as a comparison. Get your numbers from the same year.

You have a 1980 count for one and 1979 count for another. They each may be correct. But they cannot be used in this way or they will be incorrect.

MS. CAMPBELL: Okay, the reality is that we don't have yearly figures from both. Lake County -- I am not too sure -- has figures for '79. They've only recently begun compiling them.

But I understand your point, which is the figures may give improper inferences.

MS. JADIKER: Right, because 116 non-Socrates Mine Road vehicles on 173, I'm sure, is a very, very conservative estimate.

MS. CAMPBELL: I understand your point.

MS. JADIKER: That may be all I have to say on the traffic.

MS. CAMPBELL: Okay, any other comments on transportation?

MR. CORNELISON: I'm Bill Cornelison. I'm School Superintendent for the Middletown Unified School District.

Mention is made in the report of the problem relating to school buses traveling up Highway 173 facing an increased influx of geothermal trucks moving up and down the highway.

That problem is really acute in the Anderson Springs area. We operate three school buses that go up Highway 173 on the way to Cobb Mountain. All three of these buses cross the bridge. I guess it would be at Anderson Creek, on Highway 173. The bridge, of course, is quite inadequate for geothermal trucks and a school bus to pass each other at the same time.

One bus makes a left-hand turn off Highway 173 in the afternoon to go into Anderson Springs to drop off children. The access making that left-hand turn is a very dangerous one. If a truck is coming down Socrates Mine Road and is turned and is heading down the mountain, there's always a real serious chance that there will be an accident. We're fortunate there has not been one in the past.

Staff, on the bottom of page 133, indicates they concur with the suggested mitigation that project-related vehicles and school bus traffic would be to schedule the project traffic so as to avoid the school traffic. Staff concurs that this measure should be thoroughly explored and

1 implemented, if possible.

2 We've had a lot of discussion today -- or this
3 evening -- about thoroughly explored and implemented if
4 possible. I would request a little stronger language in
5 the EIR. I would go so far as to state that during that
6 13-minute period of time when those school buses are
7 operating on that dangerous portion of Highway 173, that
8 trucks simply wait there on Socrates Mine Road and not make
9 a turn onto 173 until the buses have gone past and gone up
10 the mountain.

11 There's lots of problems on that highway, but
12 certainly that area is the most severe.

13 MS. CAMPBELL: So, you would like the language
14 in the Final EIR to reflect that the geothermal trucks should
15 simply wait until buses are done in that area.

16 MR. CORNELLSON: I realize this goes way beyond
17 just Oxy, there's a lot of other trucks operating in that
18 area. But at least if one firm would make the effort and
19 try to communicate this to the subcontractors to control
20 those trucks, maybe it might be helpful with some of the
21 other growing firms and power plant construction people that
22 are in the area.

23 MS. CAMPBELL: I think if you can identify the
24 specific times, we would be willing to do language like that.

25 MR. CORNELLSON: For the sake of the record we

1 have already identified those times in the preliminary
2 hearings with Oxy and they have a complete copy of our bus
3 schedule and when our buses are operating in that area.

4 MS. CAMPBELL: Thank you.

5 MR. BROWN: I'm Carl Brown from Anderson Springs.

6 I have something that confirms with the last
7 speaker.

8 A time ago -- it might have been a year and a half
9 or two years ago -- we've had a lot of accidents, as this
10 gentleman spoke of. I'm getting afraid to, between 4:30
11 and 5:30, to turn onto Anderson Springs, because there's
12 no stop signs. And if you've got a little Datsun -- it isn't
13 like my Thunderbird -- I don't know whether to wait until
14 the traffic keeps coming down that hill.

15 But I did, a year and a half ago, start a
16 membership for Anderson Springs homeowners and they signed
17 the petition. I took it to the judge here in town. I got
18 the Lions Club to recommend it. We sent it to the State
19 Highway telling them what a wonderful condition.

20 There's been a lot of people hurt there. And there's
21 been people killed in that area. And they all agreed with
22 me. And we know if there was a stop sign right there by
23 Anderson Springs -- but they're coming down there 75 miles
24 an hour sometimes. You haven't got a chance. You're taking
25 a chance when you turn into Anderson Springs.

1 MS. CAMPBELL: Okay. I understand --

2 MR. BROWN: The Highway is on record to this, us
3 complaining about it. As I say, Anderson Springs Homeowners
4 Association, the Lions Club, and the judge here in town,
5 they've all signed and recommended -- and the Luncheon Club
6 -- all signed it.

7 MS. CAMPBELL: Okay.

8 MR. BROWN: So, that is the deal. And it's on
9 record.

10 MS. CAMPBELL: I understand that your comment is
11 supporting Mr. Cornellson's.

12 MR. BROWN: It's very dangerous.

13 MS. CAMPBELL: It's dangerous. We'll address that
14 in the Final EIR.

15 There are other things that you folks can do within
16 your own municipality, of course, trying to get stop signs,
17 at ceters, in place. It's not within the scope of the EIR,
18 but you realize there are other mechanisms you can go through?

19 MR. BROWN: Yes.

20 MS. CAMPBELL: Are there any other comments on
21 transportation?

22 MR. WHITE: Valeria, my name is White from
23 Anderson Springs.

24 You said other sources to check on this problem?

25 MS. CAMPBELL: Yeah, I mean, any -- I don't want

1 to spend a lot of time on it, because it's really tangential.
2 Sure, any citizen in a town who thinks that a traffic
3 condition is unsafe has a right and a responsibility, even,
4 to try to get to the authorities that see --

5 MR. WHITE: I have cried with the authorities for
6 the last two weeks. Because I almost got knocked off that
7 road.

8 I went to the Department of Motor Vehicles. I
9 also went to the Highway Patrolman. The Highway Patrolman
10 told me, he said, "Get the man's name and get his truck
11 number and get his license number." So, I'm already run
12 off the road. I don't know where he is. And that happens --
13 and somebody said, that turnoff was dead. You cannot see,
14 it's a blind spot coming from Middletown all the way to
15 Anderson Springs.

16 MS. CAMPBELL: We can address it in terms of the
17 geothermal power plant that Occidental has. And we'll cover
18 it in our EIR.

19 But the specifics of a dangerous place of road
20 should be handled locally.

21 MR. REYNOLDS: It would appear to me that it would
22 be very appropriate for the cumulative effects section.

23 MS. CAMPBELL: Yeah, we'll get it in there. In
24 fact, what exactly is the junction?

25 MR. WHITE: It's 173 Anderson Springs turnoff.

1 MS. CAMPBELL: 173 to Anderson Springs.

2 MR. BROWN: The state did put a white line there.
3 They did do a couple little things that helped. There's
4 no doubt. They have been.

5 But I've talked to a couple lawyers this week and
6 they suggested, more or less, like you did, probably get
7 together and suggest a stop sign. That would do 90 percent
8 of it, probably. And wouldn't cost much. Only people
9 wouldn't want to stop with them big trucks coming down there.

10 MS. CAMPBELL: Okay, we have it in our sights.

11 How about energy and material resources? Cultural
12 resources?
13 Socioeconomics? Do we have any comments, questions
14 concerns?

15 MR. CORNELLSON: I'm Bill Cornellson, School
16 Superintendent from Middletown Unified School District.

17 We have several comments and feelings on the section
18 on socioeconomics, which our school's attorney has placed
19 in writing and which I offer as part of the record.

20 For the sake of the audience, I would very briefly
21 comment on these.

22 Most assuredly, the presence of Oxy Power Plant
23 within our school district will have a very definite impact
24 on the Middletown Unified School District. The staff admits
25 this fact in their report, which we're happy to note.

1 By way of information, as far as impacts on the
2 Middletown Unified School District, from 1963 to 1973, for
3 a 10-year period of time, we grew by approximately 75
4 students. This past year, in one school year alone, we have
5 grown by 104 students.

6 And these children moving to Middletown is not
7 due to the senior citizens population of Lake County, it's
8 because of families that are being employed in the geothermal
9 industry.

10 We're happy that the staff acknowledges this fact
11 in their report. We're extremely disenchanted with the fact
12 that the staff chooses to recommend that the County Board
13 of Supervisors mitigate this impact by the use of 1903 funds
14 instead of the developer or instead of the Applicant.

15 As was pointed out very well earlier by Mary and
16 others in the room, the local school district nor the Energy
17 Commission has no authority to tell the Lake County Board
18 of Supervisors how they are to spend 1903 monies.

19 Although the Board did give us some monies this
20 year on a one-year basis only to pay for lease payment on
21 five portable classrooms, they made it quite clear they do
22 not intend to do so in the future. I would hate to be at
23 their mercy to mitigate the impacts upon the school district.

24 I certainly feel it is contrary to the
25 environmental quality law that will place the burden of

1 mitigation not upon the Applicant, but upon someone totally
2 removed from that; in this case, the Lake County Board of
3 Supervisors.

4 It is my understanding, for the sake of the record,
5 that a member of the Energy Commission staff will meet with
6 the Board of Supervisors next Monday. And at that time I'm
7 sure the Board will convey to him very thoroughly what their
8 feelings would be about these recommendations. And we will
9 later recommend that the transcript from the Board of
10 Supervisors meeting next Monday with Mr. Newhouse be made
11 a part of the record as you might be made aware of it later
12 on. Thank you.

13 MS. CAMPBELL: We appreciate the comment.

14 Are there any others on socioeconomics? Mary.

15 MS. JADIKER: Yes, I was going to say what
16 Mr. Cornelson said, but emphasizing, again, that not only
17 is it procedurally incorrect to suggest the use of 1903 funds
18 as a mitigation, but it is in the real world not feasible
19 and not practical and it simply would not happen.

20 Furthermore, the increased tax base that the
21 Occidental Power Plant will supply will not directly benefit
22 the school district, either. So, that does leave the burden
23 of mitigations almost directly upon the developer, just as
24 it falls on a subdivider or somebody else whose projects
25 under current California tax laws really can't pay their

1 way in terms of public services.

2 It's Ory's problem; it's mine, I build houses;
3 that kind of thing.

4 MS. CAMPBELL: Then I understand the comments from
5 Mary and Mr. Cornelson so far to be to the general effect
6 that they feel that Occidental should directly mitigate the
7 impacts which they are having to the school district rather
8 than to rely on the Board of Supervisors to do it with 1903
9 monies.

10 MR. CORNELISON: That's correct.

11 MS. JADIKER: Yes.

12 MS. CAMPBELL: Okay, I understand.

13 MS. JADIKER: Additional comments on socioeconomics
14 On page 212, they're talking about roads. Again
15 -- goah, I don't find it there, but my comment there is that
16 Socrates Mine Road and Butts Canyon Road -- Butts Canyon
17 Road is a county-owned and maintained road which proceeds
18 from Highway 29 to the Class II Waste Disposal Site and is
19 used by every geothermal operation in the southern half of
20 The Geysers.

21 I would assume because of the location of the Ory
22 plant that that's where they would be taking their wastewater
23 from drill pumps, and any waste sludge or anything else
24 from the power plant.

25 The document notes that Occidental has agreed to

1 contribute with other developers to the maintenance of
2 Socrates Mine Road, which is a county-owned and nobody-
3 maintained road until everyone gets together and does it.

4 I think it is also appropriate that the users of
5 Butts Canyon Road from the intersection of Highway 29 to
6 the dump site -- and the condition of the road is documented
7 and not disputed as being in poor repair due to the heavy
8 trucks that run on it -- should also be asked by the Department
9 of Public Works to make contributions to a maintenance fund
10 for that.

11 This year the Lake County Board of Supervisors
12 appropriated \$1903 funds to repair the road and bring it
13 to standard. But that is not a continuing maintenance
14 project. That's simply make the road safe for the transport
15 of waste products.

16 And I think it would be appropriate, again -- maybe
17 Occidental would have to be the first and others would fall
18 in line -- it would be appropriate for the heavy users, the
19 damage causers, to be assessed for the maintenance of the
20 road they use. Butts Canyon as well as Socrates Mine Road.

21 The last paragraph on page 213, which is all about
22 public services that.

23 "Negative physical impacts of geo-
24 thermal development are difficult to
25 predict or qualify."

1 They certainly are. However, there is no attempt
2 in this document at all to address the impacts of
3 Proposition 4.

4 There are tabulations of the total revenue that
5 the plant will generate for Occidental, but not for Lake
6 County. There are estimates of the property tax that would
7 revert to Lake County. There are estimates of the share
8 of federal funds that we would receive through the mechanism
9 known as AB 1903.

10 But there is no attempt to estimate how much of
11 this increased tax revenue the county will actually be able
12 to spend for any purposes at all. Proposition 4 was the
13 tax initiative that requires tax monies be distributed
14 according to your population growth, basically.

15 So, if you have a situation such as Lake County
16 has with a low population and an exploding tax base, we may
17 find ourselves in the wonderful position of having to return
18 property taxes because we don't have a population expansion
19 rapid enough to use these revenues.

20 I think that that would be an appropriate thing
21 for the socioeconomic section of the EIR to discuss.

22 MS. CAMPBELL: In other words, to discuss the
23 possibly dwindling tax revenues due to Prop 4.

24 MS. JADIKER: Not the -- the tax revenues would
25 not dwindle. What it is is that the projected tax revenues

1 would not be able to be spent.

2 One of the reasons why you think the project is
3 good is it's going to provide income, both for public
4 services and employees and all kinds of things. And it is
5 important for the record for the decisionmakers to know that
6 the numbers they're considering are or are not valid numbers.

7 MS. CAMPBELL: Okay, I understand you.

8 MS. JADIKER: Another comment I can make, which
9 I have to make on almost every EIR, is that there is more
10 to socioeconomic impacts on any project than the evaluation
11 of the impact on public services.

12 The potential for economic difficulties in the
13 community of Anderson Springs due to potential water pollution
14 problems is not mentioned in the socioeconomic section. And
15 I believe it rightfully should be. It's certainly covered
16 under water quality.

17 MS. CAMPBELL: You're saying the impact from the
18 water system isn't covered?

19 MS. JADIKER: The economic impacts are not covered
20 under the cumulative impacts section of socioeconomics. Or
21 if they are, I've lost them.

22 MS. CAMPBELL: Okay.

23 MS. JADIKER: You do on page 223 certainly say --
24 our favorite paragraph -- with respect to water quality,
25 trade-offs exist.

1 MS. CAMPBELL: Yes.

2 MS. JADIKER: But, again, if I have to make a
3 comment, it's who's getting traded for what?

4 But I think that that is a reasonable indication
5 that some effort should be made or even come up with good
6 numbers of the potential loss in real estate values should
7 a substantial degradation of the water supply occur.

8 MS. CAMPBELL: I know that that is covered in the
9 document. I'm trying to think of where we put it. Let me
10 think about that just a little bit.

11 MS. JADIKER: If it's in there, I don't need a
12 response. If it's in there and it's covered, fine, I'm happy.

13 If it is not, then I would request that an effort
14 be made to put that in there.

15 MS. CAMPBELL: Okay, you want impacts to real
16 estate values.

17 MS. JADIKER: Specifically related to this project.
18 Not necessarily cumulative. There are those that cost too
19 much and you know all that kind of stuff.

