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**SOUTHEAST REGIONAL WASTEWATER
TREATMENT PLANT FACILITIES
IMPROVEMENTS PROJECT AND
GEYSERS EFFLUENT PIPELINE PROJECT
Draft EIR / EIS**

Volume 1 of 2

SCH EIR/EIS No. 86-021101

May 26, 1994

Prepared for:
Lake County Sanitation District and
U.S. Bureau of Land Management





COUNTY OF LAKE

SPECIAL DISTRICTS ADMINISTRATION

Courthouse - 255 N. Forbes Street
Lakeport, California 95453
Telephone 707/263-2273
Fax 707/263-3836

STEVE BRODNANSKY

NOTICE OF COMPLETION/REQUEST FOR REVIEW

DATE: May 25, 1994

FROM: Mark Dellinger, Lake County Sanitation District (LACOSAN)

A handwritten signature in dark ink, appearing to read "Mark Dellinger", is written over the printed name.

RE: EIR/EIS for Facilities Improvements and Wastewater disposal Methods for the Southeast Regional Treatment Plant

ATTACHMENT: Draft Environmental Impact Report (DEIR), Draft Environmental Impact Statement (DEIS)

REQUEST FOR REVIEW

Please review the adequacy of the attached Draft Environmental Impact Report (DEIR)/Draft Environmental Impact Statement (DEIS) and provide comments germane to your area(s) of expertise, regulatory involvement or concerns. Due to a Cease and Desist Order placed on LACOSAN for the operation of its Southeast Regional Treatment Plant, your comments should be provided at your earliest convenience, but we ask that they be returned by July 14, 1994.

The DEIR/DEIS has been prepared pursuant to the California Environmental Quality Act and the National Environmental Policy Act. A brief project description is included with this Notice of Completion and the DEIR/DEIS.

The scope of the DEIR/DEIS was based on an Initial Study conducted by the Lake County Planning Department and US BLM, on comments received in response to the Notice of Preparation/Notice of Intent and in response to local concerns expressed by the public at several public scoping meetings.

Please submit comments on the adequacy of the investigations conducted, the feasibility of suggested mitigation measures and additional mitigation deemed appropriate.

It is the goal of LACOSAN and BLM to utilize the EIR/EIS process for problem solving. Your cooperation and assistance are appreciated.

An executive summary is included with the DEIR/DEIS along with a separate sheet for your written comments. Please send all comments to:

Mark Dellinger

Lake County Sanitation District
255 North Forbes Street
Lakeport, CA. 95453

OR

Rich Estabrook

U.S. Bureau of Land Management
2550 North State Street
Ukiah, CA. 95482

PUBLIC HEARINGS

Public hearings will be held by the Lake County Planning Commission on the DEIR/DEIS on Thursday June 30, 1994 and Thursday, July 14, 1994, in the Board of Supervisors chambers, 255 N. Forbes Street, Lakeport, CA.

BACKGROUND: The primary focus of this environmental analysis is on improvements to the Southeast Regional Wastewater Treatment Plant (SRWTP) facilities and disposal to the Geysers for injection. This analysis will be incorporated with an earlier EIR which evaluated system improvements to the SRWTP and twelve disposal alternatives. In July 1993, the Lake County Sanitation District Board of Directors (LACOSAN) selected the Geysers Effluent Pipeline as the preferred alternative to be analyzed in this EIR/EIS.

A previously prepared Facilities Plan, Draft EIR and EIR Addendum (State Clearinghouse #86-021102) have been prepared for the SRWTP and included treatment improvements and an analysis of 12 different options for the disposal of treated effluent from that facility. A Geysers disposal alternative was briefly analyzed in that document. At that time the preferred disposal alternative was to Cache Creek. Since early 1993, the analysis of the Geysers Pipeline alternative has received detailed environmental review. This DEIR/DEIS now contains a complete analysis of 11 different alternatives for disposal of treated wastewater. The previously prepared environment documents have been incorporated into this DEIR/DEIS.

PROJECT DESCRIPTION: This environmental analysis will primarily focus on improvements to the SRWTP facilities and a 24" pipeline designed to carry up to 5,400 gallons per minute of secondarily treated wastewater. The wastewater will be transported from the Lake County Sanitation District's Southeast Regional Wastewater Treatment Plant, Middletown Wastewater Treatment Plant with additional make-up water from Clear Lake to the Southeast portion of the Geysers Geothermal Field in Lake and Sonoma Counties, California. A consortium of the Northern California Power Agency (NCPA) and three private geothermal companies (Calpine Corporation, Unocal Geothermal Division and the Pacific Gas & Electricity Company (PG&E) are participants in the project with LACOSAN. A 26 mile pipeline would be constructed and operated by

(Project Description - continued)

LACOSAN while the distribution piping and injection operations would be the responsibility of NCPA, Unocal and Calpine. There are two purposes for this project: LACOSAN would use this as a wastewater disposal method and, the geothermal industry participants would use the treated effluent as a means of geothermal reservoir enhancement and to reduce steam pressure decline.

The approximately 26 mile long pipeline would begin at the Southeast Regional Wastewater Treatment Plant north of the city of Clearlake and end in the southeast portion of the Geysers Geothermal field, between PG&E's Unit 13, NCPA's power plants in southern Lake County and the Unit 18 and 20 steamfields in Sonoma County. The project would also include a water intake and piping from Clear Lake to the SRWTP treated effluent reservoir. Steel tanks would be located near Childers Peak and Northern California Power Agency's power plants in the Geysers to be used for balancing pressure and volume of the effluent. The pipeline would also be connected to the Middletown Wastewater Treatment Plant and will receive effluent from this LACOSAN operated facility. Most of the main pipeline would be buried, although portions would be above ground, especially pumping and regulating stations. Electrical supply to the pumping stations would be brought in through tap lines from existing transmission lines. In the Geysers steamfield, significant portions of the main pipeline and all of the distribution system would be above ground. Much of the distribution system piping and all of the injection wells are already in existence.

Treated effluent would come from the City of Clearlake and surrounding areas, the Community of Lower Lake, and the Community of Middletown. In the early years of operation, more make-up water would come from Clear Lake. As the volume of effluent increases in the pipeline, the volume of lake water would decrease.

In the Geysers, several leaseholds and power plants would be involved. Treated effluent would be distributed to about 12 injection wells located in NCPA's leasehold and Calpine's leaseholds which supply steam to PG&E Units 13 and 16, and 4 injection wells on Unocal's leaseholds which supply steam to P.G.&E. Units 18 and 20.

NOTICE OF COMPLETION/NOTICE OF AVAILABILITY

DRAFT EIR/EIS
State of California
Office of Planning and Research
1400 Tenth Street
Sacramento, CA. 95814

Project Title: Southeast Regional Wastewater Treatment Plant Improvements and Geysers Effluent Pipeline Project.

Project Location - Specific: North of and adjacent to the City of Clearlake, approximately 1/2 mile west of Hwy 53 and 1 1/2 miles south of Hwy. 20; pipeline runs south to Middletown and into the Geysers steam field.

Project Location - City: Clearlake

Project Location - County: Lake

Description of Nature Purpose and Beneficiaries of Project.

The proposed project consists of improvements to the Southeast Regional wastewater Treatment Plant (SERWTP) treatment facilities, Clear Lake make up water pipeline, connection of a Middletown Treatment Plant to disposal system, and disposal to the Geysers Geothermal Field through a 26 mile, 24 inch diameter effluent pipeline. The current system serves the City of Clearlake and the unincorporated adjacent areas as well as the community of Lower Lake. The new pipeline would run south through the City of Clearlake and community of Lower Lake, south to Middletown, with disposal to the Southeast Geysers steamfield.

The primary purpose of the proposed project is to resolve treatment and disposal deficiencies and provide additional capacity of the SERWTP, bring the SERWS into compliance with California Regional Water Quality Control Board (CRWQCB) Waste Discharge Requirements (WDRs), enable the lifting of the 1991 CRWQCB Cease and Desist Order with associated building moratorium, and provide additional capacity for planned service area growth beyond the year 2000.

Lead Agency: Lake County Sanitation District

Division: Special Districts
Administration

Public Hearing Dates: June 30, 1994 9:05 A.M. and July 14, 1994 9:05 A.M. - Board of Supervisors Chambers, Lakeport.

Address Where Copy of EIR is Available:

Lake County Special Districts Administration
230 A Main Street
Lakeport, CA. 95453

Review Period: 45 days but no later than July 14, 1994

Contact Person:

Area Code/Phone Extension

Mark Dellinger (LACOSAN)
Rich Estabrook (BLM)

(707) 263-2273
(707) 468-4000

Other Locations Where EIR/EIS May Be Reviewed.

Lake County Planning Department - 255 N. Forbes Street, 3rd floor, Courthouse,
Lakeport

Lakeport Public Library - 1425 N. High Street, Lakeport

Redbud Public Library - 4700 Golf Ave., Clearlake

City of Clearlake Offices - 14360 Lakeshore Dr., Clearlake

Lower Lake Water District - 16175 Main Street, Lower Lake

South Lake Fire Station - 21095 State Hwy 175, Middletown

Sonoma County Public Library - 3rd and "E" Streets, Santa Rosa

Sonoma County Planning Department - 575 Administration Drive, Room 105A, Santa
Rosa

Sonoma County Board of Supervisors Office - 575 Administration Drive, Room 104A,
Santa Rosa

U.S. Bureau of Land Management - 2550 N. State Street, Ukiah.

Yolo County Flood Control and Water Conservation District - 34274 State Hwy 16,
Woodland.

RESPONSE TO REQUEST FOR REVIEW

Lake County Sanitation District

Southeast Regional Wastewater Treatment Plant Improvements and Geysers Effluent Pipeline Project

IS 94-9

FROM: _____

COMMENTS: _____

RETURN TO: Lake County Sanitation District
ATTN: Mark Dellinger
255 N. Forbes Street OR
Lakeport, Ca. 95453

**Rich Estabrook
U.S. Bureau of Land
Management
2550 North State Street
Ukiah, CA. 95482**

Response Date: _____

Signature: _____

NOTICE OF COMPLETION AND ENVIRONMENTAL DOCUMENT TRANSMITTAL FORM

SCH # 86-021102

1. Project Title: Southeast Regional Wastewater Treatment Plant Facilities Improvements & Geysers Effluent Pipeline Project

2. Lead Agency: Lake County Sanitation District

3. Contact Person: Mark Dellinger

3a. Street Address: 255 North Forbes Street

3b. City: Lakeport

3c. County: Lake

3d. Zip: 95453

3e. Phone: (707) 263-2273

PROJECT LOCATION 4. County: Lake

4a. City/Community: Clearlake, Lower Lake, Middletown

4b. Assessor's Parcel No. various

4c. Section

Twp.

Range

5a. Cross Streets: various- see location maps

For Rural, Nearest

5b. Community: Lower Lake, Middletown

6. Within 2 miles: a. State Hwy # 53, 29, 175

b. Air-ports pierce

c. Rail-ways

d. Water-ways Clear Lake, Putah Creek

7. DOCUMENT TYPE

CEQA

01. ___ NDP

06. ___ NDE

02. ___ Early Cons

07. ___ NDC

03. ___ Neg Dec

08. ___ NDD

04. ___ X Draft EIR

05. ___ Supplement/
Subsequent EIR
(Prior SCH No.:

86-021102)

NEPA

09. ___ NEI

11. ___ X Draft
EIS

10. ___ FONSI

12. ___ EA

OTHER

13. ___ X Joint Document

14. ___ Final Document

15. ___ Other

8. LOCAL ACTION TYPE

01. ___ General Plan Update

02. ___ New Element

03. ___ General Plan Amendment

04. ___ Master Plan

05. ___ Annexation

06. ___ Specific Plan

07. ___ Community Plan

08. ___ Redevelopment

09. ___ Rezoning

10. ___ Land Division
(Subdivision, Parcel
Map, Tract Map, etc.)

11. ___ Use Permit

12. ___ Waste Mgmt Plan

13. ___ Cancel Ag Preserve

14. ___ X Other mitigation monitoring plan

9. DEVELOPMENT TYPE

01. ___ Residential: Units Acres

02. ___ Office: Sq. Ft. Acres Employees

03. ___ Shopping/Commercial: Sq. Ft. Acres Employees

04. ___ Industrial: Sq. Ft. Acres Employees

05. ___ Water Facilities: MGD

06. ___ Transportation: Type

07. ___ Mining: Mineral

08. ___ Power: Type Watts

09. ___ X Waste Treatment: Type secondary

10. ___ OCS Related

11. ___ Other:

10. TOTAL ACRES: 25-30

11. TOTAL JOBS CREATED: approximately 100

12. PROJECT ISSUES DISCUSSED IN DOCUMENT

01. ___ X Aesthetic/Visual

02. ___ X Agricultural Land

03. ___ X Air Quality

04. ___ X Archaeological/Historical

05. ___ Coastal Zone

06. ___ X Economic

07. ___ X Fire Hazard

08. ___ X Flooding/Drainage

09. ___ X Geologic/Seismic

10. ___ X Job/Housing Balance

11. ___ X Minerals

12. ___ X Noise

13. ___ X Public Services

14. ___ X Schools

15. ___ X Septic Systems

16. ___ X Sewer Capacity

17. ___ X Social

18. ___ X Soil Erosion

19. ___ X Solid Waste

20. ___ X Toxic/Hazardous

21. ___ X Traffic/Circulation

22. ___ X Vegetation

23. ___ X Water Quality

24. ___ Water Supply

25. ___ X Wetland/Riparian

26. ___ X Wildlife

27. ___ X Growth Inducing

28. ___ X Incompatible Landuse

29. ___ X Cumulative Effects

30. ___ X Other energy recovery, wastewater reclamation

13. FUNDING (approx) Federal \$ 10,000,000 State \$ 1-2 mil. grant Total \$ 39,000,000

14. PRESENT LAND USE AND ZONING: industry: \$20,000,000 \$ 5-8 mil. loan

various; see EIR/EIS

15. PROJECT DESCRIPTION: This environmental analysis will focus on improvements to the SRWTP facilities and a 24" diameter pipeline designed to carry up to 5,400 gallons per minute of secondarily treated wastewater. The wastewater will be transported from the Lake County Sanitation District's Southeast Regional Wastewater Treatment Plant with additional make-up water from Clear Lake to the southeast portion of the Geysers geothermal field in Lake and Sonoma Counties.

16. SIGNATURE OF LEAD AGENCY REPRESENTATIVE:

Mark Dellinger

DATE: 5/25/94

NOTE: Clearinghouse will assign identification numbers for all new projects. If a SCH number already exists for a project (e.g. from a Notice of Preparation or previous draft document) please fill it in.