20 Page 223 also, in the relationship between local
21 short-term uses and maintenance and long-term productivity,
22 lists several numbers. And these are probably correct numbers.
23 I've referenced Number 4, the income generated by the plant
24 counters shares of revenues.

25 But it might be a more correct summation if it

1 were pointed out that these monies do not go and may never
2 go to repair the Anderson Springs water problem.

3 One of the big problems with socioeconomics, even
4 thinking about them, let alone writing about them, is trying
5 to define where the benefits go as opposed to where the
6 detrimental effects go.

7 Page 113, paragraph 1, also mentions.

8 "Additionally, the school districts
9 in Lake County can apply for monies
10 made available through AB 1905 to further
11 mitigate impacts to the schools."

12 That is true. But the inference that when you apply, you
13 get the money, is not a correct one.

14 And I think that's the extent of my comments.

15 MS. CAMPBELL: Okay, any other comments on this
16 subject?

17 MR. HINDS: Do we go all the way to Cumulative
18 Impacts? Or are we still back on --

19 MS. CAMPBELL: Well, we can deal with cumulative
20 impacts on any subject as we come to the subject. That's
21 fine with me.

22 MR. HINDS: Well, I don't know. Have we gotten
23 to land use yet?

24 MS. CAMPBELL: No, we're right up to it.

25 MR. HINDS: Let me know when we get there.

1 MS. CAMPBELL: Public services is next. Any
2 comments on public services?

3 MR. CORNWELLSON: I'm Bill Cornwellson. From
4 Middletown.

5 This may pertain more to socioeconomics, but I'll
6 cover it now.

7 There's no mention given in the report to park
8 and recreational facilities. I would like to at least see
9 it indicated and mentioned. Mary mentioned other areas that
10 could be added to socioeconomics.

11 We have extremely limited park and recreational
12 facilities provided by the County of Lake in this end of
13 the county. We have one very small park, which is not
14 maintained nor cared for by the county, with the exception
15 of a pool, which is operational in the summertime for three
16 months, which is mainly cared for by the people here in
17 Middletown with some help from the county.

18 We make available the school facilities to the
19 geothermal workers, both to Union and to other companies
20 who come and request to use the field for softball, soccer,
21 some kind of recreation. We have a lot of single employee
22 people working in the area who like to find something to
23 do with their time for recreation.

24 And most companies try to look towards those needs.
25 other employees. And park and recreational needs not only

1 for the employees themselves, but also for their children
2 and the general influx of population in the area is a
3 socioeconomic impact that at least should be mentioned in
4 the report.

5 I'm not prepared to suggest any kind of mitigation.
6 It's a relatively large issue. But I'm sure they'll come
7 back and say, use 1905 monies to solve the problem. So,
8 at least with the problem stated, I would like to at least
9 have it in the report.

10 MS. CAMPBELL: Okay, thank you.

11 Any other comments on public services?

12 How about land use?

13 MR. HINDS: Alex Hinds, Lake County Planning
14 Department.

15 I didn't really come here prepared to do a
16 detailed analysis of the EIR. And we will be providing
17 written comments later.

18 But since I'm a land use planner, I thought I'd
19 turn to the land use section. And I'd have to state off
20 the cuff that I think it's a little skimpy.

21 One of the things that's usually in a land use
22 section is a land use map. And unless I overlooked it, I
23 didn't see it.

24 Land use maps would indicate the surrounding uses
25 around the proposed power plant, including all residences.

1 any prominent natural features or sensitive areas that should
2 be included; preferably with a clear scale that somebody,
3 a lay person, could go in and look at and know exactly the
4 distances involved.

5 Also, some discussion of potential land use
6 conflicts might be included in there as well.

7 And that's about it on land use. I do have a
8 general statement on cumulative impacts, if you're going
9 to discuss that.

10 One of the things -- I'm involved in both the
11 geothermal processing and surface mining and reclamation.
12 And we have a awful lot of gravel extraction projects going
13 on here. And usually we ask the gravel extractors what they're
14 using the gravel for. And a good percentage of the time
15 it's geothermal related.

16 So, I think it's important to mention this in the
17 cumulative impact. And this could apply to everything from
18 water quality to erosion to noise, that there's a lot of
19 support work going in terms of extracting gravel for pad
20 construction, for road repairs, maintenance, and
21 construction. And that gravel extraction involves both creek
22 bed gravel extraction -- you're taking water from creeks
23 and the kinds of impacts that may occur to water recharge,
24 which may result in lowering the table for agricultural.

25 There's a lot of subtle things like that besides

1 noise and the whole condition of riparian habitats. So,
2 I just think that that's something that somewhere needs to
3 be mentioned. That's about it.

4 MS. CAMPBELL: Are there any other comments on
5 land use?

6 As I understand it, Alex, your points were it lacks
7 a land use map, that the section is rather thin and skimpy.
8 and it could use discussion of potential land use conflicts.
9 And that on cumulative effects overall, that you thought
10 somewhere in there we should mention the gravel extraction
11 and the use of gravel in geothermal development.

12 MR. HINDS: Yes.

13 MS. ICHIKI: Alex, are you going to be providing
14 information in your written comments to help the staff in
15 their analysts in this section?

16 MR. HINDS: On land use?

17 MS. ICHIKI: Yes.

18 MR. HINDS: Sure, for what it's worth.

19 MS. CAMPBELL: Mary.

20 MS. JADIKER: And the obvious place to put that
21 gravel extraction, if it's possible, you should also obtain
22 an estimate on how many double dumps a day would go up and
23 down that mountain in the Energy and Material Resources.

24 It's probably all right. It will all come down
25 again one of these days.

1 MS. CAMPBELL: Have we got any -- I think that's
2 it on land use.

3 Any comments on aesthetics? Mr. Tocher.

4 MR. TOCHER: Yes, Craig Tocher.

5 One of the problems I have, I think it's 164 under
6 Mitigation Measures. It's a standard statement that's in
7 all EIRs and that is,

8 "Re-establish vegetation on land
9 surfaces disturbed by geothermal develop-
10 ment."

11 Do you know what this means? It's probably hydroculching
12 and seeding of grass seed and they let it go at that.

13 I don't know if that's what is planned here. But,
14 you know, it would be nice if somewhere along the line to
15 see what those mitigation measures are.

16 There's other ways to handle it. There's side
17 trenching, where the accumulation of soils, and you get some
18 other type vegetation besides grass growing in there.

19 If they want to re-establish vegetation, the nature
20 vegetation out there isn't the grass that they've removed.
21 And I think that they could do a little better in maybe
22 identifying the types of vegetation they're talking about
23 re-establishing.

24 MS. CAMPBELL: I understand your comment. I will
25 share with you that there's quite a few documents available

through -- you could examine our docket record.

Occidental has submitted a monitoring and mitigation plan -- I believe it is -- which indicates their vegetation plans. And it talks about types of seedings that will be planted and where and what all will be done.

MR. TOCHER: This is on the pads, too, that they have in there now?

MS. CAMPBELL: Yes.

MR. TOCHER: So, that could be reviewed and see what they're talking about. Thank you.

MS. CAMPBELL: Yes. Some of the information on the well fields itself is more available through the federal documentation, which is identified in the EIR right in the front pages there.

MR. TOCHER: That's either the Bureau of Land Management or the Geological Survey.

MS. CAMPBELL: Yes, that's correct. But their revegetation plan is available through the Energy Commission.

MR. TOCHER: Through the Energy Commission?

MS. CAMPBELL: Yes, the revegetation plan. Do you want a copy?

MR. TOCHER: Sure.

MR. BOHRER: It's a two-phased plan. The first phase includes grasses which are established quickly and will be fertilized and they will use the hydromulching and

juice netting.

The second phase consists of planting woody shrub and tree species on selected portions of the power plant site cuts and fills and on the plant access road.

Now, I'm not going to read too much into this, because they are addressing what our responsibility is. And that is to look at the power plant and accessory facilities. So, I wouldn't imply from this --

MR. TOCHER: I assume this other document gives information in more detail, plants per acre, and things like that. Because that's very innocuous.

MR. BOHRER: Well, it goes to seeding rates and how many plants will go in and the various species.

MS. CAMPBELL: I think what should happen is Mr. Tocher should get a copy of this plan.

Are there any other comments on aesthetics?

Now about -- now, I'm assuming that if you have comments on either Projects Specific or Cumulative, you'll come in when we hit your subject area. If you've been holding back for some reason on any subject area, let us know.

Now about the unavoidable significant adverse environmental effects? That winds up as being a summary of what staff thinks the negative effects may be.

Now about the irreversible environmental changes

and irretrievable commitments of energy and materials?

The relationship between the long and short term. Growth-inducing impacts?

Now about alternatives to the proposed project?

This is normally considered to be what one might say, the heart of a document, the alternatives.

Under CEQA -- that's the California Environmental Quality Act -- we're required not only to look at a project to look at the probable impacts, but also to discuss alternatives to the proposed action. Any comments on that section?

Mr. Bull is saying over here under his breath, don't build the plant. That is one of the alternatives, the no-project alternative is a possibility.

MS. JADIKER: I would comment only what everybody knows and that is in case of geothermal power plant sitings where there is, for example, no need for the developer to propose even an alternative site, where geothermal is already a preferred energy source declared by the Commission. The project alternatives section of the document rarely can meet the expectation it can meet in EIRs for other projects.

MS. CAMPBELL: That may be -- that may well be the case.

However, I will say that our staff went ahead and took the alternative section seriously and did propose

various alternatives.

As you know, we have been concerned with the possibility of a water quality problem. And we did address that on page 116. The bottom paragraph there discusses the possibility of an alternative location or no-development alternative for Well Pad B. We did discuss the alternatives in the document.

What I'll point out now is that the reality of what you've got on the ground is you've got the road into Well Pad B, you've got the vegetation knocked off. You're now dealing with what will give you an impact at this point. When the document was written, that wasn't true.

So, these things happen very quickly. If you see alternatives or suggestions in an EIR that you think require instant action, then it's up to you -- with the help of the Public Adviser's Office -- to figure out how to move on those.

Mr. White.

MR. WHITE: Coming back to what -- we had a little standoff a little while ago. It had to do with so far as monitoring is concerned.

It seemed to me it was a pass the buck there back and forth. I still haven't got it through my mind if the county is going to be responsible for the monitoring, if it's going to be Land Management or who. Who's going to be responsible for it?

MS. CAMPBELL: I think you're on the heart of the problem, Mr. White.

MR. HEATH: We can't answer that question right now. That will be part of the litigation or the adjudicatory phase of this project that will be decided and will be part of the final decision as to who will do it. And it is a question that is still up in the air between staff and --

MR. WHITE: Because I see monitoring in here, monitoring, but it doesn't give any answers.

MR. HEATH: We haven't pointed any fingers as to who is going to do it yet. That's our problem. And we still have a lot of hearings to go through before we get to that point as to just who exactly is going to do that.

MS. CAMPBELL: We feel that it should be done. And if members of the public feel that it should be done, we've pointed out the various agencies which could help. The Central Valley Regional Water Quality Control Board has the ultimate authority. The United States Geological Survey has permitting power over the well field. The Bureau of Land Management has a lease with lease stipulations, which may have some degree of flexibility. Lake County has quite a bit of permitting authority over this. The Energy Commission has the permitting authority over the power plant itself.

So, you've got five agencies there, each of which,

if you care, you can approach and try to influence.

MR. WHITE: That's not solving the problem right now. If you've got a power plant on Sacramentos Nine Road where they're starting to build, you're starting to get -- water quality isn't going to be the best. And who is going to enforce that?

MS. CAMPBELL: It's a question without an answer. That's our problem. And I say our problem.

MR. WHITE: Okay.

MS. CAMPBELL: Mary.

MS. JADIKER: Valerie, in response to Mr. White's righteous question, the county did issue use permits for some of the well pad sites developments and roads. And those use permits have a lot of conditions in them, including some for specific monitoring.

Your final EIR will probably have a table that shows all the water monitoring sites in it. The U.S.G.S. also has specific monitoring sites. I suppose Mr. Crawford does, too.

But in terms of who is really there to read the results or enforce corrective actions, I'm afraid I would have to say for Lake County there really is hardly anybody who could do this. If a violation occurred, a citizen could call the Planning Department and speak with Alex who would go out and say, "Yes, it sure did happen. Let's revoke the

use permit." That would never happen. I mean, he could ask, but we know it wouldn't happen.

A citizen could complain to the Health Department. The Health Department has amazing powers if they should choose to exercise it. A citizen could complain to U.S.G.A. either in Santa Rosa or in Menlo Park.

But truly the heart of lots of our problems is the -- not that we can't make wonderful rules and regulations because we all can and developers can agree to them -- but there really isn't the personnel to actually enforce anything.

And so we end up, all of us, the Energy Commission, Lake County, the Air Pollution, everyone, back to the original basis where the deal was made and that is good faith and talent of the developer working with the community. And if a developer isn't going to do it right, there's no regulatory power in the world that's going to have a clean project. We have developments in Lake County that are very well done. We some disscars.

MS. ICHIE: I might mention -- this is slightly off the topic you're talking about -- but compliance and monitoring is a basic problem that the Energy Commission must deal with.

And I believe that it's planning to deal with it. I don't know how effectively, in the upcoming Cumulative

So, if you called me, I'd certainly have a sympathetic ear and I would try to help refer you to who could help you; but I think we have been taken out of the enforcement business.

MS. CAMPBELL: Do we have any other comments about the EIR? Do we have any questions -- okay, then I would propose that we close the EIR comment session at this point unless there are any other comments.

What we can do, though, is -- let's now end this meeting and go off the record.

(Thereupon the Workshop before the California Energy Commission adjourned at 10:05 p.m.)

--oOo--

Impact Hearing on Geothermal Development in general in the NGRA area.

MS. JADIKER: That would be a good thing to have in the record.

MS. CAMPBELL: Was there another comment there in the back? Yes.

MS. COPUS: Adele Copus, Middletown Postmaster, also a member of Arthow and a resident of Anderson Springs since 1969.

And I was wondering if there isn't some way that these companies let either our regional office in Sacramento, our sectional center know in Santa Rosa so that we could get enough boxes to be able to handle these people that are coming into town.

I have 30 on a waiting list, the Arthow Postmaster has 40 on a waiting list because of this impact of the geothermal.

How many boxes should we order? We have to know two years ahead of time. I told them 300 boxes by 1981 or they'd better get a route here at Hidden Valley.

But this is what we're working with. And this is where the public is concerned.

These employees are coming in. They have more children in school, they have more boxes at the postoffice.

MS. CAMPBELL: That may be under public services

MS. COPUS: Under public services, right.

MS. CAMPBELL: We should say that the -- you're saying that the postoffice --

MS. COPUS: The Postal Authority should be notified to be able to capacitate these people as they come in.

MS. CAMPBELL: Okay.

MS. COPUS: Thank you.

MR. NEATH: Thank you.

MS. CAMPBELL: Thank you. I never thought of that. I never would have thought of that without you.

MS. COPUS: Well, I was out on the route count today and, my God, we had 350 last year and there is more now. That's just on the route alone and there's 1028 boxes planned and 30 on a waiting list.

MR. NEATH: Thank you.

MS. CAMPBELL: Okay, Alex.

MR. NINDS: My understanding is that enforcement and monitoring portions of the government has been largely taken out of the Planning Department. And not wanting to pass the buck or anything, but my understanding is that Mr. Hank Forter, who is the Flood Control and Conservation Director, is the person in charge of the water quality monitoring for the county as well as probably the Health Department would have some role in there, too.

CERTIFICATE OF SHORTHAND REPORTER

I, EILEEN JENNINGS, a Certified Shorthand Reporter of the State of California, do hereby certify:

That I am a disinterested person herein; that the foregoing Workshop before the California Energy Commission, was reported in shorthand by me, Eileen Jennings, and thereafter transcribed into typewriting.

I further certify that I am not of counsel or attorney for any of the parties to said workshop, nor in any way interested in the outcome of said workshop.

IN WITNESS WHEREOF, I have hereunto set my hand this 20th day of September, 1981.

Eileen Jennings
EILEEN JENNINGS
Certified Shorthand Reporter
License No. 5122

APPENDIX G

CEC STAFF RESPONSES TO
DEIR COMMENTS

CEC STAFF RESPONSES TO STATE OFFICE OF PLANNING AND RESEARCH COMMENTS

1. Air Resources Board

See Responses to the Air Resources Board's specific comments.

2. Environmental Health Branch

See Responses to the Environmental Health Branch's specific comments.

3. CRWQCB

See responses to specific comments.

CEC STAFF RESPONSES TO AIR RESOURCES BOARD SPECIFIC COMMENTS

1. Comment accepted, table amended.
- 2.a. The CEC staff agrees. The estimated emission rates provided by Occidental will be included in the final EIR as an additional table.
- 2.b. The concentration factor referred to in this paragraph is the factor by which the chemical constituents in the steam condensate are concentrated in the circulating cooling water. The constituents of the steam condensate are shown in AFC Table 1.4-2. The text will be amended to show these facts.
- 2.c. The secondary hydrogen peroxide H_2S abatement process will also add to the TDS of the circulating cooling water. The hydrogen peroxide process's contribution should also be included in the equation referenced in this comment. The result will be 0.6 lbs/hr particulates. The text will be amended to clarify this point.
- 2.d. Occidental provided additional data on the estimated emission rates. See Final EIR text.
- 2.e. The composition of the other 15.1 lbs/hr is water vapor.
3. Comment accepted, text amended.

CEC STAFF RESPONSES TO ENVIRONMENTAL HEALTH BRANCH COMMENTS

1. Comment accepted, text amended.
2. The CEC staff agrees with the intent of the comment. However, the staff believes that identification of the duration of these activities might be misleading to the layman, since well field development and operational activities will continue through the life of the project.

CEC STAFF RESPONSES TO CRWQCB, CENTRAL VALLEY REGION

1. CVRWQCB statement is included verbatim in the FEIR and attributed to the Regional Board.

2. CEC, USGS, and BLM personnel have agreed that the sedimentation pond and access road would cause more degradation of surface waters than the pond was designed to correct. Therefore, the pond and access road have been deleted from the project. Instead of the sedimentation pond, Occidental will increase on-site mitigation by placing straw bales at the toe of the plant site fill and additional rip rap. References to the sedimentation pond and access road will be deleted from the Final EIR.
3. Larry Pearson of the CVRWQCB indicates that since the board has no standards for settleable solids, they could not support the 27 ppm threshold limit listed in paragraph 2, page 175. The first sentence makes clear that there are currently no California standards for suspended or settleable solids. The sentence will be changed to make emphatic that neither the CVRWQCB nor Department of Health Services has established absolute standards for settleable and suspended materials in naturally occurring surface or groundwaters of the state.

According to Mr. Pearson, it was not their intent that board standards be included verbatim in the FEIR. CEC will make every effort to make clear the board's lack of absolute standards for suspended and settleable solids, particularly in raw waters.

4. The author attempted to address this issue in the first paragraph on page 175, the last four sentences:

"Although they generally regard turbidity and suspended sediment as pollutants, investigators do not agree on the levels at which suspended sediment become detrimental. To limit turbidity in drinking water supplies, the State of California adopted a monthly average upper limit of one turbidity unit (NTU). For surface waters not exposed to significant sewage hazards or recreational uses, no consecutive two-day average may exceed five units. These standards apply to water delivered to users, not raw water drawn from a well or surface stream. Appropriate treatment can bring raw water into compliance with these standards."

RESPONSE TO COMMENTS ON DEIR

Lake County Office of Education (September 3, 1981 letter)

1. Concerning mitigation measures. See amended text in EIR.
2. Assumptions regarding population distribution. Staff assumptions in determining the population distribution of geothermal workers between Sonoma and Lake counties already reflect the changing development patterns between the two counties. Previous estimates of population distribution indicated as wide a distribution as 75 percent in Sonoma County and 25 percent in Lake County. Staff distribution estimates, as noted on page 209 of the DEIR, are based on the change in development toward Lake County commuting patterns as displayed in a "Survey of Bus Passengers" by Swinerton and Walberg Company, June 15, 1979, and the proximity of communities to the potential development areas.

Despite the pattern of change in development, i.e., increasing in Lake County, construction workers already living in the four-county Geysers area have little, if any, incentive to move from existing residences. Though testimony submitted by Christine Gouig, Director of the Sonoma County Housing Authority, dated September 30, 1981, notes the problem of housing costs in Sonoma County, her comments on costs, under today's interest rates, are representative of the situation faced by all persons considering the purchase of housing. Without receiving substantial salary increases, workers already residing in the four-county area have little to gain in terms of housing to actually move into Lake County. In addition, the historical working pattern in the construction industry has included one-way commutes of up to one and one-half hours. To quote from one consultant's study, "The 1.5 hour commute was suggested by PGandE construction officials and confirmed by union representatives" (PGandE "Notice of Intent Fossil 1 and 2," Vol. II, V-164). Also, a study by Southern California Edison concluded as follows: "Many nonlocal workers prefer to drive the long distance to the plant site and 'pocket' the subsistence allowance (overnight lodging and food) they would ordinarily be entitled to receive" (SCE, "Lucerne Valley Project Application For Certification," June 1980, Vol. I, V.B. II-17). In The Geysers area, construction workers can receive a portion of a subsistence allowance, remain in their present residence, and use an existing bus system to commute to work. For example, the bus survey of geothermal power plant construction workers showed 41 workers commuting from the community of Ukiah, a round trip of 70 miles each day. The bus system was intended to provide easy access to the KGRA for construction workers. For these reasons, staff maintains its assumption that construction workers already residing in the four-county area will not move to Lake County but will commute.

3. The source of the 948 worker estimate is unclear. The peak cumulative labor demand for 1983 is 948 workers. These workers are

required for Occidental; DWR Bottle Rock and South Geysers; PGandE's 16, 17, and 18; SMUD 1; and NCPA 1, 2, and 3 projects. Staff calculations for these projects are based on their respective phase, i.e., construction, operation, etc., and are noted in DEIR Figure 1, p. 208.

The Lake County Office of Education's projection of 800 geothermal-related students in the county by 1983 is based upon several false assumptions. First it assumes all the work force increases will occur in Lake County. As discussed in No. 2 above, this will not be the case. Secondly, the projection is based upon a survey that includes students whose parents' occupations are "possible geothermal-related." Of these 70 students, the Middletown School District could only clearly identify 12 as definitely related to geothermal development. Lastly, this projection assumes that all work force increases will come from outside the four-county area. Staff's analysis, however, in recognizing the existing labor pool within the area, the high employment rate within the construction industry, and the workers' willingness to commute, assumes that 40 percent of the new work force already resides within the four-county area. Since these workers are already present, they will not pose future impacts on schools. In conclusion, staff stands by its estimate shown on page 209 of the DEIR.

4. Concerns regarding existing labor pool and housing assumptions. Staff's assumption regarding the existing labor pool is based on:
 - o The staggered development of geothermal projects which allows workers to move from one project to another, an incentive to remain in the area;
 - o Numerous discussions with union, utility, and steam field development representatives concerning work force availability and commuting patterns; and
 - o General economic and unemployment data for certain construction professions, which indicate the availability of workers.

Based on the above and staff's training in analyzing employment, staff stands by its assumptions.

Concerning housing, staff characterizes the cumulative effect as significant. However, staff also differentiates between steam field, construction, and operation and maintenance workers in its analysis. Long-term "guaranteed" jobs are in steam field and power plant work, not in construction jobs. The former also do not have similar per diem or subsistence allotments. This, combined with commuting patterns (see response to question No. 2), indicates that the construction work force is not the focal point exacerbating the local housing problem. Analysis in other regulatory cases (see response to No. 2) also indicates that the construction work force, if moving, tends to use apartments, hotels, motels, RV parks, and similar facilities rather than purchase houses and bring their

families with them. Staff believes therefore that the local housing problem is exacerbated by steam field operation and maintenance and related services people. This conclusion is substantiated, at least in the Middletown School District, by the results of its 1980 survey. This survey indicated that 30 percent of those students whose parents were employed in geothermal-related occupations were steam drillers, while a little over 40 percent were power plant operation and maintenance personnel. It must be noted that impacts resulting from steam field drilling activities are not within the scope of the CEC's regulatory responsibility. Therefore, while housing impacts will occur from the construction work force, these will mainly take place in the rental market and be dispersed throughout the four-county area. This will minimize the significance of this impact enough to not warrant mitigation of housing impacts by the developer. Operation work force for this project will locate in Lake, not Sonoma County, since there is not direct access to the plant site from Sonoma County. Cumulative housing effects will be analyzed in the CEC cumulative effects proceedings.

CEC STAFF RESPONSE TO LAKE COUNTY AIR POLLUTION CONTROL DISTRICT COMMENTS

General Comments

1. Air Quality and Public Health Sections

In the Oxy EIR and other EIRs, CEC staff has relied on air quality standards as guidelines for assessing the significance of projected air quality impacts. In the absence of standards, staff has used a range of levels considered by different researchers to be safe for human exposure. Staff compares these values with case impact estimates and best available ambient air quality data.

Air quality standards and suggested safe levels are based at least in part on public health protection and usually incorporate a margin of safety to protect sensitive individuals. Staff believes these health-based standards and suggested safe levels are reasonable guidelines for assessing potential significance of impacts. Furthermore, due to the margin of safety generally incorporated, staff believes that estimated air quality pollution levels below the standards (that is, cleaner than the standards) should not cause adverse human health impacts. We agree that such degradation is a negative impact on the environment. We believe that air pollutant levels caused by plant operation will not constitute a "significant health impact" if they do not exceed the estimated levels. To assure, however, that the cumulative impacts of many projects, each contributing a small increment less than the standards or suggested safe levels, do not cause concentrations above those considered to be safe, staff recommends monitoring as described in the health mitigation sections.

2. Air Quality, Noise, and Public Health Sections

The CEC staff believes that mitigation of potential environmental impacts was not the primary reason for the choice of the dual turbine design, but rather the interest in maintaining a high capacity factor for the facility. The CEC staff does agree, however, that the dual turbine design will significantly reduce a number of significant environmental impacts. The staff believes that this point is adequately addressed in the Air Quality section; however, staff agrees that the Noise section does not adequately address this point. Text will be amended.

Specific Comments

3. Comment accepted, text amended.
4. Comment accepted, text amended.
5. Comment accepted, text amended.
6. Comment accepted, text amended.
7. The text indicates that the constituents reported for the steam are based on only one completed well; this is incorrect. The steam constituents

reported do represent the tests for both completed wells; the text will be amended to clarify this point. Constituents other than H₂S are identified in Air Quality, Table 3, and in the Public Health section of the Draft EIR. It is the staff's opinion the Air Quality Table 3 adequately addresses the variability of these other constituents.

8. Comment accepted, text amended.
9. Comment accepted, text amended.
10. Comment accepted, text amended.
11. Comment accepted, text amended.
12. The CEC staff agrees that the state standard for SO₂ averaged over 24 hours is 0.05 ppm not 0.05 ppb. Text amended.
13. Comment accepted, text amended.
14. Comment accepted, text amended.
15. Comment accepted, text amended.
16. Comment accepted, text amended.
17. Comment accepted, text amended.
18. Comment accepted, text amended.
19. Comment accepted, text amended.
20. Comment accepted, text amended
21. Comment accepted, text amended.
22. Comment accepted, text amended.
23. Comment accepted, text amended.
24. Comment accepted, text amended.
25. The CEC staff has compared the joint stipulation to this section and found that they are consistent. With regard to monitoring and compliance requirements, it is not the CEC's policy to incorporate these in the EIR. The text will be modified to identify that the dual turbine/turbine bypass design will greatly reduce the number of stacking events.
26. Comment accepted; the federal standard has been included on pages 135 and 139 of the Final EIR.
27. Neither CEC staff nor NIOSH staff is aware of any mercury analyses in human hair in The Geysers area. No such analyses are planned at this time. Tests related to kidney function are generally more accurate than

hair analyses for determining mercury exposure (personal communication with Mr. Pierre Belanger, NIOSH, October 19, 1981).

28. According to PGandE representatives, cooling towers at existing PGandE geothermal power plants are not off limits. However, in some areas of the plants, workers are required to wear equipment protecting them from possible inorganic arsenic exposure. In other areas the equipment is optional. According to PGandE, their decision to post signs and require protective equipment in these areas was based on new OSHA regulations regarding inorganic arsenic in the workplace (personal communication with Mr. John McKenzie and Mr. Richard Draeger, PGandE, October 10, 1981).
29. Comment accepted; data added to the Final EIR.
30. Same comment as #27.
31. To prevent possible misinterpretation of the information presented, Health Table 3 has been split into two tables in the Final EIR.
32. CEC staff believes it is appropriate for Oxy to conduct or participate in a monitoring program for these geothermal pollutants due to the paucity of ambient air quality data, the potential toxicity of the pollutants, and the potential for significant cumulative impacts as mentioned in Lake County APCD's comments (see comment #1 and response above).
33. The final EIR (page 147) refers to the LCAPCD's DOC conditions for this project. Monitoring recommended in the EIR is based on CEC staff health analysis and is included to ensure the adequacy of the EIR in fulfilling the requirements of the California Environmental Quality Act.
34. At this time, CEC staff is examining the feasibility of conducting a program for assessing the health status of Geysers KGRA residents. Details of a specific health assessment study would not be developed unless it was deemed feasible and was conducted.
35. Comment accepted, text amended.
36. The Cumulative Health Impacts section references Appendix B-1 of the EIR, which summarizes potential health effects of geothermal air pollutants. Table B-1 of Appendix B-1 lists odor and health thresholds reported for H₂S exposure.
37. Comment accepted; see Final EIR, page 202.
38. EIR Appendix B-1 summarizes the potential health effects of geothermal air pollutants. The bibliography (pages 252 - 256) provides numerous references, including appropriate EPA documents, for interested parties.

CEC STAFF RESPONSES TO COMMENTS ON DRAFT EIR

BY STONE & WEBSTER ENGINEERING CORPORATION

General Comments--Hydrology

The pervasive tone throughout the DEIR that Occidental's development of their leasehold will do "immeasurable" harm to the water quality of Anderson and Gunning Creeks will be moderated in the FEIR as a result of the CEC AFC process and ongoing discussions with Occidental and their consultants. CEC staff recognizes the distinction between Gunning and Anderson creeks and will attempt to make the distinction clearer in the FEIR. However, five local residents use Anderson Creek water for domestic purposes on an intermittent basis. We feel that the entire Anderson Creek watershed, which includes both Anderson and Gunning creeks, should receive adequate protection from degradation due to geothermal development.