**SOUTHEAST REGIONAL WASTEWATER
TREATMENT PLANT FACILITIES
IMPROVEMENTS PROJECT AND
GEYSERS EFFLUENT PIPELINE PROJECT
Draft EIR / EIS**

Volume 1 of 2

SCH EIR/EIS No. 86-021101

May 26, 1994

Prepared for:
Lake County Sanitation District and
U.S. Bureau of Land Management

**Environmental
Science
Associates, Inc.**

301 Brannan St.
Suite 200
San Francisco, California
94107-1811
(415) 896-5900

Also offices in

Los Angeles

Sacramento

920386



**SOUTHEAST REGIONAL WASTEWATER TREATMENT
PLANT FACILITIES IMPROVEMENTS PROJECT AND
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ACRONYMS AND ABBREVIATIONS USED IN THIS EIR/EIS

AB	California Assembly Bill
af	acre-foot or acre-feet
af/mo	acre-feet per month
af/yr	acre-feet per year
ARB	California Air Resources Board
ARMP	Aquatic Resources Monitoring Program
ATC	Authority to Construct
BACT	best available control technology
BC-1, 2, etc.	Bear Canyon Pump Station No. 1, No. 2, etc.
BLM	U.S. Bureau of Land Management
BMPs	best management practices
Btu	British thermal unit
C	centigrade or Celsius
Cal/OSHA	California Occupational Safety and Health Administration
Calpine	Calpine Corporation, Inc.
Caltrans	California Department of Transportation
CCR	California Code of Regulations
CDFG	California Department of Fish and Game
CDOG&GR	California Division of Oil and Gas and Geothermal Resources
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CLOC	Clear Lake Outlet Channel
CLOCWD	Clearlake Oaks County Water District
cm/yr	centimeters per year
COD	chemical oxygen demand
COE	U.S. Army Corps of Engineers
CRWQCB	California Regional Water Quality Control Board
CVRWQCB	Central Valley Regional Water Quality Control Board
cy	cubic yards
dBA	A-weighted Decibel
DCS	distributed control system
D.O.	dissolved oxygen
DOHS	California Department of Health Services
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Environmental Science Associates, Inc.
F	Fahrenheit
FESA	Federal Endangered Species Act

Acronyms and Abbreviations Used in This EIR/EIS

FLPMA	Federal Land Policy and Management Act
ft	feet
GAMP	Geysers Air Monitoring Program
G&GE	Goddard & Goddard Engineering
GGF	Geysers Geothermal Field
gpm	gallons per minute
HC	hydrocarbons
HDPE	high density polyethylene
hp or HP	horsepower
IDS	injection-derived steam
I/I	inflow and infiltration
ISWP	Inland Surface Waters Plan
KGRA	known geothermal resource area
kv	kilo-volt
LACOSAN	Lake County Sanitation District
lb/hr	pounds per hour
LCAQMD	Lake County Air Quality Management District
Ldn	day-night average noise level
Leq	equivalent steady state sound level
LPA	low pressure area
m	meter
m³	cubic meters
m³/yr	cubic meters per year
MACT	maximum achievable control technology
Mc	Magnitude (coda-length)
MDL	Method Detection Limit
mgd	million gallons per day
mg	milligram
mg/kg	milligrams per kilogram
mg/l	milligrams per liter
mg-N/L	milligrams Nitrogen per liter
mg-P/L	milligrams Phosphate per liter
M1	local or Richter Magnitude
mm/yr	millimeter per year
MPN	Most Probable Number
msl	mean sea level datum
MW	mega-Watt
MWh	mega-Watt hour
MWTP	Middletown Wastewater Treatment Plant
m.y.	million years
N/A	not applicable or not available
NAAQS	national ambient air quality standard
NCG	non-condensable gases
NCPA	Northern California Power Agency
NCRWQCB	North Coast Regional Water Quality Control Board
NEPA	National Environmental Policy Act
ng/L	nanograms per liter
NPDES	National Pollutant Discharge Elimination System

Acronyms and Abbreviations Used in This EIR/EIS

NSCAPCD	Northern Sonoma County Air Pollution Control District
NTU	nephelometric turbidity unit
OSHA	federal Occupational Safety and Health Administration
PGA	peak ground acceleration
PG&E	Pacific Gas and Electric Company
pH	hydrogen ion concentration
PM10	suspended particulate matter
POTW	publicly owned treatment works
ppm	parts per million
ppm-wt	parts per million by weight
P.S.	pump station
psi	pounds per square inch
psia	pounds per square inch, absolute pressure
psig	pounds per square inch, gauge pressure
PTO	permit to operate
PURPA	Public Utility Regulatory Policy Act
PVC	poly-vinyl chloride
RDA	U.S. Department of Agriculture, Rural Development Administration
ROW	right of way
rpm	revolutions per minute
RTU	remote telemetry unit
SCS	U.S. Soil Conservation Service
SERWS	Southeast Regional Wastewater System
SERWTP	Southeast Regional Wastewater Treatment Plant
SHPO	State Historic Preservation Officer
SR	State Route
SWRCB	State Water Resources Control Board
TDH	total dynamic head
TDS	total dissolved solids
TIE	toxicity identification evaluation
TIN	total inorganic nitrogen
TRE	toxicity reduction evaluation
UIC	underground injection control
umho/cm	micromohs per centimeter
USC	United States Code
USDW	underground source of drinking water
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VMT	vehicle miles traveled
VRM	visual resource management
WET	waste extraction test
YCFCWCD	Yolo County Flood Control and Water Conservation District
yr	year
µg/l	micrograms per liter

ORGANIZATION OF THE EIR/EIS

This document is both an Environmental Impact Report (EIR) and an Environmental Impact Statement (EIS). The document combines the environmental analysis and reporting requirements for an EIR pursuant to the California Environmental Quality Act (CEQA) and for an EIS pursuant to the National Environmental Policy Act (NEPA). The state and federal statutes (CEQA and NEPA, respectively) requiring environmental impact evaluation of projects are similar in concept and intent, but the formats and approaches differ somewhat in nature. However, both the state and federal statutes encourage reducing of paperwork and recommend the combining the environmental reviews under CEQA and NEPA, with a single report that meets the information requirements of both statutes. Therefore, this combined document is called an EIR/EIS. Its format is designed to meet the guidelines for both (1) EIRs, as recommended by the State CEQA Guidelines (14 California Administrative Code Section 1500 *et seq*) and the County of Lake and, (2) EISs, as recommended by the Council on Environmental Quality (40 CFR 1500-1508) and the U.S. Bureau of Land Management.

The EIR/EIS contains twelve chapters as follows.

1. **Introduction and Summary.** This is an abbreviated version of the report that follows. It describes the primary elements of the project as proposed, without the detail presented in Chapter 2 of the main body of the EIR/EIS. It also describes the two alternatives to the project. The summary provides an overview of the significant impacts of the proposed project and alternatives. Mitigation measures that could eliminate or reduce the significant impacts are presented in table format. This chapter also identifies the responsible parties for the project and indicates how citizens may provide input into the planning process for the project.
2. **Description of the Proposed Project.** This chapter presents a detailed description of all aspects of the project that could result in impacts on the environment. It specifically identifies why the project is being proposed at this time and summarizes the history of actions that have led to this proposed project. A detailed description of the location of all proposed new facilities or changes to existing facilities is presented in this chapter. Because of the complexity of the project, the various facilities and actions are broken out into three major components: (1) the proposed Southeast Geysers Effluent Pipeline Project Component, including all related facilities, operations, construction and abandonment; (2) the proposed Southeast Geysers Effluent Injection Program Plan Component, including a description of all activities involved with deep injection of treated wastewater into the Geysers geothermal field; and (3) the proposed Southeast Regional Wastewater Treatment Plant Facilities Plan Component, including new and altered

facilities and operations at the existing plant near Clearlake. The description for each of these components includes information for each of three phases: (a) construction, (b) operations for the design life and (c) abandonment or reuse of facilities after the design life.

Chapter 2 also presents summary information about the project's economics and financing. While not specifically an environmental issue, this information is presented because of the questions about cost and financing of the project raised during the public scoping process.

3. **Description of Alternatives to the Project.** This chapter describes the No Action Alternative, that is, the conditions which would result if the proposed project were not constructed. The Project Design Alternative also is described. It includes a description of a somewhat different engineering plan for the project facilities and operations from those included as part of the proposed project. It also includes some minor pipeline route alternatives.
4. **Affected Environment.** This chapter is divided by individual topic of investigation. Each section presents a description of the existing environmental and socio-economic conditions of the project site in 1993. Because of the complexity of the project, the discussion of affected environment (as well as environmental impacts and mitigation measures in Chapter 5) is divided into the four major components of the project. Applicable issue areas are presented for each component.
5. **Environmental Consequences and Mitigation Measures of the Project.** This chapter is divided by individual topic of investigation. It indicates, first, the specific criteria applied to determine whether an impact is significant or not significant. Next, the impacts of the project on the affected environment are presented, with a determination of the level of significance. Each statement of an impact is presented in boldface type and is followed with a discussion of the nature impact. If the impact is significant, the discussion is followed by a specific mitigation measure(s) which identifies how the impact could be eliminated or reduced to a less-than-significant level. Residual impacts, that is, the nature or level of impact that would remain after mitigation measures were applied, are also presented. Impacts are numbered consecutively within each section. Related mitigation measures have the same number as the impact, and followed by an alpha identification (A, B, C, etc.).
6. **Environmental Consequences and Mitigation Measures of the Alternatives to the Project.** This chapter is similar to Chapter 5 in concept and organization. The existing environmental conditions, impacts and mitigation measures of the alternatives are presented in similar format to those of the proposed project.
7. **Impact Overview.** Chapter 7 presents information on four issues that are required to be specifically addressed in an EIR/EIS. These are:
 - 1) Unavoidable significant impacts of the proposed project. The section identifies all impacts which are both significant and which cannot be avoided or reduced in level of significance through implementation of mitigation measures. These impacts are also identified in Chapter 5, but are all presented together in Chapter 7.

- 2) Growth-inducing impacts. This section describes how the proposed project could result in, or be the impetus for, population growth and new development in the area of the affected environment.
 - 3) The relationship between local short term uses of the environment and the maintenance and enhancement of long term productivity and the irreversible commitment of resources. This section discusses whether the project would result in, or be the impetus for, the use and/or loss of resources which otherwise would be available for use indefinitely.
 - 4) Cumulative impact. This section describes how the proposed project may contribute to environmental impacts from other reasonably foreseeable future actions occurring in the area of the affected environment during project construction.
8. **EIR/EIS Scoping and Issues Identification; EIR/EIS Distribution List.**
- 1) Scoping and Issues Identification. This section summarizes the results of the scoping process for this EIR/EIS. The key issues raised by the public and agencies during scoping are identified. These issues are presented and discussed in the impact sections of the EIR/EIS.
 - 2) Agencies, Organizations and Individuals Receiving Copies of the Draft EIR/EIS. This is a list of agencies receiving the document.
9. **Consultation and Coordination.** This chapter presents information about various procedural aspects of the environmental review process for the project.
- 1) Cooperating Agencies. This section identifies all federal, state and local agencies which may be involved with permitting and formal environmental review of the project.
 - 2) Consultation Requirements. This section identifies all formal consultations with federal agencies that the lead agency must carry out in order to construct the project. It identifies the specific public law requiring formal consultation.
10. **EIR/EIS Authors and Persons Consulted.** This chapter is a list of individuals who prepared this EIR/EIS. Individuals consulted during preparation of the EIR/EIS are also identified.
11. **References Cited.**
12. **Glossary.** This chapter presents in alphabetical order technical terms that are used in the body of the EIR/EIS. A brief definition of each term is provided.
13. **Appendix.** This chapter contains supportive information to the EIR/EIS. Other file materials on the project are not included here but may be obtained at the County offices in Lakeport and BLM offices in Ukiah.

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1.0 INTRODUCTION AND SUMMARY

1.1 INTRODUCTION AND NOTICING

The Southeast Regional Wastewater Treatment Plant (SERWTP) Facilities Improvement Plan and Geysers Effluent Pipeline and Effluent Injection Project are proposed as a plan to provide expanded wastewater treatment capabilities and to dispose of the effluent by injection in the Geysers geothermal field for purposes of power production. The project is located predominantly in the County of Lake, California, and also in part of Sonoma County. The plan includes various conventional facilities improvements in wastewater treatment to a secondary level of treatment at the SERWTP. The plan includes facilities to convey the treated effluent in a 26-mile, 24-inch inside diameter pipeline to the Southeast Geysers. The wastewater from the SERWTP would be supplemented by raw lake water diverted from nearby Clear Lake. At the Geysers, the effluent would be directed into a system of distribution lines to wells located on a federal leasehold managed by the U.S. Bureau of Land Management (BLM) and private lands leased to geothermal developers within County of Lake and Sonoma County jurisdictions. Deep injection into the geothermal reservoir would occur year-round for all the wastewater/lake water delivered for these purposes, totaling an average 5,400 gallons per minute. In the geothermal reservoir, the water would be converted to steam and collected in production wells that would direct the steam to six existing power plants. Construction of the project would begin in December 1994 and require about 1 to 1.5 years to complete. Operation of the project would begin early 1996. The plan has an operating life of at least 25 years.

The plan is proposed at this time because of the need to remove a Cease and Desist Order issued by the Central Valley Regional Water Quality Control Board to the Lake County Sanitation District (LACOSAN). The Cease and Desist Order has placed a moratorium on additional connections to the sewer system, resulting in curtailed development in the SERWTP service area, which includes the City of Clearlake, community of Lower Lake and surrounding lands in the county. The plan also provides for a dependable supply of water in the Southeast Geysers to be injected into the geothermal reservoir in order to produce steam that is collected and directed to power plants. At present there is a continuing trend toward a decline in power production in the Southeast Geysers because of the decline in steam pressure.

This document is a combined Environmental Impact Report (EIR) and Environmental Impact Statement (EIS), prepared pursuant to the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA), respectively. The CEQA lead agency is LACOSAN. The NEPA lead agency is the BLM. The EIR/EIS describes the environmental impacts of the various components of the project. Mitigation measures are suggested for reducing impacts to a less than significant level.

1.2 OPPORTUNITIES TO COMMENT ON THE DRAFT EIR/EIS

The EIR/EIS is a public disclosure document. It is intended to provide information to the decision-makers, cooperating agencies, responsible and trustee agencies, and to the public about the project and its environmental effects. A 45-day review period is provided for review of this document. As required by CEQA and NEPA, all agencies and the public may provide comments on the content of this Draft EIR/EIS. Comments may be provided in writing and should be addressed to:

Mr. Mark Dellinger
Lake County Sanitation District OR
255 North Forbes Street
Lakeport, CA 95453

Mr. Rich Estabrook
U.S. Bureau of Land Management
2550 North State Street
Ukiah, CA 95482

The deadline for receiving all written comments is July 14, 1994. Written comments postmarked by that date will be incorporated into the Final EIR/EIS.

Agencies and the public also may provide comments on the Draft EIR/EIS at a public hearing before the Lake County Planning Commission to be held in the Board of Supervisors Chambers at the Lake County Courthouse, 255 N. Forbes Street, Lakeport, CA. The public hearing to receive comments on the Draft EIR/EIS will be held at 9:00 a.m. on Thursday, June 30, 1994 and, if necessary, at 9:00 a.m. on Thursday, July 14.

All comments made on the Draft EIR/EIS will be provided a response in the Final EIR/EIS. The Lake County Planning Commission and BLM will review the Final EIR/EIS and certify at a public hearing that the document meets all requirements of CEQA and NEPA. Upon certification of the EIR/EIS, the Planning Commission will make its recommendations to the LACOSAN Board of Directors regarding environmental effects and required mitigation measures to be included in a mitigation monitoring plan, a functional equivalent of a use permit.

Following the CEQA/NEPA review by the Planning Commission, the LACOSAN Board of Directors will review and consider the EIR/EIS and hold a public hearing on the project. After considering agency and public comments, the LACOSAN Board of Directors will make its decision on whether to approve the project. If the project is approved, the Board will determine which mitigation measures to incorporate into the project. Some of the mitigations incorporated into the project will be the mitigation measures recommended in this EIR/EIS and by the Planning Commission, and approved by the LACOSAN Board of Directors.

1.3 PROPOSED PROJECT

1.3.1 PURPOSE AND NEED

The proposed project is a plan to:

- (1) expand the plant capacity and wastewater treatment facilities at the Southeast Regional Wastewater Treatment Plant located near the City of Clearlake, California, as mandated by a Cease and Desist Order issued by the Central Valley Regional Water Quality Control Board,
- (2) transport the effluent mixed with diverted lake water in a 26-mile pipeline to The Geysers, adding in effluent from the Middletown Wastewater Treatment Plant, and
- (3) inject the effluent into The Geysers steam field to produce steam used in power generation.

The primary reason for proposing the project is the need to provide additional wastewater treatment capacity for the Clearlake and Lower Lake areas. Growth in the service area of the SERWTP since the facilities were installed has increased wastewater generation to a point that the demand is at or over the available capacity of the treatment plant and effluent disposal facilities. The second reason for proposing the project is the need for a dependable source of water in the Southeast Geysers that can be used for injection into the geothermal reservoir to produce steam. Since 1987, steam production has declined significantly because of the loss of steam pressure in the reservoir rock. These situations are discussed below.

The existing Southeast Regional Wastewater Treatment Plant (SERWTP), located north of Clearlake, began operation in 1975. The plant is owned and operated by LACOSAN. The installed plant capacity is 1.49 million gallons per day (mgd) and can handle peak flows up to 2.75 mgd. Secondary treatment of wastewater is performed at the plant and the effluent is directed into an existing 561 acre-foot reservoir adjacent to the plant. The effluent is drawn from

periods in winter. There is an emergency overflow spillway to a tributary creek to Burns Valley Creek, which flows through the City of Clearlake and discharges into Clear Lake. Such overflows have occurred in the past. These overflows have resulted in a violation of the Central Valley Regional Water Quality Control Board (CVRWQCB) permit for the plant which mandates that effluent be confined to the existing land disposal areas. At present the sprinkle irrigation system is not adequate to dispose of all of the effluent (when combined with precipitation run-off into the storage reservoir). Overflows from this condition also lead to discharge into Clear Lake. The discharge of wastewater into Clear Lake is prohibited by the CVRWQCB's Basin Plan for the lake and by County of Lake ordinance.

In fulfilling its delegated responsibility for wastewater treatment plant permitting under the federal Clean Water Act, the CVRWQCB issued a Cease and Desist Order in 1991 to LACOSAN, citing treatment and disposal deficiencies. That order forbids hook-ups which would put wastewater received at the plant over installed treatment plant capacity and approved effluent discharge capacity. The CVRWQCB ordered LACOSAN to provide additional capacity for the SERWTP service area and placed a moratorium on building and new hook-ups in the service area until an approved plan is in place and facilities for both treatment and disposal of wastewater are constructed.

The City of Clearlake and the County of Lake project that growth in the SERWTP service area will far exceed currently installed SERWTP capacity. Current estimates of growth indicate that there will be a need for a treatment capacity exceeding 3.0 mgd average within the next 30 years. In order to achieve this volume of wastewater treatment, new facilities for the SERWTP would have to be constructed.

The expansion of the SERWTP would provide new facilities to treat wastewater using standard engineering design to achieve acceptable levels of treatment at the plant. The more difficult problem is management and ultimate disposal of the treated wastewater effluent. Existing spray fields near the SERWTP cannot accommodate significant expansion or added volumes of effluent. Various alternatives to effluent disposal have been investigated. The project proposed and evaluated in this EIR/EIS is the preferred alternative. It would transport treated effluent through a constructed pipeline to The Geysers.

The secondary cause for proposing the project at this time is the opportunity to enhance steam production at The Geysers which has been in decline since 1987. The apparent cause of the decline is the reduction in steam reservoir pressure as a result of the unavailability of sufficient

injection water to adequately replace the amount of steam being produced. The proposed wastewater effluent would be a new source of water to compensate for this decline. The project would allow continued geothermal energy production in the southeast Geysers at higher production levels than would occur otherwise.

1.3.1.1 KEY ACTIONS LEADING TO THE PROPOSED PROJECT AND IDENTIFICATION OF ALTERNATIVES

The project has been proposed at this time because of the series of events and circumstances summarized above that have developed in both the LACOSAN service area of the SERWTP and in The Geysers. The key considerations related to these events and circumstances are summarized here to provide a general background to the proposed project.

While the construction of proposed wastewater treatment facilities at the SERWTP to comply with CVRWQCB requirements is conventional and relatively uncontroversial, the issue of ultimate disposal of the effluent is more difficult to resolve and has produced considerable controversy to date.

LACOSAN in a proposed 1991 facilities plan and an associated EIR investigated approximately twelve options for ultimate disposal of the treated effluent (wastewater). Among these options was the transport of effluent to the southeast Geysers area for disposal, which is included as the currently proposed project in this EIR/EIS. The effluent disposal options are detailed in the Southeast Regional Wastewater System Improvement Facilities Plan EIR and which is included in the present EIR/EIS. The alternative which was chosen in 1991 for further investigation was the discharge of treated effluent to Cache Creek at Peachtree Crossing. The proposed discharge of treated effluent into Cache Creek produced a very large response from the downstream water users in Yolo County. Numerous comments on the proposed plan and its environmental impacts were received during public review of the Draft EIR, and the additional environmental studies which would have been required would have caused a significant delay. The delay would have made compliance with the Regional Water Quality Control Board's mandated Cease and Desist Order unachievable for two to three years or longer, and would have been extremely costly. As a result, further investigations into the engineering and economic feasibility of disposing the SERWTP effluent in The Geysers were initiated. A comparison of possible costs and environmental problems potentially associated with the Cache Creek disposal plan and the conceptual Geysers disposal plan indicated that the latter alternative would prove possible and perhaps preferable to the originally proposed disposal plan. Moreover, there was an active

interest on the part of the geothermal industry to obtain the effluent, provided that costs for construction of the 26-mile pipeline and related facilities would be shared.

The industry has had a 25-year history of injecting into deep wells power plant cooling tower condensate that was prohibited from being discharged into surface waters. The injection wells are several thousand to over 10,000 feet deep. Initial investigations of enhanced injection in the late 1980's indicated an excellent potential for positive response in the steamfield. As a result, broader programs for enhanced injection occurred throughout The Geysers with substantial success. The principal limitation was, and remains, the lack of an available, dependable sustained supply of water for use in injection.

Because LACOSAN has a potentially available and continuous supply of wastewater, the geothermal industry has a potential source of water to meet its injection needs. Significantly, the wastewater supply would be dependable and sustainable, as it would increase as growth occurs in LACOSAN's service area. For these reasons, starting in 1994, LACOSAN and four industry partners (Calpine, NCPA, Unocal and PG&E) have entered into Agreements-in-Principle regarding construction and operation of a pipeline for delivery and use of treated effluent to the Southeast Geysers. The Agreements indicate that costs would be shared for design, construction and operation of a pipeline system delivering an annual average of 5,400 gpm of effluent to The Geysers.

From 1992 to 1994, LACOSAN and the industry partners developed a plan for constructing The Geysers Effluent Pipeline. In conjunction with that plan, an EIR/EIS is required to be prepared as noted in the Initial Study prepared for the project. The requirement for the EIR stems from LACOSAN's requirement to comply with CEQA for major public improvement projects. The EIS requirement stems from the plan to construct facilities and to inject fluids in federal lands in the Southeast Geysers managed by the U.S. Bureau of Land Management and because of funding provided by the U.S. Department of Energy. In July 1993, the LACOSAN Board of Directors tentatively adopted the Geysers Disposal alternative for detailed environmental analysis and as the preferred disposal plan for effluent from the SERWTP.

This EIR/EIS describes these various project components as part of a program of actions and includes an evaluation of their environmental impacts. It is based on a preliminary design for the project. Detailed final design and value engineering will occur later in 1994.

1.3.2 LOCATION

Most of the proposed facilities, including the SERWTP facilities, Clear Lake diversion pipeline and pumps, main effluent pipeline and pumps, are located in Lake County, California, between Clear Lake and the southeast Geysers (Figure 1.3-A). The effluent injection part of the project is located in the southwestern portion of Lake County and northeastern portion of Sonoma County. A small portion of the effluent pipeline and some of the secondary distribution pipelines to the injection wells in the steam field are located in Sonoma County. Part of the project located in The Geysers is within federal lands managed by the BLM and other portions are located on private lands administered by Lake County and Sonoma County. Figure 1.3-A provides an overview map of the project facilities locations.

1.3.3 PROPOSED PROJECT AND RELATED LAND USE GOALS

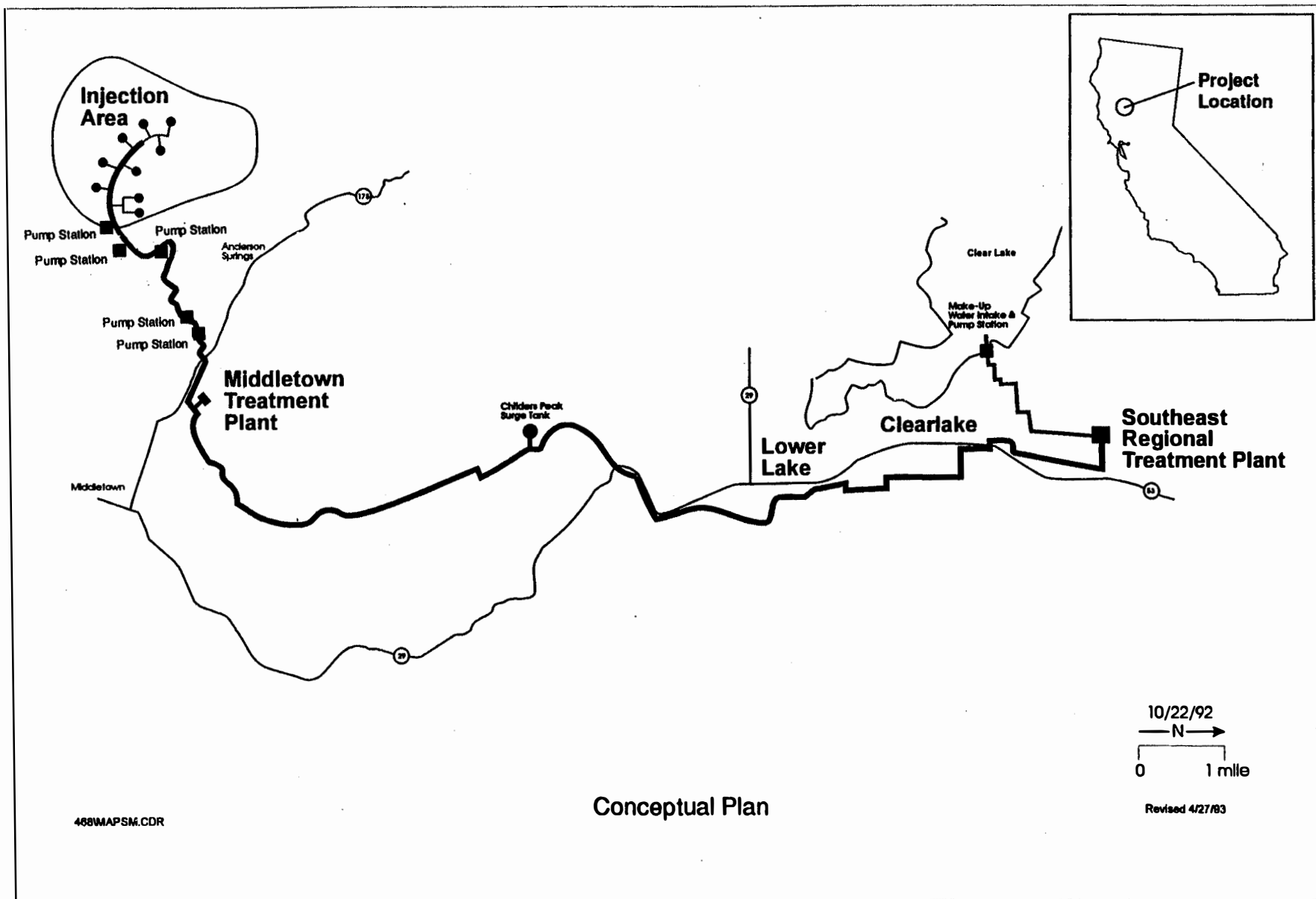
For purposes of analyzing the environmental effects of the project in this EIR/EIS, the project is divided into the following three primary components: (1) the Southeast Regional Wastewater Treatment Facilities Plan Component; (2) the Geysers Effluent Pipeline Project Component; and (3) the Southeast Geysers Effluent Injection Program Plan Component.

1.3.3.1 SOUTHEAST GEYSERS EFFLUENT PIPELINE PROJECT COMPONENT

This component of the project is the proposed pipeline and related facilities to carry effluent from the SERWTP and water diverted from Clear Lake to The Geysers.

Studies conducted by and for the County of Lake, Calpine Corporation (Calpine), the Northern California Power Agency (NCPA) and Unocal Corporation (Unocal) established that a combined lake water and wastewater effluent flow of about 7.8 mgd could be cost effectively conveyed to the southeast Geysers steam field from the SERWTP (Dewante and Stowell, 1993; EcoLogic, 1994). The average annual flow of 7.8 mgd would provide 5,400 gallons per minute (gpm) to the injection wells. The sources of this volume of flow would vary over time. As proposed for this project, the volume of flow in the pipeline would come from three sources: (1) treated effluent from the SERWTP; (2) a small amount of treated effluent from the Middletown Wastewater Treatment Plant (MWTP); and (3) water diverted from Clear Lake.

LACOSAN has entered into Agreements-in-Principle with Calpine, NCPA, Unocal and Pacific Gas & Electric Company (PG&E) to provide in the proposed effluent pipeline system an average



SOURCE: Dewante and Stowell Engineers

Southeast Geysers Effluent / 920586 ■

Figure 1.3-A
General Project Location and Conceptual Layout

annual flow of 5,400 gpm to The Geysers. It includes a combined flow of approximately 5,300 gpm from Clear Lake and the SERWTP plus an additional 100 gpm from the MWTP.

In order to maintain the volume needed to operate the pipeline, supplemental water, termed "make up water", will be drawn from Clear Lake and added to the effluent stored in the SERWTP reservoir. As SERWTP and MWTP effluent flows rise, the need for Clear Lake make up water would decline.

Proposed facilities for this component include the following.

Main Geysers Pipeline

- Geysers Effluent Pipeline: The 26-mile main effluent pipeline would have a 24-inch inside diameter for most of its length, consist of a steel force main, placed both above-ground and underground in various segments to convey effluent from the SERWTP to the terminus in The Geysers; isolation valves on the main pipeline would be spaced at approximately two-mile intervals.
- Twenty-four inch diameter pipeline extension from the SERWTP reservoir to the six operating pumps and surge tank at the SERWTP: Approximately 730 feet long, located entirely within the SERWTP yard; this would be a suction pipeline drawing effluent from the effluent reservoir.
- SERWTP pumps: Up to six turbine pumps, each would be 200 horsepower and have a 900 gpm output capacity; they would pump the effluent through the pipeline from the SERWTP to the Childers Peak Regulating Tank; an hydropneumatic surge tank would be ancillary to the pump station. A seventh pump may be installed as a backup.
- Childers Peak Regulating Tank: The steel tank would have a capacity of approximately 620,000 gallons; it would be 60 to 70 feet in diameter and 24 to 32 feet high; it would be constructed above ground on a site below Childers Peak at about 1,800 feet mean sea level (msl); it would provide the activating control water level for the SERWTP pumps and provide surge suppressing storage of effluent.
- Middletown Wastewater Treatment Plant (MWTP) facilities: Includes two pumps, suction and discharge pipeline to add MWTP effluent to the system, surge control tank, connection valve into the main Geysers Effluent Pipeline, and power supply facilities; all facilities would be located in the MWTP yard.
- Bear Canyon Pump Stations: Up to five pump stations to lift the effluent from approximately elevation 1,470 feet above msl to the high point of 3,330 feet msl in The Geysers: each station would have three operating centrifugal pumps with 250-horsepower motors and, combined, have a 5,400 gpm output capacity; the pumps would be located on 30-by-80-foot pads in an industrial-type building; a surge tank would be constructed for the first pump station. A fourth back-up pump also may be installed at each pump station.