We agree with the information presented in the second paragraph. Mitigation proposed by Occidental, if expeditiously implemented, will greatly minimize the potential to degrade the waters of Anderson and Gunning creeks. The FEIR will attempt to reflect this perspective.

We agree that the small area disturbed and the mitigation proposed will reduce if not eliminate the impact on Gunning Creek. However, the success of the mitigation measures will not be apparent until they have survived a wet winter.

If Occidental's mitigation measures are successful, the on-site erosion and sediment deposition in Gunning Creek will be less than before the project. However, Stone and Webster's argument is correct only if the mitigation succeeds in covering the bare fill slope with grasses. Heavy rainfall on the 1/4 acre of bare slope could dislodge and transport 50 tons (40 cubic yards) of material into the Gunning Creek drainage. Time alone will tell how effective Occidental's mitigation measures will be.

General Comments--Water Quality

1. The intent of the DEIR was to describe the existing water quality environment of Anderson and Gunning creeks in relation to the potential and cumulative adverse impacts which the Occidental project might exert on these waters. To do so the staff relied heavily on reports prepared by Occidental's consultant. The data and characterizations made in these reports indicated the water quality to be better in Gunning than Anderson Creek. CEC staff concern was and is for the maintenance of the existing water quality in both Gunning and Anderson creeks.

Our position is that geothermal developers should not be allowed to exacerbate the existing water supply problems in Anderson Springs by increased sediment deposition or accidental spills into Anderson or Gunning creeks. To the extent that Occidental's mitigation succeeds, our concern will diminish.

2. What CEC is describing in the second paragraph on page 40 is the low turbidity in Gunning Creek and the higher turbidity in Anderson Creek. Turbidity and sediment transport have been and continue to be problems in Anderson Creek due primarily to runoff from the unpaved surfaces of the Socrates Mine Road. Once again, our concern is with the quality of the receiving waters. We hope to prevent additional degradation of Anderson and Gunning creeks which would require more extensive and expensive treatment by downstream water users. Degrading the water quality will not improve the existing system.

CEC staff feels that the representations made in the DEIR concerning water quality in Anderson and Gunning creeks are accurate. They were presented initially by Occidental's own consultant.

We concur that waters for domestic consumption should be and are ordinarily treated regardless of the source of the raw water. The DEIR indicates that the quality of water in Gunning Creek is better than the water in Anderson Creek and is generally quite good. It is our opinion that the treatment required for the Gunning Creek waters would be less than when the watershed is converted to a geothermal industrial park with the attendant potential for water quality degradation.

3. Once again CEC staff relied on historical data for our analysis of water quality. The statement in question, i.e., "...coliform bacteria counts, which exceeded 16 per 100 ml, were the exception. Since bacteria are killed by standard disinfection, coliform counts do not indicate a significant water quality problem for raw water...", "was taken directly from a report prepared by Occidental's water quality consultants. We quote it in a section entitled "Special Water Quality Monitoring" and suggest that the data and quotation represent the best data available to us.

We have not and do not infer that the data are exhaustive. Nor do we find any data describing the presence or absence of *Ascaris lumbricoides*, *Giardia lamblia*, viruses, or other encysted internal parasites. If such pathogens are present in the waters or are introduced by geothermal development, the Anderson Springs Water Company should do whatever is required to eliminate them from water delivered to their customers.

The statement we made and the conclusion does not appear to be false. We agree with the Occidental consultant that standard disinfection kills coliform bodies and therefore does not constitute a quality problem for raw water. Nothing further was intended, and nothing further should be inferred.

The coliform data, supplied in the second paragraph by Brown and Caldwell, were collected after CEC staff prepared the DEIR. The high coliform counts, if representative of coliform bodies from the intestines of warm blooded animals, indicate possible fecal contamination.

We applaud the collection of additional data to define preproject water quality in Anderson but particularly Gunning Creek. It has long been the CEC staff position that additional sampling was necessary on both creeks.

In the light of recent findings we concur that the "pristine" characterization is inappropriate. We are still not persuaded, however, that the water quality in Gunning Creek is less than good; therefore, staff advocates protecting it from additional degradation.

4. CEC staff did not "discount the importance of storm timing and intensity" but included the following caveat on page 49: "The rainfall events which produced 7-8 mg/l were neither the first heavy rainfall of the season nor the heaviest that could be expected. In contrast, the first major rain-storm of the 1980 - 81 record period dropped more than 13 inches at (PG&E) power plant 13 in 48 hours. Much higher than 20 mg/l suspended solids concentration should be expected from storms dropping 13 inches in 48 hours."

CEC staff has repeatedly encouraged Occidental to monitor streamflow and suspended sediment on a continual basis. Records collected from continuous recording devices would define the amounts of sediment transport throughout the range of precipitation and streamflow.

Based on the currently available data and discussions with sediment specialists, CEC staff remains convinced that "suspended solids data indicate little, if any, extraneous disturbances of the Gunning Creek watershed. Pristine, undisturbed watersheds have yielded more than the seven or eight milligrams per liter transported by Gunning Creek and its tributary."

General Comments--Acreages

CEC soils and hydrology staff will incorporate the more recent acreage figures supplied by Occidental in the FEIR.

CEC RESPONSES TO SPECIFIC COMMENTS ON DEIR

1. Page ii, second paragraph. The Occidental leasehold straddles the drainage divide between the Anderson and Big Sulphur Creek drainages. CEC staff feels at the top of the watershed is more descriptive than high in as suggested by Stone and Webster. The statement that the watershed (inclusive of both Anderson and Gunning creeks) provides both potable and recreational water use is a correct statement. There are domestic users on both creeks, and both are used for fishing and commingle below their confluence in the Anderson Springs swimming area.
2. Page ii, fifth paragraph. Comment accepted. 18.5 acres will be substituted for the 16.7 acres as representing the area of power plant and access road.
3. Accepted. Text amended.
4. Accepted.
5. Accepted.
6. Accepted.

7. True, but per CEQA, the EIR generally focuses on adverse environmental impacts.
8. See response #1.
9. Text unchanged. The paragraph refers accurately to the overall watershed.
10. Text unchanged. The road is now complete.
11. Accepted.
12. Page V, Hydrology, paragraph 1. Comment accepted. 16.7 acres in the first sentence will be changed to read 18.5.
12. Page V, Hydrology, paragraph 4: In the last sentence "pristine" will be deleted and replaced with "upon which 200 permanent and 500 seasonal downstream residents rely for more than half of their water supply."
13. Text referring to rare plant study deleted.
14. Accepted. Text revised.
15. Text unchanged. Addition necessary.
16. See amended text.
17. Air Quality--See amended text.
18. Accepted.
19. Accepted.
20. See amended text.
21. Accepted.
22. Page ix, second paragraph, next to last sentence: The sentence in question, as written, refers to the water supply system, located on Gunning Creek; however, in addition to recreational water users there are three to five landowners who may intermittently draw water from Anderson Creek for domestic purposes. Whenever soils are denuded of vegetation and converted to 1.5:1 fills there is a potential for erosion and sediment transport. If the mitigation proposed by Occidental is in place prior to the first heavy winter rains, the potential for erosion and sediment transport off site is minimal. See amended text.
23. Page ix, sixth paragraph: At this point in time Oxy's contribution remains unquantified. It may or may not be large depending on conditions both within and outside of Oxy's jurisdiction. CEC staff is concerned with incremental degradation and spill incidents which may interfere with beneficial uses of the waters from the overall Anderson Creek watershed, which includes the Gunning Creek drainage.

24. Addition necessary. Oxy now owns the surface.
25. See amended text, reflecting current ownership.
26. Accepted.
27. Text deleted.
28. No change in text necessary. See third bullet.
29. Comment not accepted. McLaughlin (1981) in U.S. Geological Survey Professional Paper 1141 states (p. 17):

Recent seismic studies (Bufe and others, this volume) and investigations of vertical and horizontal surface changes over the area of steam production (Lofgren, this volume) suggest that much seismic activity at The Geysers may also be due to fluid withdrawal and reservoir subsidence, probably along pre-existing faults in the area of steam production." Focusing of differential subsidence along zones of lithologic discontinuity (such as faults) is well documented in many areas of groundwater withdrawal.

30. Text amended.
31. Page 18, second paragraph: Field observations and review of documents and maps indicate that, excluding geothermal development, land on the Occidental leasehold provides forage for wildlife and serves as a watershed for the community of Anderson Springs. The use of other watersheds by the Anderson Springs Water Company does not change the fact that the land in Anderson and Gunning creeks also serves as a watershed for Anderson Springs. However, the word "prime" will be changed to "major," which better describes the type of uses.

RESPONSES TO DEIR COMMENTS BY STONE & WEBSTER

32. Page 18, third paragraph: The last sentence which spoke of the sedimentation pond has been deleted and replaced with the following: Energy dissipators will reduce the force of flow from the leasehold prior to discharging runoff into natural channels.
33. Page 18, sixth paragraph: Comment accepted. See text.
34. Page 20, second paragraph: Comment accepted. Sediment pond references have been deleted. FEIR reflects Oxy's current plans to chip seal access road from Drill Pad C to B.
35. Page 23, second paragraph: CEC staff agrees and will change 90 percent to 85 percent as suggested.
36. Page 27, fourth paragraph: CEC staff feels that the characterization of Drill Pads B and C is geographically accurate as stated.
37. Page 27, fifth paragraph: CEC staff will change narrative in FEIR to reflect current design and construction of Drill Pad C. However, field observations by CEC staff indicate that the spring in question is intermittent rather than ephemeral.
38. Page 29, second paragraph: Comment accepted. The FEIR now reflects the individual acreages recently provided by Stone and Webster for the well pads.
39. Page 29, fourth paragraph: The fourth paragraph describes the natural ingredients on the Occidental leasehold which when disturbed by the activities of man could result in accelerated erosion. Estimates by both CEC staff and Occidental show marked increase in erosion losses when the native vegetation is removed and the soil reoriented by man. To imply that the erosion on the leasehold will be the same after removal of the vegetation cover and destruction of the soil structure and existing roots assumes too much. Comment not accepted.
40. Page 29, fifth and sixth paragraphs: The rainfall factor used in the Universal Soil Loss Equation is based not on the 1:100 year recurrence interval storm but on the EI₃₀ Index after Wischmeier.¹ It is defined as the greatest average intensity experienced in any 30-minute period during the storm. It is computed from recording rain gage charts by locating the greatest amount of rain which falls in 30 minutes (without regard to recurrence interval) and then doubling this amount to get the same dimensions as intensity, i.e., inches per hour.

The Soil Conservation Service substitutes for the EI₃₀ a rainfall factor (R) which represents the intensity of the mechanism responsible for the detachment of soil particles by rainfall. Considered on a yearly basis

1. Transactions American Geophysical Union, "Rainfall Energy and Its Relationship to Soil Loss," Wischmeier, Walter H., and Dwight D. Smith, Vol. 39, No. 2, April 1958.

its value is equal to the total number of erosion index (EI) units in a normal year's rain. The appropriate energy values equal to EI₃₀ are read from a curve entered using the 2-year, 6-hour rainfall for California sites.

The 2-year, 6-hour rainfall for the Occidental leasehold (from the U.S. Weather Bureau Isohyetal Map) is 3 inches. The 100-year, 6-hour storm would drop 5 inches on the site. For The Geysers rain gage the California Department of Water Resources determined 2.37 inches to be the 2-year, 6-hour storm. During the 34-year period, 1940 through 1974, the measured 2-year, 6-hour rainfall exceeded 2.37 inches during 21 of the 34 years, or 61.7 percent of the time. The data bears out the contention that the storms used to determine the rainfall energy for the soil loss equation occur during half of the years of record and not 1 percent of the time.

Whether or not a 2-year, 6-hour storm will occur during the 1981-82 water year remains to be seen. However, the revegetation of denuded slopes is not a sure thing. It is a calculated risk which the people downstream are being asked to share with Occidental.

The Socrates Mine Road has been the source of much sediment and consternation for the water users in Anderson Springs. The continuing problem with the road, the bulk of which is attributable to geothermal development, should be alleviated after it is realigned and paved. CEC staff and the residents of Anderson Springs certainly hope that the Occidental project will not come close to the degradation attributable to the Socrates Mine Road. However, our concern is with the additional degradation which may be contributed by the Occidental project. Because one activity--be it logging, road building, or geothermal development--causes pollution is no argument for overlooking another potential problem merely because its magnitude is less. Incremental loss of soil and degradation of surface waters could eventually add up to sizable losses for both natural resources.

It is true that not all sediment from the leasehold reaches Lake Berryessa. The sentence in question will be changed to read, "waterborne sediments from the Anderson Springs and Gunning Creek watersheds may be transported as far downstream as Lake Berryessa during years of high runoff."

41. The high sediment transport in Putah Creek at Guenoc could be natural, man-induced, or a combination. However, it is a matter of concern because of Lake Berryessa. Although there is only one unit (i.e., PGandE 13) operating in the Putah Creek drainage, the Socrates Mine Road is heavily used by geothermal developers and is an acknowledged contributor to sediment in the Putah Creek drainage. Although there are no standards for settleable solids for human consumption, there is an expressed concern for the loss of soil resources (e.g., in "California Soils: An Assessment" prepared by the California Department of Soils in 1979) and for sediment degradation of water in the Regional Water Quality Control Board Basin Plans and in many other documents, some of which are cited in

the DEIR. That there is no standard to protect California soils or water from specified amounts of erosion and sediment deposition does not allow CEC staff to overlook a potential adverse impact.

42. The Gunning Creek inflow will be characterized as "higher" rather than "high" quality inflow in the FEIR.
43. The second paragraph on page 40 is intended to verbalize the information presented in Tables 8 and 9. Staff concern is with the receiving waters and not with subsequent treatment. The purpose of the narrative is to point out the greater degradation of Anderson Creek because of the Unit 13 tributary in contrast to the better quality in Gunning Creek.

CEC staff is concerned that geothermal development in Gunning and Anderson creeks may degrade the local waters and exacerbate the management problem for both recreational and domestic waters. Additional degradation in Gunning Creek will not improve the Anderson Springs water system but will compound local water supply problems.

44. CEC staff believes that the term "significant yield" is a proper modifier. Changing to "no regional groundwater aquifers" overstates the case. Groundwater is present as attested to by water encountered in foundation excavation for Drill Pad B and a drill hole at Pad D.
45. Comment accepted; text revised accordingly.
46. Paragraph two on page 49 reiterates data and comments made by Occidental's consultant indicating the generally good quality of the raw water in Gunning Creek. It is this generally good quality that staff seeks to describe in the DEIR and protect against degradation. If, as Stone and Webster suggests, there are additional contaminants and pathogens, they should be removed from the finished product. CEC staff is not implying that further treatment is unnecessary.
 - A. CEC staff addressed this comment earlier. We feel that the DEIR addressed it fully and fairly. The pristine comparison is applicable to the available data. Should subsequent data become available which indicates high levels of sediment transport, staff will change the characterization.