- **Y-Pad Injection Fluid Tank:** This would be a 100,000-gallon steel tank constructed above ground on a concrete pad partially cut into the hillside on the south side of the NCPA Y-Pad in The Geysers at about 3,365 feet msl; it would control the flow of injectate to some of the secondary distribution pipelines and serve for storage of effluent and condensate. The tank would be located near the terminus of the Geysers Effluent Pipeline.

Geysers Secondary Pipeline System

- Secondary distribution pipelines at The Geysers to carry the effluent as injection fluid from the main pipeline to 15 existing and 7 future well heads where injection into the steam field would occur; the main pipeline to near the Calpine/NCPA boundary would be steel or polyethylene pipe buried and above ground along the road; several new polyethylene or steel pipelines buried in existing roads or above ground would be used to convey the effluent to the well-heads, as well as use of existing injection lines; the secondary pipelines vary in diameter from 8 inches to 16 inches. (No new wells are proposed to be constructed as part of this project, although some production wells may be converted to injection wells.)

Lake Diversion: Make-up Water Supply Facilities

- **Lake Intake Structure:** This would be a wire-wound screened intake feature to draw in water and an air purge system for purging debris from the intake; it would be located on the bottom of Clear Lake (elevation 1,295 msl) at a depth of approximately 30 to 35 feet below mean lake level (elevation 1,330); the underwater pipeline would be placed on the lake bottom anchored to concrete collars and would extend approximately 300 feet to the diversion pump station on the lake shore. Within 50 to 100 feet of the shoreline, the intake pipeline would be buried for the remaining distance to the pump station. The exposed underwater pipeline and intake screen would be protected by rock riprap along side and over it.
- **Lake Diversion Pump Station:** Three vertical turbine pumps, each 125 horsepower, with a capacity of 2,060 gpm at a total developed head of 160 feet; the pumps would be installed over the suction chamber; the pumps and ancillary air compressor and surge arrestor would be housed in a sound-proof building located at the lake shore.
- **Lake Diversion Pipeline:** This would be a 16,600-foot PVC pipeline, 24 inches in diameter; isolation valves would be placed at approximately two-mile intervals; it would be placed underground for its entire length from the lake shore to the SERWTP reservoir; the pipeline capacity will be up to 8.9 mgd.
- **Pipeline outlet structure:** A 24-inch outlet pipe would be constructed at the bottom of the SERWTP reservoir.

Main Pipeline Ancillary Facilities

- **Bear Canyon to M-Pad Connector Road:** new road and pump station pad located between the Calpine Bear Canyon Access Road and the NCPA M-Pad; the road would be approximately 20 feet wide, 2,400 feet long, with a widened area for the pump station (Station No. BC-3); the road would include 1.5:1 (horizontal to vertical) cut slopes, 2:1 fill slopes, and a 180-foot wide and 60-foot high fill placed for the crossing of an unnamed creek with a crib wall; the creek would be placed in a culvert.

- Power supply line in The Geysers: This would be a 21 kilo-volt (kv) 26,000 feet long power line located in a right of way between an existing line near PG&E Unit 16 and the Bear Canyon Access Road; the power line would be constructed on wooden poles immediately adjacent to an existing 230 kv line between PG&E Unit 16 and the Bear Canyon Power Plant; upon reaching the Bear Canyon Access Road, it would split, running along the roadside to the five pump stations for the pipeline; provides power to the five Bear Canyon Pump Stations.
- Power supply line at the SERWTP: A small 12 kv line, less than 200 feet long, would be constructed on poles within the SERWTP yard to supply power to the four pumps for the pipeline.
- Flow control, monitoring and telemetry system: A distributed control system (DCS) would consist of remote telemetry units (RTUs) located at the SERWTP pump station and a master RTU in The Geysers; the computerized control station would be located at the NCPA control center; the DCS would control flows on a 24-hour basis by controlling the pumps at the SERWTP pump station and the Bear Canyon pump stations; these are regulated in response to pipeline flow pressure requirements and system demand from The Geysers steam field; water levels in the Childers Peak Regulating Tank would determine the activation or shut down of the pumps; a fiberoptic line would be run from the Childers Peak Regulating Tank to the NCPA control center to transmit information on the water level in the tank.

General Operation of the Pipeline System

The overall system would deliver an annual average of 5,400 gpm in the pipeline to The Geysers. This is the equivalent of approximately 7.8 mgd. The proposed operations involve: (1) the diversion of make up water from Clear Lake to the SERWTP; (2) the collection of effluent from the SERWTP reservoir combined with the addition of make up water from Clear Lake; (3) the collection of effluent from the MWTP; (4) conveyance of the effluent in the main pipeline to the terminus in The Geysers; and (5) flow of effluent in the secondary distribution lines to the well-heads for injection. These are presented in summary fashion below.

(1) Clear Lake Diversion. To maintain the design flow of approximately 5,300 gpm from the SERWTP to the Geysers, water would be drawn from Clear Lake for a period of 25 years. The volume of water taken from Clear Lake would exceed that volume of effluent generated by the SERWTP. As the Clearlake, Lower Lake and Middletown areas grow and effluent volumes continue to increase, the need for make up water would decrease over time. However, lake water diversions would be expected to occur throughout the 25-year design life of the project. The water would be purchased from the Yolo County Flood Control and Water Conservation District, which owns the upper part of the lake.

The average annual withdrawal from Clear Lake would be 6.24 mgd in 1996, equal to approximately 1.9 inches off the lake elevation (a total theoretical drawdown assuming no replacement by inflow or recharge), eventually dropping to 5.09 mgd in 2021. This equates to an annual withdrawal of 6,994 acre-feet (af) per year in 1996, and 5,705 af per year in 2021. These rates would vary under different rainfall conditions.

Pumping would occur each day of the year, except possibly for an approximate 30-day period during the August/September period of algae bloom in Clear Lake. To offset the period when pumps were turned off during the algae bloom, the pumps would operate at higher through-put volumes during the months preceding and following the algae bloom.

A single suction line extending into the lake would draw water into the pipe and then into a suction chamber. From there, the water would be pumped in the 24-inch pipeline to the SERWTP reservoir. No facilities are planned for treating the make up water.

(2) Effluent Collection and Pumping at the SERWTP. The existing reservoir would receive both the effluent from the SERWTP and the make up water diverted from Clear Lake. The volume of SERWTP effluent varies substantially monthly, seasonally and annually. Sustained SERWTP influent flows of 3 mgd to 4 mgd already occur over many days in succession during unusually wet weather periods. Average anticipated flows in 1994 would be 1.40 mgd, rising to 1.60 mgd by the year 2000 and to 2.52 by the year 2021. As system effluent flows vary, daily adjustments in diversions from Clear Lake will be made to maintain consistent flows into the Geysers Effluent Pipeline at all times (24 hour per day, 365 days per year). Occasional shut down periods would occur for maintenance.

The combined SERWTP effluent and make up water in the reservoir would be drawn off through a proposed 24-inch outlet, and pumped through 68,000 feet (12.9 miles) of the Geysers Effluent Pipeline to the Childers Peak Regulating Tank. This flow would be about 5,300 gpm. Gravity flow would occur south of Childers Peak to the first Bear Canyon pump station (Pump Station BC-1) located along the Bear Canyon Access Road.

(3) MWTP Effluent Intake. The main effluent pipeline passes through the MWTP, located west of Middletown at elevation 1,140 feet msl. At this location, effluent generated by the MWTP would be added to the flow in the main pipeline. In 1996, it is anticipated that 0.14 mgd average wet weather flow would be added to the system; this would rise to 0.17 mgd by the year 2021.

The addition of the MWTP flow would raise the total flow in the Geysers Effluent Pipeline to 5,400 gpm.

The storage ponds at the MWTP also would be used to accommodate large fluctuations in effluent from the Middletown system, as well as flows that may occur at the SERWTP. There is sufficient storage capacity at the MWTP to handle peak system flows.

(4) Conveyance to the Terminus. The combined lake water and effluent flow from the SERWTP and MWTP in the Geysers Effluent Pipeline would flow (under hydraulic head from Childers Peak together with pumped flow from the MWTP) to an elevation of approximately 1,470 feet msl, at which would be located the Bear Canyon Pump Station No. 1 (BC-1).

The segment of the pipeline above BC-1 presents the greatest rise in elevation to reach the terminus. The highest elevation of the Geysers Effluent Pipeline is 3,300 feet msl, with the nearby Y-Pad Injection Fluid Tank located at the high point of the entire system at 3,336 feet msl. Five pump stations, placed at approximately equal vertical intervals would lift the 5,400 gpm flow of diluted effluent into The Geysers, conveying it to the pipeline terminus located at the NCPA C-Pad. A subsidiary pipeline would draw water from the pipeline and direct it into the Y-Pad Tank. The Y-Pad Injection Fluid Tank would have a 100,000 gallon storage capacity and would receive flows of both effluent from the Geysers Effluent Pipeline and condensate from NCPA's existing operating system. The tank would be used to regulate flow of effluent to some of the distribution lines for injection.

(5) Effluent Distribution to Injection Well Heads. The overall operating system for the entire pipeline is driven by the demand for injection fluids in The Geysers and requirements for maintaining pressure in the pipeline. Demand would be based on steamfield operations determined by and controlled through the existing monitoring and flow control systems of NCPA, Calpine, and Unocal. At present, overall demand for injection water would be able to absorb all the effluent produced by the SERWTP and MWTP. On a daily basis of injection, the demand may fluctuate, and these fluctuations would be reflected in the overall operation of the system for storage in the SERWTP reservoir, the Childers Peak Regulating Tank and the Y-Pad Injection Fluid Tank. Adjustments in make up water withdrawals from Clear Lake would be made to ensure even flows and efficient operating conditions of the pipeline. This would be accomplished by a computerized monitoring system, termed the distributed control system (DCS), that would convey information by telemetry to the central control station at the NCPA control center related to the water levels in the tanks, line pressure, valve positions and flows at

discharge points. Overall control of the system is handled by control of the pumps at each of the key locations for effluent input to the system (the Clear Lake diversion pumps, the SERWTP main pumps for the Geysers Effluent Pipeline, and the MWTP pumps). The Bear Canyon pumps would be regulated by water levels in the Childers Peak Regulating Tank. Remote control of all the pumps would occur from the central control station at the NCPA control station. The entire system would be computerized, with a back-up system at the SERWTP to ensure continued operations if the primary monitoring and control system were to fail.

The monitoring system also would identify abnormal operating conditions, such as a sudden increase of pressure in the pipeline or high or low water level in the Childers Peak Surge Tank. A low water level might indicate a loss of pressure in the pipeline because of failure. The system would provide an alarm to the central control station.

1.3.3.2 SOUTHEAST GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT

This component of the project entails the ultimate disposal method of the effluent by deep injection into The Geysers steam field.

Proposed Facilities

New facilities for this component include the piping and valves that would be installed at existing well-heads that are not currently being used for injection. Unocal proposed to widen an existing 2,000-foot Jeep trail.

General Operation of the Effluent Injection Program

Under the Project Agreement, ownership of the effluent would be equally divided between NCPA, Unocal and Calpine. A flow of 1,800 gpm would be distributed by NCPA to seven of its existing wells used for injection and two existing wells that are not currently being used for injection. Delivery of effluent to Calpine and Unocal would occur at the terminus of the main pipeline. Calpine would distribute its flow of 1,800 gpm to three existing wells used for injection and four existing wells not currently used for injection. Unocal would distribute its 1,800 gpm flow of effluent to four existing injection wells.

This EIR/EIS evaluates the initial effluent injection strategy proposed by Calpine, Unocal and NCPA. It is anticipated that monitoring of the effects of the injection program on steam

production over time will lead to modifications of the program, including both the selection of the wells to be used for injection and the rates of injection to those wells.

The injection area includes the steam fields operated by Calpine which supplies PG&E Units 13 and 16. There are no plans at present to use project effluent to supply steam to the Bear Canyon Power Plant although injection into the Bear Canyon area may occur after 1998. The NCPA injection area includes steam fields for Plant Nos. 1 and 2. The Unocal injection area includes steam fields supplying PG&E Unit 18 and Unit 20. The proposed 5,400 gpm of injection would approximately double the current rate of injection in this part of The Geysers by Calpine, Unocal and NCPA.

The injection method is the same as that used in current injection operations using power plant cooling tower condensate and collected storm water runoff from well pads and power plant sites. In basic concept, the effluent would be injected into deep wells, where it would migrate through fractures and pores in the hot reservoir rock, heating and flashing into steam. The steam flow derived from the injection fluid would increase steam pressure in the geothermal reservoir, thereby increasing the output of existing production wells. Existing pipelines gather the steam and direct it to the power plants.

Seven existing and two new NCPA injection wells would receive between 200 gpm to 1,800 gpm as an average annual rate of flow (NCPA also would add other sources of water for injection, such as rainwater, raising the upper rate of injection to 2,000 gpm). The injection intervals are typically on the order of 3,000 feet to over 10,000 feet deep. The amount of effluent injection at each well would vary.

Three existing and four new Calpine injection wells would receive between 200 and 1,800 gpm as an average annual rate of flow. The injection intervals are typically on the order of 2,400 feet to over 8,000 feet deep. The amount of injection effluent in each well would vary and effluent will likely be mixed with power plant condensate prior to injection into some wells.

Four existing Unocal injection wells would receive between 200 and 4,000 gpm (adding to other sources including already permitted stream diversions) as an average annual flow rate. The injection intervals are typically on the order of 2,800 to over 9,000 feet deep.

The annual energy production related to this 5,400 gpm of effluent injection is anticipated to be between approximately 197,100 and 657,000 Mega-Watt hours (MWh).

1.3.3.3 SOUTHEAST REGIONAL WASTEWATER TREATMENT PLANT FACILITIES
PLAN COMPONENT

The proposed project consists of capacity improvements to the SERWTP treatment facilities. Effluent would be secondarily treated.

Proposed filtration facilities consist of a chemical coagulant aid/feed mix system and single or multi-media filters. The effluent would be filtered by passing it through a filter system after the addition of a chemical to increase the removal of solids (coagulant aid). Coagulant aid chemicals would be either polymer or aluminum sulfate (alum), both commonly used for this purpose in domestic water supply treatment systems. Filters would be conservatively sized and have backup units for dependability.

Under normal conditions, the oxidation ditch process would be operated on a continuous year-round basis to produce a high quality secondary effluent. This effluent would be conveyed into the existing reservoir for storage. Prior to actual disposal, stored effluent would be disinfected.

An improved chlorine disinfection system would have the capability of processing effluent from either the clarifier, the reservoir, or filtration facilities.

Proposed treatment facilities improvements include:

1. a separate septage/grease receiving structure
2. grit chamber improvements
3. replacement of the existing comminutor with a mechanically cleaned bar screen
4. ditch distribution box
5. oxidation ditch improvements
6. clarifier splitter box
7. a new secondary clarifier
8. a new return/waste sludge pump station
9. effluent flow metering additions
10. chlorine contact pipeline additions
11. sludge drying beds or
12. belt filter press facility
13. oxidation ditch

1.3.4 MAJOR ISSUES AND RELEVANT DATA CATEGORIES

The following is a brief summary of major relevant environmental issues which were raised in the scoping process.

Biological Resources. The EIR/EIS should describe impacts to native vegetation, including listed plant species; wildlife, including barriers to migration; and impacts to fish. Information was also requested regarding the methods of trenching and stream crossings, width of the corridor and disturbed area restoration.

Clear Lake. The EIR/EIS should describe the impacts on Clear Lake from withdrawals of water.

Cultural resources. The EIR/EIS should describe the impacts on cultural resources. Consultation with Native American groups should be conducted.