47. The 70 percent figure for water use from Gunning Creek is attributed to Anderson Springs Water Company operating personnel and quoted on page 1 - 3 by Brown and Caldwell in a report entitled Study of the Anderson Springs Water Gathering System. In subsequent conversations Occidental's consultant pointed out that the figure was very general and could be less than 70 percent. CEC staff and Occidental representatives agreed that more than half of the Anderson Springs Water Company is drawn from Gunning Creek. The FEIR will reflect the lower estimate.

As footnoted (32) in the DEIR, the "700 residents of Anderson Springs" is quoted from page 9, Water Resources section, paragraph two, the first sentence in the U.S. Department of Interior, Geological Survey, Environmental Assessment 131-81 Well Site B, December 1980.

CEC staff and USGS qualified the number by stating approximately 700 residents. The amount of hookups (185) may not translate to 700 people. However, there are additional upstream users on both Anderson and Gunning creeks. Therefore, the figure is only approximate, not precise.

48. The figure 16.7 acres will be changed to 18.0 acres in the FEIR.
49. Comment accepted. Reference to the sediment pond will be deleted in FEIR. In its place reference will be made to energy dissipators and enhanced mitigation as appropriate.
50. Whether or not the waters from the plant site are clear or cloudy, polluted or unpolluted is unknown at this time. However, runoff from buildings, cut and fill slopes, and paved parking lots are in staff's opinion more akin to urban or industrial areas than to the surrounding natural areas.
51. The following paragraphs will be added to the FEIR after the paragraph describing spill incidents:

During 1980 and 1981 there have been 4 major (10,000 gallons or more) spills from geothermal developments in The Geysers KGRA. Two were due to settling pond spillage at PGandE Unit 7 and two failures of pipelines after settling ponds at PGandE Units 7 and 11. The last spill occurred May 6, 1981.

Placement of berms at newer plants, e.g., Occidental's, should reduce the frequency and severity of spills. However, spills which occur outside bermed areas on access roads, along pipelines, or due to sump overflow or human error remain a possible source of surface water pollution.

52. In accordance with new figures submitted by Stone and Webster, the area disturbed by transmission lines will be changed from 13 acres to 1 in the FEIR.
53. The term "during construction" will be replaced with the term "from bare slopes." The assumption of maximum soil loss (i.e., 55 to 250 tons per acre) assumes intense rainfall on denuded slopes. Revegetation may begin before the first winter storms, but whether or not it will be established on all areas disturbed by construction remains to be seen.
54. CEC staff will make the suggested change in the FEIR.
55. Changes in text have been incorporated.
56. This point has been sufficiently covered. No change in text.
57. Correction made.
58. Text stands as is. No information to the contrary has yet been presented.

59. Sentence restructured to clarify.
60. Appropriate section stricken from sentence.
61. This is substantially the same as the existing sentence. No change in text.
62. This paragraph has been changed to reflect the current situation.
63. Comment acknowledged. No change in text is considered necessary.
64. This comment is not totally correct. The ARM agreement may continue longer than three years. No change made in the EIR.
65. Comment accepted, °F added.
66. Comment accepted, text amended.
67. Comment accepted, text amended.
68. Comment accepted, text amended.
69. Comment accepted, text amended.
70. The staff assumes that there is an error in the comment, as the text reads as the comment suggests. The CEC staff will modify the sentence to be consistent with Comment #68.
71. The CEC staff disagrees with the comment. The staff has examined the SAI model computer printout of the 1984 simulation of the Oxy #1 limited mixing impact (computer printouts were provided in the SAI Report referenced on page 105 of the text). Using the same criteria that SAI used to verify the model (i.e., predicted peak concentrations 2 to 3 grid cells away from the sensitive receptors were examined and showed the greatest accuracy when compared to measured values), the peak concentrations for this model simulation near the sensitive receptor areas was 1.8 ppb not 1.6 ppb.
72. The CEC staff disagrees, see the response to Comment #71.
73. The CEC staff agrees with the intent of the comment. However, the staff believes that the proposed wording change would be misleading to the general public, since it would imply the lower levels are typical for sites near roads. The staff will add a statement after the first sentence in this paragraph that will indicate that the higher noise levels were measured near roads in the area.
74. The CEC staff disagrees; the accuracy of the source and projected noise levels does not justify the reporting of these noise levels with this precision.
75. Comment accepted, text amended.

76. Text amended.
76. Text amended.
77. While it is true that the publicly owned ASWC is a simple system, the true point is the vulnerability of that existing system to degradation in the raw water which enters it.
78. Comment accepted; wording changed in Final EIR, based on Health Finding 10c, Joint Prehearing Conference Statement of the Applicant and the Commission Staff, September 4, 1981.
79. Oxy has agreed to the the monitoring program described in the sixth paragraph on page 147, Final EIR (see Finding #13 of the September 4, 1981 Joint Prehearing Conference Statement of the Applicant and the Commission Staff).
- 80.
81. On September 22, 1981, Oxy and CEC staff agreed that Oxy should not be required to monitor asbestos concentrations in Gunning Creek. This decision was based on a letter from the Department of Health Services (John M. Gaston, Chief, Sanitary Engineering section, to Nancy Post, CEC, September 17, 1981). The letter states that "the value of one or two samples from the creek would be very questionable" and "if runoff is prevented from reaching the creek, there should be no reason to suspect that asbestos will reach the creek from the drilling sites."
82. Work has started on Socrates Mine Road, but paving will not start until all preliminary work has been completed. EIR revised.
- 82a. Paragraph revised.
83. Socrates Mine Road entry has been revised to reflect current conditions.
84. Paragraph revised to reflect current conditions.
85. Comment incorporated in new paragraph.
86. Paragraph has been revised.
87. Mitigation measures revised to reflect this.
88. So noted.
89. Text amended.
90. Text amended.
91. Text amended.
92. Text modified.
93. Text amended.

94. Comment accepted, text amended.
95. Comment accepted, text amended.
96. Concerning visibility of the proposed project from the east, the site is visible from locations in Anderson Springs.
97. In regard to aesthetic degradation of Anderson Creek, staff stands by its analysis that water quality impacts from the Occidental project will lead to aesthetic impacts to Anderson Creek.
- 97B. The phrase, "e.g., those proposed by Oxy" will be replaced in the FEIR with the phrase "in areas being impacted by urban development in California."
- 97C. The density of roads in the Klamath, Trinity, and Smith basins is 0.4 percent of the combined basins (i.e., 46 mi² out of 10,795 mi²). The 11.7 acres of roads proposed by Occidental is 0.2 percent of the 5,632 acres in the Anderson Creek watershed above its confluence with Putah Creek. Most of the roads, unlike those proposed by Occidental, were unsurfaced. However, road surface erosion was characterized as an "added minor problem." The chief source of sediment was unstable cut banks, which were necessarily wide in steep terrain.

The above characterization will be incorporated in the FEIR.

- 97D. The point is not that Occidental will convert 40 percent of the leasehold to grass but that the conversion of forest land to rangeland destroys the existing deeper root structure of the trees and shrubs, which in turn decreases the structural strength of the soil and its resistance to shear forces. Soils developed on steep terrain often exist at angles greater than the normal angle of repose for such soils. They are able to do so only because of the tensile strength of the roots.

Our concern is that areas developed at the Occidental leasehold will disturb the soils, change the angles of repose, and destroy the existing root systems. All such changes have at other sites, and could on the Occidental leasehold, result in increased erosion and sediment transport.

98. Whether Gunning Creek is or is not impacted by the 1/4 acre of fill slope remains to be seen. If all the mitigation proposed by Occidental is in place and the 1-1/2:1 slope revegetated prior to winter rains, the impact will be insignificant. If, as sometimes happens, heavy rains occur prior to the re-establishment of grass cover and a fibrous root system, erosion could result and sediment could be transported into Gunning Creek. Text unchanged.
99. CEC staff will change the paragraph in question to reflect the greater mitigation proposed for Drill Pad B and the access road. See revised text.
100. The development of Drill Pad B close to Gunning Creek was, is, and continues to be of concern to CEC staff. We recognize the "extraordinary" measures taken by Oxy. We also are cognizant of the extraordinary concern

the people of Anderson Springs have expressed concern concerning the impact of geothermal on what they consider to be their last source of good quality water.

Whether or not Oxy's mitigation effectively precludes erosion and surface water degradation depends on its timely application and careful maintenance, both of which may be effective; however, no one can say for certain before the fact.

CEC staff will add a sentence similar to the one proposed by Occidental with the caveat if the mitigation measures are successful.

101. CEC staff assumes that the exception Occidental takes to the first paragraph is the "pristine" characterization of the waters in Gunning Creek.

The wording of the first sentence in the FEIR will state that "more than half" of the Anderson Springs water supply is derived from Gunning Creek, which is a relatively "undegraded" watershed.

102. CEC staff will modify the first sentence of the second paragraph on page 174 to reflect federal and local approval of Drill Pad B and the access road.

103. Comment accepted. See revised text.

104. The last two sentences of the paragraph make clear that the standards do not apply to "raw" water and "appropriate treatment can be used to bring the water into compliance."

105. Whether or not the impacts on domestic water sources are less than under preproject conditions remains to be seen and depends on the effectiveness of mitigation measures and rainfall conditions on both Anderson and Gunning creeks. Staff notes that there are 3 - 5 intermittent users on Anderson Creek.

106. Comment accepted; text revised.

107. CEC staff proposes to change the paragraph in the FEIR to read: In spite of Occidental's proposal to implement extensive erosion control measures, the possibility remains that soils may be eroded from the leasehold and deposited in Anderson Creek and to a greatly lessened extent in Gunning Creek. Deposition of sediment in the local creeks could physically and chemically degrade waters for the following uses:

1. On Anderson Creek mostly for recreational purposes and for domestic supply for 3 - 5 intermittent users.
2. On Gunning Creek for over half the domestic supply of the community of Anderson Springs and assorted upstream domestic recreational and agricultural uses.

108. The entire Mitigation/Monitoring section was rewritten. See amended text.

109. Discussion of the Mitigation and Monitoring Requirements on page 178 has been deleted and rewritten as described in Item 108.
110. If a continuous turbidity monitor is not available, a conductivity bridge should be substituted as a method of determining spills.
111. The entire section was deleted and with it the statement concerning the monitoring of "other physical and chemical parameters." The comment referred to the Brown and Caldwell "Scope of Work for Baseline Water Quality Monitoring, Occidental Geothermal Leasehold, Lake County."
112. Correct figures substituted.
113. This comment is unsupportable conjecture. No change in text is necessary.
114. The text has been changed to indicate that these facilities have been constructed.
115. Changes incorporated as suggested.
116. Language has been incorporated to indicate that Occidental will participate in the Aquatic Resource Monitoring Program.
117. Comment acknowledged. No changes in text deemed necessary.
118. The CEC staff disagrees. See response to Comment #71. The staff has examined the results of the SAI modeling studies using the same techniques SAI used to verify the model (i.e., examining the peak concentrations within two to three grid cells of the receptor locations). Based on this examination, the peak background concentrations reported are those presented in the Draft EIR. The SAI analyses of the data also averaged the upper quartile of the model predicted concentration surrounding sensitive receptor areas, to develop an estimated background H₂S level. The CEC staff disagrees with this approach, since it is inconsistent with the concept of a peak concentration.
119. The CEC staff disagrees. See response to Comment #118. Based on the staff's analysis the statement is true as written.
120. Text amended.
121. Text unrevised. Staff disagrees due to ambient levels.
122. The CEC staff disagrees. See response to Comment #118. Based on the staff's analysis, the statement is true as written.
123. Comment accepted, text amended.
124. Comment accepted, text amended.
125. The CEC staff disagrees. The staff's estimated incremental impact under limited mixing conditions for the Oxy #1 facility is based upon (1) tracer

test conducted for the Oxy #1 project, (2) the SAI model simulation of that tracer test and the model simulation of the 1976 worst-case day, and (3) the worst-case impact estimated for the SMUDGE #1 project (see Draft EIR page 112; also see response to Comment #106.).

- 126. Comment accepted, text amended.
- 127. Comment accepted, text amended.
- 128. Staff recognizes that the emission rates used in the analysis over-estimate the impact. EIR Appendix C, Assumptions for Public Health Impact Analysis, assumption 2 notes that "this assumption allows for a worst-case analysis only; it is not precise." Note also that vapor phase mercury may also be present; therefore, the claim that "they (arsenic, boron, mercury) are particulates" is not entirely accurate.
- 129. Comment accepted; wording changed in Final EIR.
- 130. See response to comment #128.
- 131. Comment accepted; wording changed in Final EIR.
- 132. Oxy has agreed to participate in the SMUDGE #1 ambient air monitoring program or a generic ambient air monitoring program for these pollutants (Health Findings 10a, Joint Prehearing Conference Statement of the Applicant and the Commission Staff, September 4, 1981). Furthermore, the Lake County APCD conditioned the DOC on Oxy's participation in a generic ambient air monitoring program if one is developed. LCAPCO and CEC staff believe that the extent of ambient air quality monitoring for each plant should be based on results from the first year of monitoring.
- 133. Comment accepted; wording changed in Final EIR.
- 134. Occidental has agreed to monitor as indicated in the third paragraph on page 203 of the Final EIR. (Health Finding #13 of the Joint Prehearing Conference Statement of the Applicant and the Commission, Staff, September 4, 1981). Note that the ARM program, as presently designed, does not provide monitoring of all pollutants of health concern.
- 135. Text deleted; see response to comment #81.
- 135. Actual amount of AB 1905 money awarded to Konocti and Middletown School Districts is less than stated in the DEIR. Text will be changed: "To date, the Middletown and Konocti School Districts have received a total of \$46,500 from the Lake County Board of Supervisors in 1905 monies." No applications have been made for AB 1905 funds administered by the CEC.
- 136. Regarding public service impacts resulting from degradation of Anderson Springs domestic water supply, regardless of the current condition of the existing supply and distribution system a deterioration of water quality will result in fiscal impacts to the community. If the system does require upgrading, water quality impacts to the water supply system can only raise the cost of this upgrading. A community water district has been formed in which Anderson Springs would assume responsibility for the water system.

137. Comment accepted, text will read: "The Lake County Board of Supervisors and the CEC separately administer monies provided under AB 1905..."
138. Comment accepted. Text amended.
139. Since the sediment basin is no longer part of the project, this paragraph is no longer appropriate and will be deleted from the FEIR.
140. The statement as written is accurate. Text unchanged.
141. Accepted. Text revised.
142. Text revised.
143. CEC staff feels that in spite of extensive mitigation it is still possible for activities on the Oxy leasehold to "degrade local recreation and drinking waters" for reasons stated in our previous responses.
144. Text revised.
145. See response #136.
146. CEC staff proposes in the second sentence to change "to the town below" to "downstream water users." Anderson Creek does not supply domestic water for the town of Anderson Springs, but it may supply water intermittently to three - five parcels downstream from the Oxy leasehold. For the same reason, CEC staff considers the suggested change in the last sentence to be inappropriate.
147. CEC staff made the suggested addition to the FEIR.
148. In the first sentence the phrase "will impact" will be modified to say "may impact." Whether or not Oxy's activities benefit Gunning Creek remains to be seen.
150. Comment acknowledged. No change in text.
151. Text amended.
152. CEC staff also hopes that there will be no degradation of Gunning Creek, but accurately predicting the success of Oxy's mitigation measures cannot be done at this time. See modified text.
153. In light of CEQA, staff believes that steam field developers and power plant proponents who benefit from geothermal development should mitigate whatever adverse impacts result from proposed projects.
154. Text corrected.
155. The CEC staff disagrees with the first part of this comment. It is the purpose of this section to identify alternatives to the proposed project. The Metal catalyst system is an alternative, although the staff will concede desirable alternatives. The CEC staff agrees that the Carbon

Dioxide pH Control is a relevant alternative to the proposed system and should be discussed here. A section on this alternative will be added.

156. Accepted. Text deleted.
157. Appropriate changes will be made in the matrix to reflect actual conditions on the leasehold.
158. Appropriate changes in the matrix will be made prior to the FEIR release.
159. "The disturbance of soil structure" will be substituted for "the scalping and comingling of top soil with subsoil."
160. CEC staff is concerned that during large storms sediment and other materials not ordinarily found in nonindustrialized watersheds will discharge into the Anderson Creek tributary.
161. CEC staff will add "to a minor extent" before Gunning Creek. The word "potential" will be changed to "possible."
162. The same changes made in the body of the report relative to the flood hazard to Site C will be made in the FEIR matrix.
163. So long as Oxy complies with the stipulations in the federal and local permits governing the use of water from Anderson or Gunning creeks, CEC staff will be satisfied with Oxy's purchase of water "from those who have a legal right to sell it." No change in text.
164. Appropriate changes made.
165. Comment not substantial. Text unrevised.
166. Accepted. Text revised.
167. See Responses to General Comments, Water Quality.
168. Text unrevised. Statement is accurate. These levels are proposed; they have not yet been adopted (personal communication with Dr. Morris Katz, York University, October 21, 1981).
169. "Spring 82" will be changed to "Summer 82."
170. The table from the August Mitigation Plan is attached in the FEIR.
171. CEC hydrology staff does not care in which arena the sampling is done as long as it encompasses the program described in Brown and Caldwell's Scope of Work for Baseline Water Quality Monitoring, Occidental Leasehold, Lake County, with the addition of arsenic, mercury, chromium, oil, and grease in water quality samples and for geothermal fluids silica, and mercury in the gaseous state.

TABLE 6

MONITORING SCHEDULE OF BIOLOGICAL RESOURCES MITIGATION EFFORTS

<u>Mitigation Measures</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Storm drainage systems checked	F	Sp, F	Sp, F	Sp, F	Sp, F	Sp, F
Sedimentation pond checked	F	Sp, F	Sp, F	Sp, F	Sp, F	Sp, F
Removal of sediment from pond				Su	Su	Su
Phase I revegetation field sampling		Su	Su	Su	Su	Su
Phase II revegetation field sampling			Su	Su	Su	Su
Prescribed burning field sampling (to continue for a 20-year period)		Su?	Su?	Su?	Su?	Su?
Monitoring of closed, nonessential roads and trails	Su	Su	Su	Su	Su	Su
Boron/vegetation studies field sampling	Su	Su	Su	Su	Su	
Seep/spring monitoring	Sp, F	Sp, F				
Annual reports to CEC of mitigation/monitoring efforts		Su	Su	Su	Su	
Final report to CEC of mitigation/monitoring efforts						Su

Sp = Spring

Su = Summer

F = Fall

W = Winter

CEC RESPONSES TO
USGS COMMENTS ON OXY DRAFT EIR

1. All references to surfacing roads on the Oxy leasehold will specify "chip sealing" in the FEIR.
2. Later comments in the DEIR describe the impact of the unpaved Socrates Mine Road. The lack of data for Gunning Creek limits the characterization of sediment content although CEC staff states that sediment transport is probably higher after heavy storms than indicated by existing data.
3. Text revised. See transportation section regarding Oxy's contribution to Socrates Mine Road improvements.
4. Ringtail should have been studied prior to certification; failing that, CEC recommends such studies as a condition of certification.
5. Text unrevised. The County role is unclear.
6. Ok.
7. Text revised.
8. Text revised.
9. (Elsewhere) "geologic parent material" will be changed to "parent bedrock" as suggested.
10. "Water quality" will be inserted to modify "monitoring program."
11. The reader will be referred to Soils Appendix D, pp. 349 and 350 in the FEIR.
12. The word "water" will be removed from the phrase "soils water resource."
13. Concerning the singularity or plurality of the word "data" the Funk and Wagnalls "Standard College Dictionary" 1974 has the following comment: "Those who continue to regard data as a Latin plural use it with a plural verb (These data are new), but its use with a singular verb (This data is new) is widespread."
14. CEC staff will include in the FEIR phrases modifying Anderson and Gunning creeks which indicate that the former originates on the leasehold and the latter just upstream from the northern boundary of the leasehold.
15. The FEIR will include the drainage area of Anderson Creek above its confluence with Gunning Creek as 1.6 square miles.
16. "Upstream" will be changed to "upslope" for clarity.

17. The estimate of 1:100 runoff will be changed to coincide with the 320 acres of the Anderson Creek drainage above the leasehold boundary, as shown in Water Table 1.
18. Current figures supplied by Occidental indicate that the total project will disturb 50.8 acres. One-half an acre will be disturbed by off-site transmission lines and is assumed to be in the Big Sulphur Creek drainage. One-quarter of an acre disturbed by Drill Pad B will drain into Gunning Creek. Therefore, although the preponderance of the disturbance is in the Anderson Creek drainage basin, a small amount falls outside. The FEIR will be changed to reflect the more current figures.
19. The acreage slated for disturbance in the Anderson Creek drainage will be changed to 50 exclusive of the quarter acre of Drill Pad B in the Gunning Creek drainage and the half acre of transmission line assumed to be in the Big Sulphur Creek drainage basin.
20. The erosion section will be introduced with a sentence to the effect that erosion is governed by rainfall energy, soil characteristics, ground cover, plus length and steepness of slope.
21. Total expected yield for the power plant site appears on page 53. The purpose of the paragraph in question is to show the disparity of erosion rates on a pre-, during- and postproject basis. The recommended three tons per acre per year was quoted from California Soils: An Assessment prepared by the California Department of Conservation in 1979. The entire quotation is "The soil erosion rates in the Eel and Mad River Basins are 15 tons/acre/year and 7 tons/acre/year, respectively. These rates are much higher than the 1 - 3 tons/acre/year these soils can sustain without losing essential nutrients and water holding capacity. If these rates continue unabated, there will be a gradual loss of production with the potential for complete denudation of these watersheds."

On pages II-10 and II-11 the authors made the following assessment of soil loss tolerances for upland soils. (The soils on the Oxy leasehold fall within the category of upland soils.)

"Many California soils in the uplands and mountainous areas of the State are particularly susceptible to erosion. Degradation of soil resources occurs when the rate of soil erosion exceeds the rate of natural soil formation. Soil, as a natural resource, is not renewable over the short term. It has been estimated that in the Midwest, from 30 to more than 1,000 years may be required to form 2.5 cm (or 1 inch) of surface soil from parent material by natural processes. Under California conditions, however, 2,000 years may be needed to produce an inch of top soil by natural processes alone. Yet, in most areas of California, the loss of soil by natural and man-caused forces exceeds the rate at which soils are being formed.

Since it is difficult to draw a line between natural and accelerated soil loss, the question usually becomes, 'what is the maximum level of erosion that the soil can tolerate and still suffer no progressive deterioration?' If we use the more

optimistic time span of 30 years to form 2.5 cm (or 1 inch) of soil, this rate would form 5 tons per acre per year of soil (a layer one inch thick on an acre of land weighs 167 tons). This would be the maximum target figure allowable for erosion. However, it must be emphasized that this figure is based on the best possible (most rapid) soil forming conditions.

Realistically, erosion rates of 1 to 2 tons/acre/year should probably be the maximum target figures on most upland soils due to their location on steep slopes and their shallowness. But studies done on the north coast of California have shown erosion rates from 10 to 100 times the rates of other river basins, ranging from 6.4 to 16 tons/acre/year. Studies have shown that the rate of natural soil regeneration is presently one-tenth to one hundredth the rate of soil loss in the north coastal ranges. In the long term, the result of such an imbalance will be the same as in those areas of the Middle East where barren slopes have replaced the forests."

22. It is CEC staff's position that the development of the Oxy leasehold is the continuation of industrialization of the Anderson Creek drainage. More significantly, it is the beginning of permanent industrialization of the Gunning Creek drainage. In the latter sense we do see it as a trigger mechanism. These matters are mentioned here and throughout the DEIR because of CEC concern over the industrialization of a watershed which supplies domestic and recreational waters to downstream users. Such change of land use could impair the waters of Anderson and/or Gunning creeks for existing beneficial uses.
23. The six tons per acre soil loss would apply to the the first three years after construction. If the mitigation measures presently proposed by Oxy are successful, long-term soil losses would be reduced to one ton per acre per year. The last sentence will be changed to reflect current mitigation plans.
24. FEIR will be changed to read "March" 1965.
25. CEC staff agrees that the comment is inaccurate. The last two sentences will be changed in the FEIR to read:

"Water Table 9 also summarizes the number of turbidity samples taken at each station (16) and the number of those samples which exceeded the corresponding maximum contaminant level (MCL). As many as nine samples per station exceeded the MCLs for turbidity."

Note that turbidity increased in the downstream direction on both Anderson and Gunning creeks...."

26. The reference cited on pg. 40, in paragraph 5, line 5, is not attributed to Jim Knott of the USGS but rather to Occidental Geothermal, Inc.'s AFC "Appendix C Geothermal Investigation," Harding-Lawson Associates.

27. The sediment basin has been deleted from the project and FEIR; therefore, there will be no need to dispose of accumulated sediment.
28. The stations referred to are represented on Figure 3 as open hexagons on Gunning Creek at Ford Flat Road and above Socrates Mine Road on Anderson Creek. The FEIR will be modified to make clear at which stations the samples were collected. The quality of reproduction of Figure 3 is not precise enough to show that the station in question is located in an arroyo tributary to Gunning Creek and not on a ridge.
29. 20 mg/l in the last line will be changed in the FEIR to 8.2 mg/l.
30. The fifth paragraph will be replaced with a paragraph from the Oxy AFC which explains how they propose to dispose of storm runoff with the caveat that "runoff collected later during the storm" may "be similar in composition to natural...runoff."
31. The reference numbers in the body of the Water Quality section refer to the numbered references listed on pages 57 through 60 and not to the unnumbered references listed on pages 243 through 246. If the first, or numbered, set of references is used, they should be more meaningful and appropriate.
32. All references to the sediment pond and access road will be deleted from the FEIR.
33. Since the magnitude and duration of erosion and silt deposition in the Anderson Creek tributary is presently unknown, the duration of the impacts on amphibian populations is likewise unknown.
34. The erosion rates of 55 to 250 tons per acre will be identified in the FEIR as Occidental and CEC staff estimates. The post project rate of 4.2 tons per acre per year is an Occidental estimate, while the 6 tons per acre is the comparable CEC estimate. The conflict is caused by a different application of an estimation technique.
35. Figure 6 is intended to show the proposed and alternate transmission routes. Figure 2, page 4, depicts the access roads to pads D and B.
36. Changes incorporated.
37. This comment is not substantive and therefore no response is necessary.
38. No site-specific information is available for these species.
39. Cooling tower drift has been related to the loss of vegetation in The Geysers in some areas (e.g., at PGandE's Units 3 and 4, and 5 and 6, denudation has occurred immediately around the power plants). The "loss of vegetation" does not imply denudation only. "Vegetation" is used synonymously with "plant community" and refers both to the floristic composition and physical structure of an assemblance of plants (see Mueller-Dombois, D.H. Ellenbury, 1974, Aims and Methods of Vegetation Ecology, John Wiley & Sons, for a further understanding of what the term

"vegetation" implies). A change in the species composition and/or vegetation structure does constitute a change in vegetation. Where there appears that long-term changes have or will occur, a vegetation "loss" appears to be the most fitting descriptor. There has been a "loss" of vegetation surrounding existing power plants, and in some cases a change in species composition is evident over large areas. The effect of long-term, low-level (chronic) boron stress has not been fully described; yet if it is the same as other low-level pollutants (there is no reason to presume it is not) a marked change will occur over time (see Woodwell, G.M., 1970, "Effects of pollution on the structure and physiology of ecosystems, "Science, 168:429-433). Current boron stress is evident in well over 250 acres in The Geysers when one adds the damage documented in 1978 to that which has occurred around power plants since 1978 (See Malloch, B.S., M.K. Eaton, and N.L. Crane, 1979. Assessment of Vegetation Stress and Damage near The Geysers Power Plant Units. Pacific Gas and Electric Company, Department of Engineering Research, San Ramon).

The sentence will be changed to reflect a broader potential for injury.

40. Exposure to boron-bearing cooling tower drift has resulted in severe damage and death among numerous native plant species. It is prudent to expect that the tolerance of rare plants in The Geysers is no greater than other native species in that region until specific research indicates otherwise. To assume that a plant which is tolerant to one stress will be tolerant to another or that a plant that is tolerant to one substance is tolerant to an unrelated substance is totally unsupported (see the literature on air pollution effects on any of a number of plant species). The ability of a species to tolerate even serpentine soils (which are characterized by high levels of toxic elements, nickel, cadmium, and magnesium and low levels of the essential element calcium) provides absolutely no indication of a capability to withstand an additional stress caused by boron.
41. The current statement is a prudent evaluation of potential cooling tower drift effects and properly presents the possibility of the effects occurring given current data. No changes have been made in the EIR.
42. This will be clarified.
43. The reference is on page 251 of the DEIR.
44. The source of this section is DWR's May 29, 1981 submittal, entitled "South Geyser Information," 81-AFC-2. Oxy indicated that a maximum of 2,500 gallons daily of raw sewage may be produced. The discrepancy is caused by different numbers of people using the sanitary facilities.
45. Text amended.
46. See changed text.
47. Amended.

48. Work on the road through Birdsong Meadow and the fire road and has been completed, and they have been paved. Text revised.
49. Text revised.
50. The source and rationale of the allowable soil loss of one to three tons per acre per year was explained in an earlier response.
51. The phrase "e.g. those proposed by Oxy" will be replaced in the FEIR with "in areas being impacted by urban development in California."
52. Initially, Occidental proposed to gravel surface their access roads, not chip seal them. Therefore, the roads would have been very susceptible to erosion. Chip sealing will reduce erosion considerably. The BLM should be commended for requiring the additional mitigation.