Effects on environmentally sensitive areas. The EIR/EIS should discuss impacts on any wetlands, wild and scenic rivers, floodplains, vernal pools, streams, critical habitats and other environmentally sensitive areas.

Effects on geothermal reservoir. Question was raised regarding the impacts of injection on the geothermal reservoir rock and long-term operations in the southeast Geysers.

Induced Seismicity. Question was raised whether the project would induce increased earthquake hazards.

Water Quality. Question was raised regarding chemistry of the effluent in relation to groundwater, including potential for impacts to community water systems and bottling companies using spring water at Cobb Mountain.

1.4 ALTERNATIVES TO THE PROJECT

LACOSAN and the BLM can take one of three basic actions with regard to the application for the proposed project. (1) The proposed project can be approved with mitigation measures including those presented in this EIR/EIS. (2) The proposed project could be abandoned or postponed indefinitely. That decision, in effect, would establish the No Action/No Project Alternative as the selected course of action with respect to the objectives of the project. (3) The proposed project can be amended to include approved design alternatives to those proposed as part of the project.

1.4.1 NO ACTION/NO PROJECT ALTERNATIVE

The No Action/No Project Alternative is the condition which would apply if the project or the design alternative were not constructed. The alternative does not include any new facilities, operations or activities that are related to the objectives of the proposed project. Instead, the No Action/No Project Alternative presents a scenario of conditions which would exist if the project or the design alternatives were not constructed. There would be no environmental impacts related to facilities construction, operation or abandonment.

None of the project objectives would be realized under the No Action Alternative. Under the No Action Alternative, the conditions which led to proposing the project at this time would continue to exist. These are:

- The requirements of the regulatory agencies to correct wastewater problems at the SERWTP would not be met.
- The existing Cease and Desist Order from the California Regional Water Quality Control Board (CVRWQCB) would be violated.
- Raw wastewater could overflow manholes in local streets because of surcharging of the sewer pipes during wet weather. During maximum flow conditions, some sewers could back up temporarily, causing stopped or slow flow of toilets and drains.
- Wet weather conditions would result in untreated wastewater overflows to Burns Valley Creek and eventually into Clear Lake and Cache Creek.
- The moratorium on new connections to the sewer system would be continued indefinitely. Further growth would be prohibited in LACOSAN's SERWTP service area, including the City of Clearlake, the Lower Lake area and all other areas in the district.
- LACOSAN would incur financial penalties (with fines possibly as high as \$10,000 per day) and possible prosecution for criminal negligence. Assuming the fees to cover the cost of fines alone, the rates charged to existing users would be increased by as much as \$0.53 per day per person for violations which were fined the maximum allowable amount. Assuming 60 days of violation per year in 1994, this could total up to \$40 per month per household (Goddard and Goddard, 1991).
- Continued declines in steam pressure in the southeast Geysers would be anticipated. This, in turn, would result in continued decline in power production at The Geysers.

1.4.2 PROJECT DESIGN ALTERNATIVES

The Project Design Alternatives include an assortment of engineering design and pipeline local route variations from those included in the proposed project. As these are all sub-components of the overall Geysers Effluent Pipeline, they do not individually or collectively represent a complete alternative to the proposed project. If approved, individually or collectively, the Project Design Alternatives would be an amendment to the proposed project design.

The Project Design Alternatives include two types: alternative facilities designs and alternative routes for some pipeline segments. Each is described below.

1.4.2.1 ALTERNATIVE FACILITY DESIGNS

Lake Diversion Pumps and Pipeline on Pier

Under this alternative facility design, the pumps and pipeline to the lake shore would be located on a pier constructed approximately 300 feet horizontally into Clear Lake. The location would be the same as that for the proposed project (for which the pipeline would be under water and the pumps located in a building on the shore). The pumps, motor control center, air compressor, and air receiver would be housed in a small, sound-proof garage-like structure on the pier. The surge arrestor would be situated on the shoreline as in the proposed plan. Water pumped from depth in the lake would be directed into a 24-inch pipeline that would be located on the pier to the lake shore, at which point it would pass underground as with the proposed design.

Bear Canyon Single Pump Station and One-Way Surge Tank in the Geysers

A single pump station is an alternative design concept to the proposed use of five separated pump stations to lift the effluent up to The Geysers after leaving the MWTP (see Section 2.3.3.5). The single pump station would be located at the Bear Canyon Access Road/Highway 175 intersection in an area currently used for vehicle parking and open space. A total dynamic head of about 1,800 feet is needed to convey the effluent to The Geysers. Up to six vertical turbine pumps, each with an output capacity of 900 gpm and with 600 horsepower motors would operate 24-hours per day. A seventh pump could be installed to serve as a back-up pump to the operating pumps. Ancillary electrical facilities at the pump station would be housed in a single building. The pumps would be located outdoors. The entire site would occupy approximately 0.4 acres and would be entirely fenced (chain link-type).

Associated with the single Bear Canyon Pump Station described above is the need for a surge tank on the Geysers Effluent Pipeline at the high point of the pipeline in The Geysers. This would be a one-way surge tank to prevent the potential for destructive down-surge conditions caused by an instantaneous pump shutoff. The volume of the tank would be determined during detail design; at this time, it is estimated to be no greater than 50,000 gallons. The steel tank would be exposed to the atmosphere at the top. Upon excessive down-surge in the Geysers Effluent Pipeline, the tank contents would drain through a check valve to fill the line and prevent a separation of the water column that could be highly destructive to the pumps. The tank would be located on an existing pad near the NCPA Plant 2 occupied partly by a fire control water storage tank. The proposed tank would be constructed immediately adjacent to that fire control tank. It would be constructed entirely above-ground. The tank would be up to 20 feet high and 25 feet in diameter.

Under the proposed project design, the one-way surge tank would not be needed.

Lake Diversion By-Pass Pipeline at the SERWTP

As an alternative to discharging diverted lake water into the SERWTP reservoir, a pipeline would be constructed between the point where the lake diversion pipeline enters the SERWTP and the pumps for the Geysers Effluent Pipeline. This would be a 24-inch pipeline constructed entirely within the SERWTP. This alternative would directly convey the diverted lake water to the Geysers Effluent Pipeline instead of conveying it to the reservoir. Mixing of the lake water and the SERWTP effluent would occur at a junction point at the suction side of the pumps at the SERWTP instead of mixing in the reservoir. Under this alternative, an additional or larger outlet pipeline to the existing 18-inch reservoir outlet pipe would not be needed to draw water from the reservoir.

1.4.2.2 ALTERNATIVE ROUTES FOR PIPELINE SEGMENTS

This section describes alternative routes that were evaluated in this EIR/EIS for specific segments of the Geysers Effluent Pipeline and the Childers Peak Regulating Tank. These alternatives were proposed because of engineering design considerations and flexibility in final site selection. Each route segment is identified below including the station post (referenced to the proposed route).

These alternatives do not include overall route alternatives for the Geysers Effluent Pipeline which were evaluated early in the planning process and rejected.

- Alternate Route A-1 (station 23.3 - 24.5). This alternative located north of the Clear Lake Outlet Channel is proposed in order to avoid placement of the pipeline in an existing private driveway. This alternative would be about 1,000 feet long. It would add about 400 feet to the proposed route.
- Alternate Route A-2 (station 23.3 - 24.5). This alternative (near A-1) is proposed in order to avoid placement of the pipeline in a private driveway. It is a variation similar to Alternate A-1. This alternative would be about 1,050 feet long. It would add about 450 feet to the proposed route.
- Alternate Route B. Crossing of Clayton Creek (station 38.8 - 39.1). This alternative route is proposed because of the possible limitations of construction on the bridge (that is, future bridge widening would be limited by the pipeline). As an alternative to crossing Clayton Creek on the bridge, just upstream of the bridge the route would span the deeply incised channel. This alternative would be about 250 feet long. It would reduce the proposed route by approximately 100 feet.
- Alternate Route C. Crossing of Highway 29 (station 53.0 - 53.3). This route would be taken to avoid damage to some large trees on the east side of the highway. The alternate is neither shorter nor longer than the proposed route.
- Alternate Route D. (station 74.5 - 75.5). This alternative is proposed in order to reduce the length of the pipeline. This alternative would be about 500 feet long and would reduce the length of the pipeline by about 250 feet by avoiding the longer turn that the existing road takes. In this remotely-located portion of the pipeline route, the proposed alignment would be in an existing dirt road leading down from Childers Peak saddle.
- Alternate Route E. (station 97.0 - 98.5). This route is proposed in order to reduce the need for easement acquisition. It would avoid crossing the northern edge of a pasture between Big Canyon Road and Harbin Springs Road. This alternative would be about 2,000 feet long. It would about 900 feet longer than the proposed route, but would be entirely located within or in the shoulder of public roads.
- Alternate Route F. (station 121.0 - 124.0). This route was the alignment originally proposed by the project engineers to connect the Bear Canyon Access Road and the M-Pad. It was believed to be less costly to construct and less disruptive of the environment than the proposed alignment. The overall length of this alternative route would be approximately 5,000 feet; of this about 2,000 feet would be the overland segment. This alternative would be about 2,700 feet longer than the proposed route, but it would require substantially less grading. Under this alternative, a pump station would be constructed on the M-Pad instead of Pump Station BC-3.
- Alternate Distribution Pipeline Route G (station 138.5 - 139.5). This alternate route was proposed in order to avoid construction disturbance in the road at the busy NCPA gate. At approximately 400 feet south of the NCPA gate, the 16-inch diameter pipeline would leave the road and follow along the southern edge of the pad to its western side, then head northerly in a cleared area used for access that ends in the main road on the Calpine leasehold.

- Alternate Site for Childers Peak Regulating Tank. The engineering advantage of this location would be its more direct tie-in to the pipeline where it ascends Sweet Springs Canyon. The Childers Peak Regulating Tank would be located at the high point of the Geysers Effluent Pipeline between the SERWTP and the MWTP. The proposed tank site would be located in an open area along the west side of the saddle in the Big Canyon Creek watershed. The alternate site would place the tank more to the east of the saddle. To accommodate the tank at the alternate site, a fairly substantial cut would be made into the hillside.

1.5 SUMMARY OF ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Impacts of the project are summarized in Tables 1.5-1 through 1.5-3. Impacts related to the Geysers Effluent Pipeline Component are summarized in Table 1.5-1. Impacts related to the Southeast Geysers Effluent Injection Program Plan Component are summarized in Table 1.5-2. Impacts related to the SERWTP Facilities Plan Component are summarized in Table 1.5-3. Impacts related to the alternatives to the project are summarized either where they are significant or potentially significant, or where they differ significantly from the impacts of the proposed project (see Table 1.5-4). The impact summary tables begin on page 1-23.

1.5.1 SIGNIFICANT AND UNAVOIDABLE IMPACTS

Significant and unavoidable impacts of the project are adverse environmental effects which cannot be reduced to a level less than significant through mitigation. The following impacts of the project are both significant and unavoidable:

- Impacts 5.2.1.1 and 5.2.2.1 Constuction of the proposed pipelines, pumps stations and tanks would result in significant short-term accelerated erosion in some areas. Construction of the Geysers Effluent Pipeline Project component would also result in significant short-term impacts to water quality in Sweet Springs Creek and the unnamed tributary to Bear Creek.
- Impact 5.2.2.3 Underwater construction of the Lake Diversion water intake and pipeline would temporarily substantially increase local turbidity in Clear Lake at the construction site.
- Impact 5.2.3.11. Construction of the project pipeline could result in a permanent cumulative loss of montane hardwood woodland, montane hardwood-conifer woodland and mixed chaparral that provide habitat for special status species of birds.
- Impact 5.2.6.1. The Geysers Effluent Pipeline Project component could permanently destroy or damage important historic and prehistoric cultural resources.

(continued on p. 1-77)

TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
<u>GEOLOGY, SEISMICITY, AND SOILS</u>		
5.2.1.1. Construction of the proposed pipelines, pump stations and tanks would result in accelerated erosion. (S; ST)	*Residual Impact: Following implementation of Mitigations 5.2.1.1.A through 5.2.1.1.J, erosion impacts would be reduced to insignificant with the exception of intervals along Sweet Springs Creek, the unnamed tributary to Putah Creek, and the unnamed tributary to Bear Creek. 5.2.1.1.A. Detailed design plans and specifications for construction of the project shall conform to the Lake County Grading Ordinance. Detailed design plans and specifications for construction of the re-graded Unocal access road shall conform to the Sonoma County Grading Ordinance. 5.2.1.1.B. All construction and grading activities shall expose as little new ground surface as possible. In all areas requiring removal of vegetation but no grading, root crowns shall be left intact so as to retard soil erosion. (See also Mitigations 5.2.3.10.B and C.) 5.2.1.1.C. Site grading shall be minimized to reduce the possible risk of future slope and/or foundation instability. In areas to be graded, the ground surface shall be cleared and stripped of vegetation and surface soils containing organic materials. The strippings shall be saved for reuse in landscaping, unless disposed off-site in a location approved by the Lake County Planning Department or Sonoma County Planning Department, as appropriate. 5.2.1.1.D. Revegetation of graded areas shall take place as quickly as possible in autumn as weather permits, but generally no later than October 15th.	S; ST*

LSAM= Level of Significance After Mitigation; S= Significant; PS= Potentially Significant; I= Insignificant Impact; NI= No Impact; UI= Undetermined Level of Impact; B= Beneficial Impact; ST= Short-term; LT= Long-term; CUM= Cumulative Impact

TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.1.1. (continued)	5.2.1.1.E. Upon completion of final design and route surveys, an erosion control plan should be developed and implemented. Emphasis should be on site-specific methods to prevent or minimize erosion at each stream crossing identified in Table 4.4.2-1 and areas identified in Table 5.2.1-1 as having high potential for accelerated erosion. Specific plans and drawings should be submitted prior to initiating any ground clearing or surface disturbing activities and should be incorporated into Stream Alteration Agreements with the California Department of Fish and Game. 5.2.1.1.F. Construction monitoring should be performed on an on-going basis during all site preparation and grading activities. 5.2.1.1.G. Reports and certification should be routinely prepared and submitted by the project sponsors to the Lake County Planning Department, BLM and Sonoma County Planning Department (as appropriate) documenting that construction of the project components has conformed to the design plans/specifications, best construction practices, and mitigation measures. 5.2.1.1.H. Construction activity involving ground disturbance (including clearing, grading, and placement fill or spoils) shall be limited to the dry season between April 1 and November 1. 5.2.1.1.I. Following completion of construction of the various project components, and prior to the first rains of the wet season, all accumulations of loose soil and other debris associated with project construction should be removed and properly disposed. The environmental inspector should make observations of the project components when completed (or at the end of each construction season) and certify that clean-up/grooming has been properly completed.	