The similarities between the Oxy leasehold and the Mad and Eel river basins are as follows:

- a. All three are underlain by the Franciscan geologic formation.
 - b. The soils have similar erosion hazard ratings, the majority of which are high or very high. The soils of the Oxy leasehold are shallower than those on the north coast and could not tolerate as much soil loss without loss of productivity.
 - c. The deeper soils of the Eel and Mad rivers basins have moderate infiltration rates and the ability to absorb more rainfall than the shallower soils on the Oxy leasehold. The slow rates of infiltration and internal transmission of the shallower soils on the Oxy leasehold could result in increased runoff and a higher erosion potential.
 - d. The 2-year, 6-hour rainfall is generally higher (3") on the Oxy leasehold than in the Eel and Mad rivers drainages (2+").
53. The statement at the top of page 171 is nearly a direct quotation from the California Department of Conservation report California Soils: An Assessment and is credited by them to the USDA, River Basin Survey Staff, Reconnaissance Survey Report, February 1966, Conservation Treatment of the Dry Creek Watershed.

In the FEIR we will identify it as the Dry Creek Basin in Sonoma County.

54. CEC staff sees no valid reason for setting "nitrogen" off from the modifying phrase "the most limiting nutrient."
55. The paragraph in question will be completely rewritten in the FEIR to specify chip sealing and the placement of crushed rock in the drainage ditches.
56. Aminoil has developed two exploratory drill sites in the Gunning Creek watershed, the PDC-1 site and one near the Socrates Mine Road. The FEIR will be modified to reflect two sites.

57. CEC staff based this conclusion on evidence presented in federal reports and permit requirements by Lake County. The Bureau of Land Management suggested that the buffer zone adjacent to streams be enlarged to 300 feet in its comments on the pre-draft EIR.

Because of the importance of Gunning Creek as a domestic water supply we feel that any error should be on the conservative side. If the preponderance of research indicates 20 - 30 feet of buffer to be adequate and it becomes widely required, we will also adopt similar measures. However, the shallowest protective strip suggested by Paul E. Parker and George F. Christiansen (in "Guides for Controlling Sediment from Secondary Logging Roads," Intermountain Forest and Range Experiment Station, Ogden, Utah) is 53 feet wide to reduce sediment by 83 percent. This set of circumstances requires the spacing of depressions or mounds one foot apart down the intervening slope. To control 97 percent of the sediment, the 53 foot spacing would have to be increased an additional 30 feet, for a total buffer strip of 83 feet.

58. The FEIR will be changed to reflect the USGS/BLM and Lake County permit requirements to restore the old logging road adjacent to drill pad B.
- 59., 60., and
61. The last paragraph on page 177 and all of the narrative on page 178 will be replaced in the FEIR as follows:

"In compliance with requirements of the Central Valley Regional Water Quality Control Board, Occidental is required to collect water quality samples from Anderson Creek at Anderson Springs when a toxic spill is suspected, as reflected by an increase in turbidity above 25 nephelometric units and a stable water level in the creek."

Occidental, through its consultants, has agreed to additionally monitor the streamflow in Anderson Creek and collect water samples for sediment analysis during periods of high flow. Occidental's monitoring, coupled with monitoring required of other steam field developers at various sites in the basin, will help establish the frequency and extent of degradation and spills attributable to geothermal development.

Monitoring is not intended to supplant mitigation, but rather to define the need for additional mitigation. The major concern expressed in federal, state, and local reports, permits, and proceedings to date has been the vulnerability of the waters of Anderson and Gunning creeks to degradation by geothermal development.

The impending industrialization of the Anderson and Gunning creeks watersheds and the potential for attendant impacts required the people of Anderson Springs to gamble with their water supply and land values. Land developers have been asked to pay a proportionate share for public utilities, e.g., roads and sewer systems, because their activities placed additional burden on local governments. The CEC staff considers it no

more unjust for those who reap financial benefits from geothermal development to assume a proportionate share of utility costs than those who benefit from land subdivision.

62. Typo corrected.
63. Text changed.
64. Wording changed as suggested.
65. The current level of detail is sufficient.
66. Corrections made.
67. Corrections made.
68. Participation in ARM will suffice as the monitoring program for purposes of identifying effects on aquatic resources.
69. The timeframe for the work force and population estimates is noted in Figure 1, 1979 through 1993. The specific analysis, in order to determine maximum impact, estimates peak work force demands to occur in late 1982. Peak work force requirements will result in 446 workers needed. Of the 446 workers, 268 will move into the four-county area, accounting for a population increase of 605 people (workers, spouses, and children).
70. Typo corrected.
71. Text amended.
72. Text unrevised. This section refers only to construction of the transmission line. See left hand column.

CEC RESPONSE TO COUNTY OF SONOMA COMMENTS

1. Transportation

- a & b - Oxy has indicated (Stone and Webster comments on DEIR for Oxy, September 30, 1981) that it will not use Sonoma County Roads. Oxy has no agreement with Union for the use of Union's private roads through the Geysers. Because the Union roads are not open to the public it appears that there will be no impact to the Sonoma County roads due to the Oxy project.
- c & d - Testimony by John Morelli, Sonoma County Department of Public Works, indicates that Sonoma County would have a difficult time maintaining Healdsburg-Geysers Road.
- e - The CEC presently has a contract with CalTrans for a study of transportation to the Geysers. Recommendations from this study will be incorporated by CEC staff in its presentations for the hearings to be conducted on Cumulative Effects at The Geysers. At this stage of our knowledge the suggested conditioning of the certification may be inappropriate. It should be noted Oxy has been invited to participate in the Cumulative Impact Hearings.

2. Safety

While the DEIR does address the potential for accidents during construction and operation (Initial Environmental Impact Evaluation), it does not specifically address emergency medical and evacuation services. The DEIR does state that construction workers and operators will be covered by CAL-DOSH requirements. Section 1512 of Title 8, California Administrative Code (CAL-DOSH) provides for Emergency Medical Services for construction workers. This section provides for provisions for obtaining medical services. The section also requires employers to have a written plan to provide emergency medical services. The plan is required to specify means of implementing all applicable requirements. Similarly the General Industry Safety Orders of CAL-DOSH covering employees is discussed in section 3400 entitled Medical Services and First Aid of Title 8.

3. Socio-Economic

- a - Regarding availability of labor supply, please refer to response no. 2 to Lake County Office of Education.
- b - Regarding housing impacts, please refer to response nos. 2 and 4 to Lake County Office of Education. In addition, staff believes Sonoma County will have little, if any, housing impact, since there will be no direct access to the site from Sonoma County.
- c - Regarding mitigation measures, please refer to response No. 1 to Lake County Office of Education. Note response no. 2 above.

- d - The Sonoma County Superintendent of Schools reported enrollment in Sonoma County School District is down about 1,300 students from last year. Due to its enrollment situation and the condition that few, if any, workers will locate in Sonoma County from this project due to lack of direct access, staff stands by its analysis that Sonoma County School districts will not be significantly impacted.
- e - The Draft Environmental Impact Report does address financial impacts on Sonoma County on page 212. The County of Sonoma does receive property taxes and AB 1905 monies from the Occidental development, as 70 acres of the leasehold are located within that county. Staff stands by its analysis that in Sonoma County negative impacts will be insignificant to the positive fiscal benefits coming from the project.

4. Schools

In responses to mitigation of school impacts by use of AB 1905 funds, please refer to response no. 1 to the Lake County Office of Education.

OCCIDENTAL GEOTHERMAL PROJECT

CEC RESPONSES TO COMMENTS ON OXY DRAFT EIR, MADE BY

COUNTY OF LAKE (OCTOBER 2, 1981 LETTER)

1. Water Quality

CEC staff agrees with Lake County that:

- a. Critical unresolved issues remain regarding accidental and/or long term cumulative impacts to the Anderson Springs domestic water supply.
- b. Industrialization by steam field and power plant developers and operators will exert an adverse cumulative impact on local water supplies, and
- c. Something should be done to safeguard local water supplies and equitably distribute costs for restitution.

However, the DEIR is probably not an adequate forum in which to explore and resolve these issues. CEC staff has made a concerted effort to describe the existing environment, anticipated cumulative impacts and effective on-site mitigation methods, and an off-site monitoring program.

Equitable distribution of costs should be addressed in a generic forum rather than via individual projects, e.g., the Occidental AFC proceedings. CEC staff has suggested that applicants for steam field permits or certificate of power plants either:

- a. Post a performance bond to cover erosion or sedimentation during and after construction,
- b. Be assessed a proportional share of the cost of enclosing the source(s) of potable water for the community of Anderson Springs, or
- c. Work with Lake County in developing an ordinance which would equitably assess proportional shares of the cost for mitigation measures to safeguard the local domestic water supply.

2. Land Use

As identified within the Draft Environmental Impact Report (p. 162) the proposed development is consistent with both Lake County's General Plan and Zoning Ordinance. As geothermal development is the major land use adjacent to the proposed project, few conflicts exist. Impacts to other adjacent land uses have been identified under the appropriate sections (i.e., noise, water quality) of the DEIR. Staff feels inclusion of a land use map would add no further information and, in the interest of reducing the amount of extraneous material within the document, is not warranted.

Potential water quality impacts from Occidental development are discussed under the Water Quality and Cumulative Impacts--Water Quality sections. Lake County review of Occidental's proposed plan of development is presently under way.

Land use conflicts are discussed within the Draft Environmental Impacts; specifically, the decline of recreational activities is discussed under land use, and impacts to the domestic water supply of Anderson Springs is found within the Water section. The question of surface owner rights versus federal mineral lease holder rights under the 1916 stockraising Homestead Act is, as stated in the Draft EIR, still in litigation.

CEC STAFF'S RESPONSES TO CRAIG TOCHER'S COMMENTS
(FROM SEPTEMBER 16, 1981, PUBLIC WORKSHOP REGARDING OXY DEIR)

BIOLOGICAL RESOURCES

Mr. Tocher raised concern about the impact of the Oxy development on fish in the Anderson Creek drainage. In particular, his concern mentioned the potential for accumulation of toxic levels of arsenic and/or mercury by fish in Anderson Creek.

Presently, there is no indication of either mercury or arsenic toxicity problems in Anderson Creek. In 1980, Pacific Gas and Electric Company issued a report on the Water Quality of the Upper Putah Creek drainage area which included both Anderson and Gunning creeks. The study examined levels of both arsenic and mercury in the water and mercury in the sediments.

Tests indicated that mercury levels were well within levels which would be considered "normal" within the franciscan formation. Two tributaries to Putah Creek (Bear Creek and Hot Creek) did show high mercury levels which could most likely be attributed to abandoned mercury mines within those watersheds.

Trace levels of mercury are associated with steam condensate in The Geysers region. It appears unlikely that emissions from cooling towers will produce levels of mercury which would be of any substantial concern to anyone consuming fish from Anderson Creek. However, any attempt to predict the impact of geothermal development on concentrations of mercury in fish could not be confirmed without direct monitoring of the fish in Anderson Creek.

It would appear that the issue of greatest potential impact on the fishery of Anderson Creek is the effect of sedimentation from soil disturbance and erosion within the watershed. This will be monitored by Occidental for a period of at least two years.

WATER RESOURCES

Text not revised.

CEC staff calculated pre-, during, and post-Occidental project one-in-a-hundred chance occurrence streamflow across your property bordering Anderson Creek. These calculations were made in response to the concerns expressed by you that development of the Occidental leasehold will increase the flood hazard on your adjacent property.

We determined that the Anderson Creek drainage, upstream from the point where the stream exits your property, contains 486 acres. Full development of the Occidental leasehold will disturb 50 acres. Approximately 40 percent will be converted permanently to industrial use while 60 percent will be revegetated.

Without any disturbance by Occidental a peak discharge of 386 cubic feet per second (cfs) could be expected to flow down Anderson Creek across your eastern boundary in a 1:100 year storm. Should a 1:100 year storm occur during

construction, when all 50 acres were disturbed and bare of vegetation, the flow would increase to 465 cfs. The peak discharge would be increased by 79 cfs, or 20.4 percent. Occidental is required by federal and local permits to confine earth-moving activities to the periods of the year when precipitation is least likely to occur. Therefore, although possible, the chance of a 1:100 storm occurring during construction is very unlikely.

Such storms could occur after completion of the project and mitigation proposed by Oxy is in place. During this period the 1:100 flow would be reduced to 419 cfs, which is 8.5 percent greater than the preproject 1:100 runoff.

Without conducting actual channel surveys through the Tocher properties it is impossible to determine accurately what the cross sectional area, depth of flow, and lateral extent of the 1:100 flow might be. However, assuming a flood flow rate of 7 feet per second and a trapezoidal channel section having a 15 foot top width and 12.5 foot bottom width, the depth of flow prior to disturbance would be 4 feet. Under worst-case conditions when the flow is 465 cfs, the corresponding depth would be 4.8 feet, or 0.8 of a foot deeper than under normal conditions.

Upon completion of the project after the plant site is paved, the roads chip sealed, and the cut and fill slopes revegetated, the 1:100 flow would be 419 cfs and the corresponding depth 4.36 feet, an increase of 0.36 of a foot.

The flood flow could, and probably would, spread more than increase in depth at flood stages. Whether or not there would be a flood hazard for man-made structures on the Tocher properties depends on their location in relation to Anderson Creek. However, a depth increase of 0.36 to 0.8 a foot or the corresponding lateral spread would not increase the flood hazard appreciably over the preproject 1:100 flood.

CEC STAFF RESPONSES TO PUBLIC COMMENTS
RECEIVED AT 9/16/91 WORKSHOP IN MIDDLETOWN
(Refer to miniature reproductions of 9/16/81 Workshop
Transcripts, Appendix E)

Regarding Seismicity: p. 8, line 10 et seq., through p.14, line 15:

The following response addresses the comments of Mr. White, Mr. Brown, Ms. Sweat, and Ms. Anderson:

The U.S. Geological Survey has 8 seismic stations in and around The Geysers steam field; one station is located within a mile of Anderson Springs. Instruments at the stations are designed to locate and measure earthquakes within the steam field with Richter magnitudes as small as 0.5. They cannot be used to distinguish shaking caused by blasts from that caused by earthquakes.

Microseismic events (those with magnitudes of 3 or less) around a new power plant usually increase significantly within six months of plant start-up. Thus, it is clear that this microseismicity is induced by steam withdrawal and possibly by fluid injection. As the developed area of the steam field expands and as new power plants are added, the number of earthquakes and the area in which they are centered will also grow.

Most microseismic events are imperceptible. Only the most sensitive individuals or sites "feel" events with magnitudes of 2.5 or less. To date about one seismic event (magnitude 3.1 or greater) per year has occurred in the steam field; such events can commonly be felt by local residents. The largest such event to occur in the steam field since establishment of the present seismic network (circa 1970) was magnitude 3.8. The largest to be felt by persons in the Andersons Springs area was an event of magnitude 4.5 located near Mount Konocti and was entirely unrelated to steam field development. Probably a large number of the earthquakes felt by local residents are normal tectonic events centered outside the steam field.

The frequency with which local residents feel induced earthquakes will undoubtedly increase as the steam field is further developed, and a few each year will be disturbing to the most sensitive individuals or at the most exposed locations. However, the felt number of induced earthquakes will probably not exceed the number of felt natural tectonic earthquakes centered outside the steam field. Furthermore shaking strong enough to damage local property will be far more likely to result from a natural tectonic earthquake than from an induced earthquake in the steam field.

P. 17, line 24 - see responses to Craig Tocher (biological and water resources).

P. 22, lines 16-25 and p. 23, lines 1-4, Mr. White

Response: No change in text; see response given in DEIR Hearing, p. 23, lines 8-14 and lines 16-25, and p. 24 all and p. 25, through line 15.