LSAM= Level of Significance After Mitigation; S= Significant; PS= Potentially Significant; I= Insignificant Impact; NI= No Impact;
UI= Undetermined Level of Impact; B= Beneficial Impact; ST= Short-term; LT= Long-term; CUM= Cumulative Impact

TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.1.1. (continued)	5.2.1.1.J. The project sponsors should prepare and implement for the project a long-term inspection and maintenance plan for the right of way and all ancillary facility sites. 5.2.1.1.K. Unocal should cover the regraded Jeep trail with a layer of crushed rock, or other material acceptable to Sonoma County, in order to minimize further rutting and rilling of the road bed.	
5.2.1.2. Construction of the project would result in streambank erosion and silt deposition in stream channels. (S)	5.2.1.2. To reduce impacts of silt deposition, implement Mitigation Measures 5.2.1.1.A through J for areas of potentially significant streambank erosion and silt deposition. Mitigation Measures contained in Sections 5.2.2 and 5.2.3 should also be implemented. *Residual Impact: Significant along Sweet Springs Creek, parts of the tributary to Big Canyon Creek, and parts of the tributary to Bear Creek but short-term if proper stabilization techniques are used. Insignificant elsewhere.	S*
5.2.1.3. Slope failures and/or soil settlements could damage project components. (PS)	5.2.1.3.A. To minimize hazards of slope failure at the Childers Peak Regulating Tank site and pipeline alignments listed in Table 5.2.1-3, geotechnical investigation should be undertaken in potentially unstable areas which could be destabilized by erosion. Recommendations for adequate foundation design will be followed. 5.2.1.3.B. The Geysers Effluent Pipeline should span the serpentine soil and deeply gullied area between Stations 66.4 to 66.8. The support piers shall be located a few tens of feet to either side of the serpentine deposit.	I I

LSAM= Level of Significance After Mitigation; S= Significant; PS= Potentially Significant; I= Insignificant Impact; NI= No Impact; UI= Undetermined Level of Impact; B= Beneficial Impact; ST= Short-term; LT= Long-term; CUM= Cumulative Impact

TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.1.4. Construction activity for the Geysers Effluent Pipeline could reactivate an old landslide between Stations 57.3 and 57.4. (PS)	5.2.1.4. Project design should include a determination of the level of construction-related vibration the project components can withstand without reactivation of the landslide. A geotechnical engineer should be present on site during construction to determine whether grading and construction activities or related vibration may be undermining the stability of the slope.	I
5.2.1.5. Blasting may be required in some areas for constructing the Geysers Effluent Pipeline. Potentially significant impacts of blasting include potential damage to nearby structures from vibration and fall-out of particulates at the blast site. (PS)	5.2.1.5. A blasting plan that reduces the impact to non-hazardous levels in developed areas should be developed. The plan shall comply with all county, state and federal safety regulations pertaining to blasting. If such a plan cannot be successfully developed and implemented, the pipe segments should be built above ground or relocated to an area not requiring blasting or which is inherently more safe for blasting.	I
1-26 5.2.1.6. Improper or unauthorized spoils disposal could result in unstable slopes and accelerated erosion. (PS)	5.2.1.6.A. All spoil disposal sites should be located, graded, compacted, seeded and left in such a manner that they are well-drained and protected from erosion. Spoil disposal sites should not be located within or in the immediate vicinity of streams. Under no circumstances shall spoil be sidecast into or in close proximity to canyons, sidewalls, streams, gullies, drainage ditches or wetlands.	I
	5.2.1.6.B. Spoils disposed at the MWTP should be compacted and seeded and spray-irrigated to establish an erosion resistant surface. Additionally, a straw bale check dam to trap sediment should be constructed on any drainage way between the fill site and Putah Creek to prevent sediment discharge into the creek.	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.1.6. (continued)	5.2.1.6.C. At the Childers Peak site, in addition to Mitigation 5.2.1.6.A, carry out land imprinting; hydroseeding of all exposed fills and irrigate it to allow vegetation to establish. Construct silt fences and straw bale check dams to trap sediment from the fill site before it can enter the unnamed tributary to Big Canyon Creek.	I
	5.2.1.6.D. In areas along the pipeline corridor where spoils would be spread, carry out Mitigation 5.2.1.6.A and sprinkle irrigate the surface until the vegetation is established and the onset of the rainy season begins (until mid-October at the earliest). In no cases, should spoil be left in piles or unprotected from erosion and sites with over three percent gradient should be avoided.	I
	5.2.1.6.E. In areas along the pipeline corridor where spoils would be spread, the construction contractor should be held responsible for all spoils stabilization and erosion control to the satisfaction of the County. Each contractor should be required to post a bond to ensure that proper methods have been implemented for spoils disposal in all areas within his construction segment.	I
	5.2.1.6.F. Spoils disposal in unspecified offsite areas should be evaluated by the County Planning Department at the time such sites are proposed to receive the soil.	I
5.2.1.7. Seismic groundshaking could damage project components. (PS)	5.2.1.7. The project final design should include development of a "maximum credible design earthquake" which the project components can withstand without failure or major damage.	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.1.8. The Collayomi Fault crosses the alignment of the Geysers Effluent Pipeline. (PS)	5.2.1.8. As a precautionary mitigation measure, the installation of isolation valves on either side of the projected fault trace is recommended. This would include the pipeline segment between about Station 102.5 and 105.0, roughly from the northeast edge of Collayomi Valley, northwesterly to the Middletown WWTP.	I
5.2.1.9. Soils that are subject to some severe limitations could damage the pipeline. The impact is of undetermined significance because of limited data, but should be regarded as potentially significant. (PS)	5.2.1.9.A. Conduct soil testing to identify shrink/swell properties between Stations 86.3 to 93.3. If the soil is subject to severe shrink/swell, the material should not be used as backfill unless amended with other materials to achieve an acceptable level for engineering.	I
	5.2.1.9.B. Dewatering may be required during construction for Stations 97.6 to 98.0. Special drainage may be needed for the backfill and/or greater support needed for the pipeline if the soils are soft.	I
HYDROLOGY AND WATER QUALITY		
5.2.2.1. Construction of the Geysers Effluent Pipeline Project component would have a significant short-term impact on water quality of Sweet Springs Creek, the unnamed tributary of Big Sulphur Creek, and the unnamed tributary of Bear Creek. (S; ST)	5.2.2.1. The construction contractor shall employ best construction practices in compliance with CVRWQCB and NCRWQCB requirements and the Manual for Construction Stormwater Management and County grading ordinances. Application of Mitigation Measures 5.2.1.1.A through J, 5.2.3.1.G, 5.2.3.10.A, B and C, and 5.2.3.12.A and B, should also be required.	S*
	*Residual Impact: The impact in Sweet Springs Creek and the unnamed tributary to Bear Creek is partially mitigable through use of best construction practices.	
5.2.2.2. The crossing of Copsey Creek, Big Canyon Creek and Putah Creek could result in direct degradation of water quality from sediment and dead vegetation. (PS; ST)	5.2.2.2.A. The construction contractor should limit construction in the channels of Copsey Creek, Big Canyon Creek and Putah Creek to the period of low flow (generally between August 1 and September 30).	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.2.2. (continued)	5.2.2.2.B. The construction contractor should use “in-the dry” construction methods in the channels of Copsey Creek, Big Canyon Creek and Putah Creek and should remove all cleared dead vegetative debris upon completion of construction.	I
	5.2.2.2.C. The construction contractor should not dispose of any soil or vegetative debris in any part of the stream channel of Copsey Creek, Big Canyon Creek and Putah Creek.	I
5.2.2.3. The placement of fill in the channel of the unnamed tributary to Bear Creek and the unnamed tributary to Big Sulphur Creek could result in significant degradation of water quality. (S)	5.2.2.3.A. To avoid impacts of fill placement in the unnamed tributary to Bear Creek, construct a span crossing of the pipeline in the canyon and install an isolation valve on the uphill side of the pipeline. *Implementation of Mitigation 5.2.2.3.A would reduce the impact to insignificant. OR as an alternative to 5.2.2.3.A 5.2.2.3.B. If fill is placed in the unnamed tributary to Bear Creek as proposed, the fill slopes should be terraced and roughened to reduce direct runoff and covered with jute or other types of netting. The fill slopes should be seeded according to BLM or County specifications and sprinkled to promote seed germination and growth. 5.2.2.3.C. If fill is placed in the unnamed tributary to Bear Creek and the unnamed tributary to Big Sulphur Creek, as proposed, carry out a detailed program of silt control including avoiding construction where there is water in the creek. Additionally, place straw bales and rock check dams to collect silt and dissipate stream flow energy. These should be cleaned manually for the first three years after construction.	PS, ST*

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.2.3. (continued)	5.2.2.3.D. The fill slopes for both the unnamed tributary to Bear Creek and the unnamed tributary to Big Sulphur Creek should be inspected yearly for the life of the project. Any gullying or mass wasting of the fill should be corrected immediately. 5.2.2.3.E. Rock rip rap should be placed along the creek bottom for both the unnamed tributary to Bear Creek and the unnamed tributary to Big Sulphur Creek at the outlet of the culvert to dissipate erosive energy of water flowing through the culvert. *With implementation of Mitigations 5.2.2.3.B-E, the impact would remain potentially significant for the unnamed tributary to Bear Creek.	
1-30 5.2.2.4. Construction of the Lake Diversion water intake and pipeline would substantially increase local turbidity in Clear Lake at the construction site. (S; ST).	5.2.2.4.A. LACOSAN and the BLM shall consult with the COE to determine if any permits are required, and conditions which may apply to the permits, for disturbance of lake bottom sediments. *Residual Impact: The effects are unavoidable and cannot be mitigated to result in a substantial reduction in effect. The impacts would be short-term and subside relatively rapidly as soon as construction ceases.	S, ST*
	5.2.2.4.B. LACOSAN shall consult with the CDFG to determine the requirements for a Lake Alteration Agreement.	I
5.2.2.5. Construction of the Geysers Effluent Pipeline would require the closure of an irrigation well. Improper well closure could introduce surface contaminants into the groundwater. (PS)	5.2.2.5. The project sponsors shall comply with all requirements of the California Division of Mines and Geology (CDMG) for well closure. A CDMG inspector shall certify that the well has been properly sealed and capped.	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.2.6. Failure of the Geysers Effluent Pipeline could result in a spill of wastewater and related wash-out at the discharge point. (PS)	5.2.2.6.A. Prior to start-up, prepare an Operations Manual that details procedures for remote and manual system operation of the system. The manual should specify training requirements and responsibilities of district personnel.	I
	5.2.2.6.B. Prior to start-up, prepare an Emergency Response Plan.	I
	5.2.2.6.C. Establish a valve exercising program for the isolation valves.	I
	5.2.2.6.D. Spare parts and repair equipment should be stocked by the project sponsors.	I
	5.2.2.6.E. Install locking covers on all valves and switches to prevent unauthorized use.	I
	5.2.2.6.F. Evaluate the effectiveness of a cathodic protection system to prevent pipeline corrosion.	I
	5.2.2.6.G. Project sponsors should provide full-time inspection during all phases of project construction. The completed system should be fully tested prior to regular operation.	I
	5.2.2.6.H. Final design of the pipeline, Childers Peak Regulating Tank and other facilities should incorporate groundshaking intensity associated with a maximum credible earthquake.	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.2.6. (continued)	5.2.2.6.I. Install isolation valves at a minimum of 2-mile intervals, as proposed, as well as (or spaced to include a location at) at the following stream crossings: Burns Valley Creek; the Clear Lake Outlet Channel; Clayton Creek; Copsey Creek (upper crossing at El Roble Grande Ranch); Sweet Springs Creek at Station 60, Big Canyon Creek; Station 100; Putah Creek; and at the crossing of the unnamed tributary of Bear Creek.	I
5.2.2.7. The Geysers Effluent Pipeline could experience slow leaks that could contaminate local groundwater. (PS)	5.2.2.7.A. Conduct a detailed survey of wells located within 100 feet of the final pipeline alignment. Identify any wells that are used for domestic water supply, their depths and capacities.	I
	5.2.2.7.B. As part of the final design, install impermeable liners in the pipeline trench where the alignment comes within 100 feet of an existing domestic water well. OR, as alternative mitigation to 5.2.2.7.A and B,	I
	5.2.2.7.C. Conduct annual sampling of well water for any domestic water well within 100 feet of the pipeline alignment, and provide contractual assurances to the well-owner of a guaranteed supply of potable water at the expense of the Project Sponsors in the event a leak in the pipeline is identified as the source of groundwater contamination.	I
5.2.2.8. The Geysers Effluent Pipeline would have an insignificant impact on surface water resources, flood hazard and ground water. The project would transfer approximately 8,564 acre-feet per year out of the Clear Lake Basin. (I)	No mitigation is required.	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
<u>BIOLOGICAL RESOURCES</u>		
5.2.3.1. Construction of the Geysers Effluent Pipeline and Lake Diversion Pipeline could result in loss of habitat and direct loss of individuals of California red-legged frog. (S)	5.2.3.1.A. A survey for all life-cycle stages of California red-legged frog should be conducted immediately prior to initiating construction to determine whether California red-legged frogs are present in all perennial and intermittent streams and wet meadows potentially crossed by or in close proximity to the pipelines, access roads and construction areas.	I
	5.2.3.1.B. All construction work in streams and wetlands should be conducted during the dry season, between July 1st and October 30. If there is any streamflow, a check dam above and below the trench must be installed to prevent adult red-legged frogs from entering the trench. The trench should be inspected daily and the frogs should be removed carefully out of the construction areas.	I
	5.2.3.1 C. In accordance with USFWS and CDFG requirements, the project sponsors should prepare and implement a mitigation program prior to the initiation of any ground clearing, grading, construction or any other activities which would disrupt this species.	I
	5.2.3.1.D. In disturbed habitat of the red legged frog, surface soil in the trench ROW and stream sediments should be carefully excavated and stockpiled to be returned to the top of the finished trench at the same elevation as the original ground level.	I
	5.2.3.1.E. Spoils should not be disposed within habitat of the red-legged frog. Spoils should be placed no closer than 50 feet from streams and wetlands and should be spread so as not to create mounds or other barriers. All spoils should be replanted with plant species common to the area.	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.3.1. (continued)	5.2.3.1.F. As required by County ordinance, all work should be completed within the dry season to minimize the amount of sediment that is suspended in the water of the swale or stream course.	I
	5.2.3.1.G. Application of chemicals harmful to wildlife in the ROW during construction and operational phases of the project should be prohibited.	I
	5.2.3.1.H. The pipeline construction corridor should be as narrow as is possible, and no wider than 15 feet in stream crossings or wetlands in which red legged frogs are found.	I
	5.2.3.1.I. If vegetated at the time of project construction, the banks of the stream should be replanted with the same native species present on the undisturbed banks upstream and downstream from the disturbance.	I
	5.2.3.1.J. A qualified representative of the County should monitor construction to ensure contractor compliance with these requirements.	I
	5.2.3.1.K. The construction contractor should be required to provide all workers with information about identification and impact avoidance for red-legged frogs.	I
	5.2.3.1.L. Standard provisions to control construction activities, protect water quality, and provide for dust and erosion control as well as the designation of Environmentally Sensitive Areas (ESAs) to protect this habitat should be implemented to substantially reduce or eliminate potential indirect impacts to red-legged frog.	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.3.2. Construction of the main Geysers Effluent Pipeline could result in loss of habitat, as well as direct loss of individuals, of northwestern pond turtle. (PS, CUM)	5.2.3.2.A. Immediately prior to construction, a specific survey should be conducted to determine the presence of this species within Clayton and Copsey Creeks for an area 100 yards upstream and downstream of each crossing site.	I
	5.2.3.2.B. Standard provisions to control construction activities, protect water quality, and provide for dust and erosion control as well as the designation of Environmentally Sensitive Areas (ESAs) to protect this habitat should be implemented to substantially reduce or eliminate potential indirect impacts to turtles.	I
	5.2.3.2.C. Prior to and during construction, the streams supporting northwestern pond turtles should be temporarily dammed both up- and down-stream of construction areas and turtles should be carefully relocated upstream of construction activities by a qualified biologist.	I
5.2.3.3. Construction of the project pipeline could result in loss of habitat and direct loss of individuals of foothill yellow-legged frog. (PS; CUM)	5.2.3.3. Apply Mitigation 5.2.3.1. A and B but with reference to the foothill yellow-legged frog.	I
5.2.3.4. Construction of the project pipeline could result in loss of habitat, as well as direct loss of individuals, of California horned lark. (PS; CUM)	5.2.3.4. Conduct California horned lark nest surveys prior to construction and, if identified, avoid construction during the nesting period.	I
5.2.3.5. Construction of the project pipeline could result in loss of habitat, as well as direct loss of individuals of loggerhead shrike. (PS; CUM)	5.2.3.5. Apply Mitigation Measure 5.2.3.4, but with reference to the loggerhead shrike.	I
5.2.3.6. Construction of the project Pipeline could result in loss of habitat, as well as direct loss of individuals, of black-shouldered kite. (PS; CUM)	5.2.3.6.A. Conduct black-shouldered kite nest surveys in the early nesting season and avoid construction near nesting sites during the nesting period.	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.3.6. Construction of the project Pipeline could result in loss of habitat, as well as direct loss of individuals, of black-shouldered kite. (PS; CUM)	5.2.3.6.A. Conduct black-shouldered kite nest surveys in the early nesting season and avoid construction near nesting sites during the nesting period.	I
	5.2.3.6.B. Between Morgan Valley Road and Clayton Creek Road, place new access roads without loss of trees and restore grassland areas to their original condition.	I
5.2.3.7. Construction of the project pipeline could result in loss of habitat, as well as direct loss, of Cooper's hawk and sharp-shinned hawk . (PS; CUM)	5.2.3.7.A Immediately prior to construction conduct a nesting survey of Cooper's hawk and sharp-shinned hawk.	I
	5.2.3.7.B. Spoils disposal should not occur around the base of coast live oaks, black oaks and cottonwoods.	
1-36 5.2.3.8. Construction of the pipeline in the area of Clear lake could remove roosting snags required for wintering bald eagles. (I)	No mitigation required.	I
5.2.3.9. Laying of the underwater intake structure and pipe from the lake shore could increase the turbidity of the water, which would be a significant impact for listed species of fish. (S)	5.2.3.9. Laying of the pipe should be conducted so as to avoid adult spawning and fry feeding areas of listed species.	I
5.2.3.10. Construction of the Geysers Effluent Pipeline and one secondary distribution line could result in loss of habitat and direct loss of the seed bank of populations of six plant species that are federal candidates for listing as endangered. (PS)	5.2.3.10.A Conduct pre-construction surveys in May-June and salvage all perennial special status plants within the pipeline corridor.	I
	5.2.3.10.B. If spoils disposal occurs at the Childers Peak Regulating Tank site, salvage all serpentine soils and create a 6-inch to 1-foot thick cover of the salvaged soil over the spoils.	

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(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.3.11. Construction of the Geysers Effluent Pipeline would displace grassland along the entire route, and would displace woodland, serpentine chaparral, serpentine grassland, serpentine seep, serpentine barrens habitat, and an old road bed that has been recolonized by native annual species, including two federal candidates, along identified portions of the route. (PS)	5.2.3.11. Salvage the topsoil and seed bank to ensure the re-establishment of these special status species and other native species.	I
5.2.3.12. Construction of the Geysers Effluent Pipeline and a permanent access road in the roadless area of Sweet Springs Creek would result in loss of riparian vegetation and temporary degradation of stream habitat. It would add to the cumulative loss of riparian habitat in the region. Approximately 1.4 acres of new road (0.8 miles) would be constructed in this area. (PS; LT; CUM)	5.2.3.12.A. Eliminate the creation of a new access road in Sweet Springs Creek Canyon. *Residual Impact: Mitigation measure 5.2.3.12.A would reduce the impact to a less than significant level.	I*
	5.2.3.12.B. Reduce construction corridor impact to a minimum (estimated 15 feet in width) using special construction methods in areas where no previous road exists in Sweet Springs Creek Canyon. *Residual Impact: Mitigation 5.2.3.12.B would probably reduce the impact to a less than significant level. However, no road will remain paralleling the pipeline.	I*
	5.2.3.12.C. (Alternate Mitigation) Reduce impact resulting from creation of a new permanent access road (estimated 10 feet width) using special construction techniques in areas where no previous road exists in Sweet Springs Creek Canyon. *Residual Impact: If Mitigation 5.2.3.12.C is completed, the impact would be reduced substantially but possibly not to below the level of significance.	PS*

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(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.3.13. Construction of the project pipeline could result in cumulative loss of montane hardwood woodland, montane hardwood-conifer woodland and mixed chaparral that provide habitat for special status species. (PS; CUM)	5.2.3.13. Please refer to Mitigation Measures 5.2.3.1.A, 5.2.3.5 and 5.2.3.7. *Residual Impact: Implementation of mitigations would reduce but not entirely eliminate the impact.	PS*
5.2.3.14. Construction of the Geysers Effluent Pipeline connector road from the Bear Canyon Access Road to NCPA's M-Pad (Stations 121 to 124) would fill and culvert a tributary watercourse. (S)	5.2.3.14.A. The road fill would require a Stream Alteration Agreement to be signed with the California Department of Fish and Game (pusuant to CDFG Code 1603), and one of the conditions of this agreement would likely be mitigation for the loss of stream values and bank disturbance.	I
	5.2.3.14.B. Avoidance of impacts by minor redesign of the stream crossing should include the following actions:	I
	• Conduct a pre-construction survey of the stream for red-legged frog adults, tadpoles, and eggs, depending on the season and if any are found construct check dams both upstream and downstream to prevent the frogs from being crushed by the fill. • Design and construct a headwall on both the upstream and downstream sides of the road crossing. • Design road construction on both sides of the stream to eliminate fill on the slope above the stream. • By careful design, remove as few trees for the road construction as is possible.	

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(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.3.14. (continued)	5.2.3.14.C. In consultation with the County and California Department of Fish and Game develop a mitigation plan to compensate for unavoidable impacts.	I
	5.2.3.14.D. Best Engineering Practices should be followed to minimize the erosion from the newly constructed fill of the stream crossing.	I
5.2.3.15. Construction of the Geysers Effluent Pipeline, Lake Diversion Pipeline and Unocal access road would result in the removal of some large mature oaks and conifers. (I)	5.2.3.15.A. Vegetation disturbance shall be minimized and limited to the removal of vegetation necessary for the construction of the approved facilities.	I
	5.2.3.15.B. The project sponsor shall not remove trees four inches in diameter or greater (measured at thirty-six inches above natural grade) unless specifically approved by the Planning Department and shown in the project plan.	I
	5.2.3.15.C. Prior to the issuance of development permits, the project sponsor should submit a tree preservation plan for review and approval of the Planning Department. This plan should include the locations of all mature trees within the construction or activity areas of the proposed use.	I
	5.2.3.15.D. Unless specifically otherwise approved, no excavation, placement of fill, compaction, or irrigation should take place within the dripline of mature trees.	I
	5.2.3.15.E. Vegetation beyond the construction perimeter should not be disturbed. Clearing limits for development shall be specified in the development plans, and specifications shall be submitted for approval to the Planning Department.	I

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(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.3.15. (continued)	5.2.3.15.F. Critical environmental features, such as County designated riparian Environmentally Sensitive Areas along Putah, Harbin and Big Canyon Creeks, shall remain in open space. No grading, building or removal of trees over 4 inches in diameter at 3 feet in height shall occur without written authorization of the Planning Director in consultation with the California Department of Fish and Game. No side casting of dirt shall occur outside of approved areas.	I
5.2.3.16. Construction of Lake Diversion Pipeline would result in the loss of approximately one-quarter acre of wet meadow. (I; CUM)	No mitigation is required.	I
5.2.3.17. Construction of the Geysers Effluent Pipeline could result in a degradation of habitat for rainbow trout (<i>Salmo Gairdneri</i>) in Big Sulphur Creek. (S; ST)	5.2.3.17.A. Prior to and during construction, temporary sand/pea gravel damming of the tributary to Upper Big Sulphur Creek downstream of the construction area would reduce the temporary adverse impact of sedimentation flowing downstream into Upper Big Sulphur Creek. 5.2.3.17.B. Mitigation 5.2.3.14.A, B and D should also be employed for the crossing of the unnamed tributary of Big Sulphur Creek.	I
<u>AIR QUALITY</u>		
5.2.4.1. Construction of the proposed pipelines and related facilities would generate criteria air pollutant emissions, particularly PM ₁₀ and NO _x , over the construction period. (PS; ST)	5.2.4.1.A. The project sponsors shall obtain an Authority to Construct (A/C) prior to construction, and a Permit to Operate (P/O) from the LCAQMD and NSCAPCD, as appropriate. The project sponsors shall follow the conditions of these permits. The recommended dust control program should be followed if one is not specified in the A/C.	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.4.1. (continued)	5.2.4.1.B. The construction contracts should specify that temporary construction yards or staging areas shall not be in proximity to residential dwellings and schools.	I
	5.2.4.1.C. The construction contracts should specify that the contractor shall offer wood from trees felled for construction purposes to the land owner for use as firewood. With other vegetative material, the contractor shall acknowledge and follow the burn requirements set forth in the LCAQMD or NSCAPCD <i>Rules and Regulations</i> , as appropriate.	I
5.2.4.2. Construction of the pipelines could generate asbestos dust emissions. (PS)	5.2.4.2. See discussion of this impact and related mitigation measures under Impact 5.2.10.1.	I
5.2.4.3. Operation of the effluent pipeline could result in odorous emissions if anaerobic conditions are allowed to develop in the pipeline itself. (I; LT)	5.2.4.3. If acceptable to LCAQMD, LACOSAN should add sufficient chlorine to the effluent to reduce the potential for odor impacts from operation of the pipeline.	I
5.2.4.4. Long-term operation of the project would have an insignificant impact on air quality. (I; LT)	No mitigation is required.	I
5.2.4.5. Growth-inducing impacts of the project in the LACOSAN service area would not have a significant adverse cumulative effect on air quality, with the possible exception of PM ₁₀ impacts in the City of Clearlake. (I; CUM)	No mitigation is required.	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
<u>NOISE</u>		
5.2.5.1. Construction of the proposed pipelines and related facilities would result in a substantial increase in ambient noise levels along the proposed routes. The impact would be relatively brief at any one location along the routes. (S; ST)	5.2.5.1.A. The construction contracts should specify that noisy construction activities are to be limited to 8:00 a.m. to 6:00 p.m., Monday through Saturday.	I
	5.2.5.1.B. The construction contracts should specify that construction equipment powered by internal combustion engines must be equipped with best available mufflers.	I
	5.2.5.1.C. The construction contracts should specify that blasting should be avoided unless there is no feasible alternative. If blasting is necessary, the construction contractor should employ blasting techniques utilizing the most current technology so as to limit noise levels and vibration and shall notify all property owners within a 2,000-foot radius of the blasting site of the blasting schedule as soon as practicable.	I
	5.2.5.1.D. The construction contractor should coordinate with Pomo School and Lower Lake Elementary and High Schools for scheduling purposes to minimize the temporary noise impacts at those locations.	I
	5.2.5.1.E. The construction plan should identify all construction yards and staging areas. The construction yards/staging areas should be located as far as practicable away from existing residences and schools.	I
	5.2.5.1.F. All vehicles and heavy equipment used on-site shall be adequately muffled to comply with Motor Vehicle Code requirements.	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.5.1. (continued)	5.2.5.1.G. Adjustable backup beepers (when required by law) shall be set to the lowest allowable levels.	I
	5.2.5.1.H. In the event substantive noise complaints are received, the project sponsors shall submit a noise control plan for review and approval by the Lake County Noise Control officer. This noise control plan may require reduced hours of construction or other noise mitigation measures.	I
5.2.5.2. Operation of the proposed pumps at SERWTP would increase noise levels in the vicinity. The noise from the pumps could exceed 50 dBA, Ldn at the nearest residence if left running 24-hours per day. (PS)	5.2.5.2. The project design should be revised to specify that the pumps at SERWTP would be enclosed.	I
1-43 5.2.5.3. Other pump stations would have less-than-significant noise impacts. (I)	No mitigation required.	I
<u>CULTURAL RESOURCES</u>		
5.2.6.1. The Geysers Effluent Pipeline Project component could destroy or damage important historic and prehistoric cultural resources. If the project were implemented as proposed, the impact is unavoidable but partially mitigable through resource recovery. (PS)	5.2.6.1A. The project sponsors should seek to avoid archaeological sites to the extent feasible. To establish the site boundary, the areal extent of resource deposits shall be identified in field studies by a qualified professional archaeologist.	I
	5.2.6.1.B. The project sponsors should retain a qualified professional archaeologist to conduct subsurface studies to determine the Cultural Resource Significance (CRS) of the sites.	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.6.1. (continued)	5.2.6.1.C. If potentially significant archaeological materials are found, a program of resource recovery shall be developed and implemented at the site. Additionally, sites with significant cultural resources may be eligible for inclusion in the National Register of Historic Places. 5.2.6.1.D. In the event that burials are encountered, the archaeologist should contact the County Coroner, and if the burial is a Native American, consult with Native American groups of the region to determine their preference for final internment of the remains. 5.2.6.1.E. In all cases of identified archaeological or historic sites, a qualified observer should be present on site at all times during site clearing and excavation. The observer should have authority to halt construction in the event that cultural resources are encountered in order to evaluate the resource and carry out appropriate recovery.	I I I
<u>VISUAL AND AESTHETIC RESOURCES</u>		I
5.2.7.1. The Geysers Effluent Pipeline Project component would have a less than significant impact on the visual/aesthetic environment. (I)	No mitigation is required.	I
5.2.7.2. Station 101.5 to 102.5 of the main Geysers Effluent Pipeline would create a permanent strong visual contrast of relatively high visibility although primarily in the background of the viewers' landscape. (I; LT)	5.2.7.2. (Recommended) The project sponsors should revegetate the ROW to minimize textural contrasts with the surrounding hill slopes.	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.7.3. Station 121 to 122 of the main Geysers Effluent Pipeline would create a permanent strong visual contrast of relatively high visibility although primarily in the background of the viewers' landscape. (I; LT)	5.2.7.3. (Recommended) The cut and fill slopes should be revegetated using grasses and planted shrubs and trees typical of the surrounding hills. The project sponsors shall submit a landscaping plan for approval by the County Planning Department. Monitoring of revegetation success shall occur for a period of no less than five years.	I
5.2.7.4. The proposed cut and fill and Y-Pad Injection Fluid Storage Tank would create a permanent strong visual contrast of relatively high visibility although entirely in the background of the viewers' landscape. (I; LT)	5.2.7.4. (Recommended) Mitigation would be the same as Mitigation 5.2.7.3, with reference to the Y-Pad Injection Fluid Storage Tank and pad.	I
5.2.7.5. The pump house for the Lake Diversion Pipeline on the lakeshore would be visible in the foreground to nearby residences. A tree may be removed for the pipeline. (I)	5.2.7.5. (Recommended) The pump house and surrounding landscaping should be designed to provide aesthetically compatible features with the lake shore environment. The final plan shall be approved by the Lake County Planning Department in consultation with the City of Clearlake Planning Department.	I
LAND USE		
5.2.8.1. The Geysers Effluent Pipeline Project component would occupy a total of approximately 11 acres. (I)	No mitigation required.	I
SOCIOECONOMICS AND PUBLIC FACILITIES		
5.2.9.1. The project would create a small amount of employment opportunity in the short term for construction and in the long term. (B; ST, LT)	5.2.9.1 (Recommended). The project sponsors should prepare a local hiring and training program for approval by the Planning Department. It shall be the goal of this program to maximize employment of Lake County residents, thereby reducing socio-economic impacts on housing and transportation, while increasing benefits to the local community. The program shall be prepared in consultation with the Labor Management Committee for Lake County, and be approved prior to issuance of grading permits.	B