P. 26, line 23 et seq., Mr. Jacobsen

Response: The Applicant will provide the people of Anderson Springs with an emergency water supply in case of geothermal pollution in Gunning Creek.

P. 29, line 8-12, Mr. Brown summarized by Ms. Campbell

Response: As indicated earlier, Oxy will provide an emergency water supply; however, funding for the permanent water supply could be provided from CEC and Lake County AB 1905 funds combined with those provided by Oxy.

P. 31, line 8, Mr. Brown

Response: Oxy will provide an emergency water supply. Specifically, Oxy is working with the Lake County Planning Department, and will participate in an ordinance which will assess proportionate contributions from geothermal developers to provide safeguards to the domestic water supply for Anderson Springs.

P. 33, line 13-16, Ms. Jadiker

Response: Considering the amount of impact expected from the Oxy project, and the extent of on-site and off-site mitigation including Oxy's agreement to provide an emergency water supply, CEC staff feels that adequate mitigation measures are being implemented. We recognize, however, that the ideal mitigation would be to totally enclose the water system so that it cannot be polluted.

P. 34, line 2-4, Ms. Campbell summarizing Ms. Jadiker

Response: See response to question, p. 33, line 13-16. Staff believes that Oxy's mitigation measures will reduce the risks of degradation to domestic water and that the emergency tank system provides an additional safeguard.

P. 35, line 16 and 17, Ms. Campbell summarizing Ms. Jadiker

Response: See attached letter from USGS which clarifies the constraints of the USGS bond. (See attached 9/3/81 USGS letter - Conover to Acting Deputy Conservation Manager, Geothermal.)

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SOLICITOR

3610 CENTRAL AVENUE, SUITE 104
RIVERSIDE, CALIFORNIA 92506
September 3, 1981

SECRET
81-AFC-1
DATE: SEP 3 1981
RECD: OCT 1 1981

Memorandum

To: Acting Deputy Conservation Manager, Geothermal

From: Field Solicitor, Riverside

Subject: Occidental's Bond for Lease CA-5636

Reference is made to your memorandum of July 30, 1981, respecting the use of Geothermal Lease Bonds for the restoration of water quality on stream flows at Anderson Springs an incorporated community which has its source on lands covered by Occidental's lease CA-5636. Geothermal lease compliance bonds and protection bonds are provided for in 43 CFR subpart 3206. Lease compliance bonds are for the purpose of guaranteeing compliance by the lessee or operator with all the terms of the lease. There are some specific lease terms pertaining to water pollution. These are contained in the following regulations 43 CFR subpart 3204.1 (c) (2) as 30 CFR §270.30, §270.41, and §270.44.

If lease operations on the lease hold causes a deterioration in water quality of any of the head waters of the stream which is located on the premises that could constitute non-compliance with the foregoing provisions, and there is a default on the part of the lessee on operator to regain compliance, the lease bonds may be called upon to assist in securing such compliance. In this respect you have asked the following questions to which we offer the following responses:

1) What is the "trigger" mechanism to use the bond for water quality "repairs"?

The trigger mechanism is the lessee's failure or default upon demand to make water quality repairs, or to otherwise bring the situation into compliance with the lease terms and regulations.

2) Can the bond be used for down-stream repairs or only repairs within the leasehold boundaries?

It can be so used if that is where it is needed, but it would seem that the repairs would have to be made at the source of the trouble which by definition would be within the leasehold boundaries.

3) Would the full dollar value of their bond(s) be accessible in the case of a water-quality incident caused by Occidental?

Yes, but the face amount of the bond is reduced by that amount, and must be reestablished by the lessee to the minimum limits as prescribed in the regulations 43 CFR §3206.7-2.

4) How long does it take to actually have the money in-hand to remedy a problem?

I don't know. It depends on the surety or bonding company involved.

ROBERT D. CONOVER
Field Solicitor

RECEIVED

SEP 9 1981

OFFICE OF DEV. GEOTHERMAL
CONSERVATION DIVISION
U.S. GEOLOGICAL SURVEY
MENLO PARK, CALIFORNIA

P. 36, lines 4-5, Mr. Malfonte

Response: In the staff's opinion, Oxy has agreed to provide all reasonable mitigation measures. Should they fail to provide these measures, CEC's Compliance Unit can actually shut down their power plant.

P. 39, lines 15-20, Ms. Lang

Response: Geothermal developers on Federal lands (like the Oxy leasehold) pay money into the AB 1905 fund. The purpose of this fund, in part, is to mitigate the impacts of geothermal development on the local environment.

P. 41, lines 21-25, Ms. Sweat and p. 42, lines 1-11

Response: The comment is essentially that there has been a lot of talk and no action. Staff is satisfied that Oxy's mitigation measures, including the emergency water supply, will actually occur.

P. 46, line 7-10, Mr. Tocher

Response: See Figure 1 from Brown & Caldwell Scope of Work for Water Quality Baseline Monitoring for location of monitoring stations in Final EIR.

P. 48, lines 11-23, Ms. Jadiker

Response: While it is cumbersome to place copies of all applicable permits into the Final EIR, these documents are available upon request from the originating agencies. Key documents are as follows:

- o California Regional Water Quality Control Board Central Valley Region - Order No. 81-103 - Waste Discharge Requirements for the County of Lake and Aminoil, USA Socrates Mine Road Project - Lake County, Amended 9/25/81
- o California Regional Water Quality Control Board Central Valley Region - Monitoring and Reporting Program No. 79-228 for Occidental Geothermal, Inc. and U.S. Bureau of Land Management - USA Lease CA-5637 - Lake County, Revised 9/4/81
- o Memo to the Acting Deputy Conservation Manager, Geothermal from Robert D. Conover, Field Solicitor, Riverside, USGS. Subject: Occidental's Bond for Lease CA-5636, dated September 3, 1981
- o U.S. Department of the Interior, Bureau of Land Management - Geothermal Resources Lease, Competitive - Conversion Right. Serial Number CA-5636. USGS-KGRA Determination: The Geysers-Calistoga, Parcel #5, dated 1/16/79.

- o U.S. Department of the Interior, Bureau of Land Management - Assignment Affecting Record Title to Geothermal Resources Lease Part I. Serial No. CA-5636. The Geysers - Calistoga, Parcel No. 5, dated February 21, 1979.
- o U.S. Department of the Interior, Bureau of Land Management, Geothermal Resources Lease, Competitive. Serial Number CA-5637. USGS-KGRA Determination: The Geysers - Calistoga, Parcel #6, dated 1/16/79.
- o U.S. Department of the Interior, Geological Survey letter from Reid T. Stone, Area Geothermal Supervisor to Occidental Geothermal, Inc. regarding: Plan of Operation, CA-5637, Geysers-Calistoga KGRA, Lake and Sonoma Counties, CA., dated July 15, 1979.
- o U.S. Department of the Interior, Geological Survey letter from William F. Isherwood, Acting Deputy Conservation Manager, Geothermal to Occidental Geothermal, Inc., Attention Gale Simmons regarding: Special Conditions of Approval in accordance with USGS Environmental Assessment (EA) #131-81, dated January 9, 1981.
- o U.S. Department of the Interior, Geological Survey letter from William F. Isherwood, Acting Deputy Conservation Manager, Geothermal to Occidental Geothermal, Inc. regarding: Special Conditions of Approval in accordance with USGS Environmental Assessment (EA) #149-80, dated September 5, 1980.
- o U.S. Department of the Interior, Geological Survey letter from William F. Isherwood, Acting Deputy Conservation Manager, Geothermal to Occidental Geothermal, Inc., Attention Gale Simmons regarding: Special Conditions of Approval in accordance with the USGS Environmental Assessment EA 174-81, dated July 14, 1981.
- o U.S. Department of the Interior, Bureau of Land Management Decision and Details of Grant. Serial Number CA-9228, dated March 26, 1981.
- o California Regional Water Quality Control Board Central Valley Region - Monitoring and Reporting Program No. 79-228 for Occidental Geothermal, Inc. and U.S. Bureau of Land Management, USA Lease CA-5637, Lake County - Notification, dated September 22, 1981.
- o County of Lake Use Permit, Occidental Geothermal Site "D" signed by Irene L. Brown, Secretary for George R. Volker, Planning Director, dated October 16, 1980.
- o Lake County Planning Commission Use Permit, Occidental Geothermal, Inc. Drill Site "A", Federal Lease CA-5637 signed by Irene L. Brown, Secretary for George R. Volker, Planning Director, dated February 8, 1980
- o County of Lake Use Permit, Occidental Geothermal Site "B", #UP 80-25 signed by Irene L. Brown, Secretary for George R. Volker, Planning Director, dated January 19, 1981; with Use Permit Modification to #UP 80-11, by John A. Thayer, Jr., Planning Director.
- o AGREEMENT between County of Lake and Occidental Geothermal, Inc. No. UP 80-11, signed by Chairman, Board of Supervisors, Lake County, and Deputy County Counsel for Occidental, dated April 13, 1981

Also, see Ed Crawford's remarks, pages 49-51, and Zene Bohrer's and Tom Hamilton's, pages 51-66, ending line 11.

P. 56, line 9 et seq., Ms. Jadiker

Response: See subsequent comments by CEC staff in transcript text.

P. 59, lines 23 et seq., Bob Reynolds, refer to Transcript p. 61, lines 2-25, and p. 62, lines 1-3.

Response: Comment identical to #1 of Bob Reynolds's Written Comments. Comments accepted, text amended.

P. 62, lines 4-25, and TR p. 63, lines 1-10; Bob Reynolds, LCAPCD

Response: Comment identical to #2 of Bob Reynolds's Written Comments. See response to LCAPCD, comment #2.

P. 63, lines 11-18; Bob Reynolds, LCAPCD

Response: Comment identical to #10 of Bob Reynolds's Written Comments. Comment accepted, text amended.

P. 63, lines 10-25; Bob Reynolds, LCAPCD

Response: Comment accepted, the DOC conditions and the Joint Findings and Conclusions will be appended to the Final EIR.

P. 66, lines 4-25; Bob Reynolds, LCAPCD

Response: See response to TR, pgs. 61 and 62.

P. 70, lines 22-25, and TR p. 71, lines 1-6; Bob Reynolds, LCAPCD

Response: Comments identical to #20, #22, #23, #24, and #25 of Bob Reynolds's Written Comments. Comments accepted, text amended.

P. 70, lines 14 & 15, Ms. Campbell summarizing Ms. Sweat

Response: CEC staff recognizes that there may be some attendant loss in the rural life style which accompanies geothermal development; however, it is difficult to quantify this sort of loss, and so it is difficult to recommend appropriate mitigation measures.

Staff has recommended, for instance, that Oxy paint the power plant facilities to blend as much as possible into the natural landscape. With respect to water quality, CEC staff and CVRWQCB staff recommend careful monitoring of Anderson Creek. With respect to Gunning Creek,

CEC staff has worked closely with Lake County planning staff to include all geothermal developers on Gunning Creek within a local ordinance which will levy equitable assessment on all geothermal developers within this sensitive drainage in order to protect the domestic water supply. We truly hope that our regulatory governmental efforts will aid in accomplishing expeditious geothermal development in a manner which is sensitive to the environment and to the local residents.

P. 71, lines 8-25, and Transcript p. 72, lines 1-10; Bob Reynolds, LCAPCD

Response: Comments identical to #35 of Bob Reynolds's Written Comments. Comment accepted, text amended.

P. 78, lines 8-16; Bob Reynolds, LCAPCD

Response: Comment accepted, the Joint Noise Findings and Conclusions will be appended to the Final EIR.

P. 78, lines 18-25; Mr. Hinds, Mr. Tocher, and Mr. Bohrer

Response: The Final EIR has been amended to include an analysis of the potential impact to the Tocher cabin.

P. 81, lines 1-8; Bob Reynolds, LCAPCD

Response: Comment accepted, text amended.

P. 84, Jadiker, line 5 -- EIR revised to reflect increased trucks.

P. 85, Jadiker, line 1 -- EIR revised to more clearly address peaks and actual traffic.

P. 85, lines 14-18; wanted to know the injection well depth of casings to prevent ground water pollution

Response: P. 85. The depth of the casings depends on the depth of the ground water and the location of the well. The Division of Oil and Gas will review Oxy's proposed injection well and determine the appropriate requirements to make pursuant to Section 3714 of the Public Resources Code.

P. 85, lines 14-18; wanted to know the injection well depth of casings to prevent ground water pollution.

Response: P. 85. The depth of the casings depends on the depth of the ground water and the location of the well. The Division of Oil and Gas will review Oxy's proposed injection well and determine the appropriate requirements to make pursuant to Section 3714 of the Public Resources Code.

P. 87, Cornelison, line 5 -- EIR revised to incorporate Oxy agreement to schedule project traffic around school traffic to the extent feasible.

Pp. 89-92, Various speakers -- EIR revised in light of recent information to reflect potential heavy traffic concerns. See Final EIR, Transportation Figures 3 & 4 and accompanying explanations.

P. 95. Comments from Mr. Cornielson and Ms. Jadiker regarding mitigation and use of AB 1905 funds.

Response: This issue is addressed in response #1 to the Lake County Office of Education.

P. 97. Comments from Ms. Jadiker regarding fiscal impacts and Proposition 4.

Response: The following discussion will be instituted into the text on p. 213, second paragraph. Proposition 4, passed by the voters in 1979, limits government appropriation on the basis of changes in population and the cost of living. With a rapid expansion of geothermal development, which could generate significant new property taxes, a county might exceed its spending limit imposed by Proposition 4 if the cost of living and population growth were minimal during a given year. Thus, a county might be placed in the position of not being able to use a certain portion of the tax revenues generated by geothermal development. Since these limits are tied to the county's population growth and the cost of living, estimates of the impact of the proposed power plant, when it comes on line, concerning the county's appropriations are difficult to make. Without undertaking a complete tax revenue and government costs study, the cumulative effect of geothermal development due to Proposition 4's limitation are not known.

P. 98. Comment concerning economic impact on community from water quality degradation.

Response: Economic impact is mentioned under public services on p. 212 of the Draft EIR.

P. 99. Comment concerning loss in real estate values due to degradation of water supply.

Response: Staff feels a change in real estate values due to aesthetic impacts is subject to too many variables to attempt to quantify such a loss. Staff will amend DEIR page 164, third paragraph, adding a last sentence as follows:

Aesthetic impacts may decrease the real estate market for some properties in Anderson Springs.

P. 101. Comment concerning impacts to recreational facilities.

Discussion under public services identifies an increased demand for services from increased population. Recreational facilities will receive increased use due to all growth, including that attributable to geothermal development. Staff believes this is the type of indirect effect intended for mitigation through the AB 1905 process.

P. 102. Comments concerning land use conflicts and land use maps.

Response: These issues are addressed in Response #1 to the County of Lake Planning Department.

P. 113. Comment concerning increased demand for post office boxes.

Response: Neither the Applicant nor the CEC has control over where workers locate. However, the staff will supply local postal authorities with estimates of cumulative development and a schedule thereof to assist them in planning for the demand for post office boxes.

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