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.9.2. The project would have an insignificant impact on public services for short-term construction. (I; ST) .	No mitigation required.	I
<u>ENVIRONMENTAL CONTAMINATION HAZARDS</u>		
5.2.10.1. Pipeline construction would require excavation of asbestos-containing serpentine rock that would result in the release of asbestos fibers, and possibly would expose workers to mercury or other heavy metals associated with the serpentine. (PS)	5.2.10.1.A. The construction contractors shall comply with LCAQMD regulations for the excavation of serpentine rock in Lake County and meet the LCAQMD performance goals while excavating in Sonoma County. 5.2.10.1.B. The construction contractors shall comply with OSHA and Cal/OSHA asbestos removal worker requirements whenever serpentine rock containing over one percent asbestos is being excavated. 5.2.10.1.C. Any serpentine material encountered in disturbance areas prior to or during construction shall be analyzed for heavy metals. If the levels of the metals exceed the state CCR Title 22, Section 66261 limits, the construction contractor shall comply with the hazardous waste worker safety requirements.	I
5.2.10.2. Construction of pipelines could expose workers to agricultural chemicals in the Burns Valley Area. (PS)	5.2.10.2.A. The construction contractors should consult the Lake County Agricultural Commissioner to determine when the permitted application of restricted use pesticides to field or orchards is occurring, and the construction contractor shall amend the construction schedule to avoid exposures as necessary. 5.2.10.2.B. The construction contractor shall use dust control practices as required by the LCAQMD (See Mitigation 5.2.4.1.A).	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.10.3. If hydrocarbon contaminated soil is encountered, project construction could expose workers to hydrocarbon vapors, generate hazardous wastes, and would limit future site clean-up options. (PS)	5.2.10.3.A. If petroleum vapors are detected or petroleum stained soil is encountered along the route, the soil to be excavated should be tested for the presence of hydrocarbons. If the levels of hydrocarbons are greater than the regulatory threshold for hazardous waste, the pipeline should either be rerouted around the contaminated site or the contaminated soil should be excavated and disposed as a hazardous waste. Contaminated soil should not be used as backfill.	I
	5.2.10.3.B. When excavating hazardous (i.e., contaminated) soil, the construction contractor must comply with all federal, state, and local hazardous waste regulations.	I
	5.2.10.3.C. Prior to initiating earth work, the construction contractor should conduct an information meeting to discuss hazard recognition and other issues related to worker safety.	I
5.2.10.4. Improper use, storage, or disposal of hazardous substances used in project construction and long-term operation, such as fuel, oil, solvents, and hydraulic fluids, could expose workers to hazardous substances and cause environmental contamination. (PS)	5.2.10.4.A. The construction contractors, LACOSAN and the geothermal operators must comply with all federal, state, and local hazardous substance regulations.	I
	5.2.10.4.B. The construction contractors, LACOSAN and geothermal operators should service construction equipment only on impermeable surfaces with spill containment features.	
	5.2.10.4.C. Any fuel wagon or temporary fuel storage structure used by the construction contractor in the field should not leak and should not release large amounts of fuel in case of a fuel hose rupture.	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.10.4. (continued)	5.2.10.4.D. The construction contractor, LACOSAN, and the geothermal operators should instruct workers on the proper and safe procedures for disposal of hazardous wastes generated during project construction and long-term operation.	I
5.2.10.5. The improper use of hydrocarbon wastes and some herbicides for ROW maintenance can cause environmental contamination. (S)	5.2.10.5.A. No used motor oil or other mostly petroleum hydrocarbon material, such as diesel, should be used for ROW dust or weed control. 5.2.10.5.B. Only herbicides recommended by the Lake County Agricultural Commissioner, and the California Department of Fish and Game shall be used for ROW maintenance.	I
1-48 5.2.10.6. Excavation of former drilling sumps could expose workers to the waste and break the clay liner of the sump.	5.2.10.6. The pipeline and distribution pipelines should be routed around any existing or former drilling waste sumps.	
<u>TRAFFIC AND CIRCULATION</u>		
5.2.11.1. Pipeline construction could delay emergency vehicle access on roadways along the pipeline route. (PS; ST)	5.2.11.1.A. The contractor should be obligated to provide for emergency vehicle access in a timely manner, i.e., as quickly as possible. To minimize disruption and delays for emergency vehicle access, LACOSAN would identify detours and require the contractor(s) to maintain steel trench plates at the construction sites to restore access across open trenches. The amount of open trench at one time would be limited to 500 feet.	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.11.1. (continued)	5.2.11.1.B. Police, fire, and emergency services should be notified weekly of the timing, location, and duration of construction activities throughout the project for that week and a schedule of construction activities by area and date. Additionally, the construction contractor should monitor emergency service provider radio channels during all periods of road closure on Big Canyon Road and Riata Road so as to provide a quick response for the passage of emergency vehicles.	I
5.2.11.2. An increase in roadway wear in the project vicinity would occur as a result of heavy truck and construction equipment movements. (PS; ST)	5.2.11.2.A. Conduct a preconstruction survey of the road condition on key access routes to the project sites. Monitor the pavement and/or road surface condition of local streets and designate roads judged to be in good condition for use by heavy truck traffic.	I
	5.2.11.2.B. Roads damaged by construction traffic should be repaired to a condition equal to or better than that which existed prior to construction activity.	I
	5.2.11.2.C. Detour roads should be selected to use paved roads to the extent feasible to reduce damage to unpaved roads and to minimize dust.	I
5.2.11.3. Pipeline installation within and across streets would result in the temporary closure of local roadways, and would reduce the number of, or the available width of, travel lanes on major roads. This would result in temporary disruption of traffic flows and brief increases in traffic congestion. (I; ST)	5.2.11.3. (Recommended) Special traffic control measures should be incorporated into the construction contract specification documents.	I
5.2.11.4. Construction activities would restrict access to adjacent land uses. (I; ST)	5.2.11.4. (Recommended) Require adequate public notification of construction activity, including any applicable detour routing to alternate access and/or parking for affected land uses.	I

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TABLE 1.5-1: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT
(Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.2.11.5. An increase in vehicles trips in the project vicinity would occur as a result of construction activities. (I; ST)	5.2.11.5. (Recommended) Measures to plan construction travel routes should be incorporated by the Project Sponsors into contract specification documents to ensure implementation by the construction contractor(s).	I
5.2.11.6. Construction of the Bear Canyon to M-Pad Connector Road could result in a re-distribution of traffic on Bear Canyon Access Road, Socrates Mine Road and State Route 175. (B)	No mitigation is required.	B

ENERGY AND MATERIALS

1-50 5.2.12.1. Construction of the proposed pipelines and related facilities and long-term operation of the pumps would consume substantial amounts of energy, but would be more than offset by the energy derived from injection of the effluent. (B)	No mitigation is required	B

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TABLE 1.5-2: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SOUTHEAST GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
<u>GEOHERMAL RESERVOIR EFFECTS</u>		
5.3.1.1. The proposed injection of effluent could double the recovery rate of injection derived steam (IDS) within several years in Calpine, NCPA and Units 18 and 20 Unocal leaseholds. (B)	No mitigation is required.	B
5.3.1.2. The proposed injection of effluent would slow the rate of decline in the Low Pressure Area (LPA) but would not change its spatial extent. (B)	No mitigation is required.	B
5.3.1.3. The proposed injection of effluent would be compatible with the chemistry of reservoir geothermal fluids and, therefore, would not have significant adverse impacts on geothermal field and power plant operations. (I)	No mitigation is required.	NI
<u>INDUCED SEISMICITY</u>		
5.3.2.1 The project would result in increased microseismicity in the project area and vicinity, but probably would not induce larger earthquakes that pose a substantial threat to public safety and substantial damage to structures. (I)	No mitigation is required.	I
5.3.2.2 The project probably would not result in significantly increased hazards of major earthquakes, but project-related induced seismicity potentially could contribute to minor local property damage. (I)	No mitigation is required.	I

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TABLE 1.5-2: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SOUTHEAST GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
<u>HYDROLOGY AND WATER QUALITY</u>		
5.3.3.1. Effluent injection with the proposed project would not contaminate groundwater aquifers and/or public water supply sources. (I)	No mitigation is required.	I
5.3.3.2. Leakage of effluent through damaged injection well casings could migrate to the surface and contaminate surface water. While highly unlikely, this would be a significant impact if it occurred. The impact is mitigable. (PS)	5.3.3.2. Effluent injection pressures should be monitored in accordance with CDOG&GR and BLM requirements.	I
1-52 5.3.3.3 An accidental spill of injection fluid could result in potentially significant temporary degradation of streams in the Southeast Geysers. The impact is mitigable. (PS)	5.3.3.3-A Employ measures contained in the existing spill prevention control and counter measure plans required by the Hazardous Materials Business Plan and Lake County or Sonoma County Ordinance, as appropriate.	I
	5.3.3.3-B. The operator of the leasehold in which an uncontained spill occurs should undertake clean-up of all damages to the watershed and undertake repair and restoration of the affected stream channels.	I
<u>ENERGY RESOURCE ISSUES</u>		
5.3.4.1. The project is expected to result in (at least) a net increase in electricity generation of approximately 184 million kWh. (B)	No mitigation is required.	B

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TABLE 1.5-2: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SOUTHEAST GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
<u>AIR QUALITY</u>		
5.3.5.1. Construction of secondary distribution lines in the Geysers would generate criteria pollutant emissions from combustion of fuel by construction equipment and from vehicle movement over unpaved roads. Emissions of PM ₁₀ could violate the state PM ₁₀ standard in the immediate vicinity of construction areas. (PS)	5.3.5.1 The project sponsors should follow the same mitigation measures as those discussed under Mitigation 5.2.4.1.A and 5.2.4.1.C (which are related to construction of the Lake Diversion and main effluent pipelines).	I
5.3.5.2. Construction of the distribution pipelines in the Geysers could generate asbestos dust emissions. (PS)	The mitigation measures listed under Impact 5.2.10.1 also apply to this impact.	I
5.3.5.3. Over the long-term, the increase in steam production due to the project would not substantially affect emissions (and downwind concentrations) from geothermal development in the Southeast Geysers since injection-derived steam has low concentrations of non-condensable gases (NCG), including H ₂ S. (I)	No mitigation is required.	I
5.3.5.4. The project could result in the release to the atmosphere of toxic emissions contained in the proposed injection fluid, which would be a combination of water from Clear Lake and effluent from SERWTP and MWTP. (I)	5.3.5.4 (Recommended) Viral and bacterial contamination of IDS and/or effluent should be evaluated to assure absence or destruction of pathogens prior to atmospheric release.	I
5.3.5.5. The project could result in short-term emissions increases during the process of converting production wells to injection wells. (I; ST)	5.3.5.5. (Recommended) In consultation with LCAQMD, the steam field operators shall employ best available emissions control technology and techniques.	I

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TABLE 1.5-2: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SOUTHEAST GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
<u>NOISE</u>		
5.3.6.1. Conversion of production wells to effluent injection wells could result in a temporary noise impacts for the closest residents in the Southeast Geysers and in Anderson Springs. (I;ST)	5.3.6.1. (Recommended) Employ best available (noise) control measures in consultation with LCAQMD.	I
5.3.6.2. With the project, steam production in the Southeast Geysers would decline more slowly than it would without the project and the occasional noise events and complaints that accompany geothermal development activity would decline more slowly as well. (S)	5.3.6.2. The steamfield operators and power plant operators need to continue to work with LCAQMD to minimize the impacts of their activities on nearby residents. This means continuing to use best available (noise) control measures, to notify residents of scheduled noise events (where noise control is infeasible or ineffective), to take into account seasonal and meteorological factors in scheduling noisy activities, among others. *Residual Impact: Since the current, cumulative noise impact of geothermal development activity in the Southeast Geysers is significant, the project's effect of continuing this activity would also have a significant noise impact on the nearest residents.	S*
<u>SOCIOECONOMICS AND PUBLIC SERVICES</u>		
5.3.7.1. The project would continue to provide work opportunity for approximately 112 existing positions in the geothermal industry. (B)	No mitigation is required.	B
5.3.7.2. An economic benefit of the project would result from royalties paid to the federal, state, and county governments and from tax revenues. (B)	No mitigation is required.	B

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TABLE 1.5-3: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SEWTP FACILITIES PLAN COMPONENT

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
<u>GEOLOGY</u>		
5.4.1.1. There are no known geologic hazards or soil limitations which would prevent construction of the proposed treatment and disposal facilities. (NI)	5.4.1.1. Geologic studies should be conducted as part of the detailed design prepared for the construction of the facilities and may include test pits or borings.	I
5.4.1.2. Excavations will be as deep as 12 to 15 feet for the construction of the treatment facilities. Construction of treatment plant facilities will involve excavation of 19,000 cubic yards of earth. Excavated material will be used for backfilling, spread on-site, or hauled to the Eastlake Landfill and used as daily cover material. (I)	5.4.1.2.A. Detailed design plans and specifications should be prepared for the project. They should conform to the Lake County Grading Ordinance and be based on adequate geotechnical design investigation of the project components. For open excavations which are 5 feet or deeper, the contractor should obtain a permit from the applicable agency as required by California Labor Code 6424. 5.4.1.2.B. The project geotechnical investigation should include soils-related design criteria for use in preparation of and/or reviewing the plan. Soil testing and profiling should be done prior to excavation. Compaction should be obtained by mechanical means, hand tamping, or a combination of these methods. 5.4.1.2.C. Design plans and construction specifications for all project facilities and grading shall be prepared by a registered civil engineer subject to approval by the Lake County Public Works and Building Departments. 5.4.1.2.D. The project sponsors shall obtain a grading permit from the Lake County Public Works Department prior to commencement of grading activities. All grading shall be in accordance with the Lake County Grading Ordinance implementation of which is the responsibility of the Lake County Building Department.	I

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TABLE 1.5: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SERWTP FACILITIES PLAN COMPONENT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.4.1.2. (continued)	5.4.1.2.E. No grading shall be conducted during the rainy season or during wet weather. Grading shall be limited to between April 10th through October 10th, unless an extension has been approved by the Public Works and Planning Departments based on dry weather, suitable soil conditions and installed erosion control measures. 5.4.1.2.F. All construction and grading activities shall expose as little new ground surface as possible. In all areas requiring removal of vegetation but no grading, root crowns shall be left intact so as to retard soil erosion. 5.4.1.2.G. Site grading shall be minimized to reduce the possible risk of future slope and/or foundation instability. In required areas to be graded, the ground surface shall be cleared and stripped of vegetation and surface soils containing organic materials. The strippings shall not be used in compacted fills, but shall be saved for reuse in landscaping, unless disposed of off-site in a location approved by the Planning Department. 5.4.1.2.H. Revegetation of graded areas shall take place as quickly as possible as weather permits, but in no case later than October 15th. At a minimum, revegetation shall consist of reseeding with grass all graded areas. Straw and/or mulch shall also be used to control erosion on all graded banks and slopes over 10%. For projects with slopes of 20% or greater, or located within 100 ft. of a blue line water feature (as identified on a USGS map), the project sponsors shall also install a silt fence or straw bales with rebar around downhill perimeters or lakeward of the fill areas prior to grading activities.	

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TABLE 1.5-3: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SERWTP FACILITIES PLAN COMPONENT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.4.1.2. (continued)	5.4.1.2.I. Excavated materials shall not be sidecast or pushed over the edges of slopes during construction and final grading. Cut and fill operations shall be carried out so that earthen materials (rocks, dirt strippings, etc.) shall be disposed of in manner and location approved by the Planning and Public Works Departments. 5.4.1.2.J. Replanting of all exposed surfaces consistent with approved revegetation and slope stabilization plans shall be accomplished within the first growing season following disturbance, unless other scheduling is approved by the Planning Department. 5.4.1.2.K. Loose soil mounds or surfaces shall be protected from wind and/or water erosion by being appropriately covered when construction is not in active progress or when required by the Planning Department. 5.4.1.2.L. The project sponsors shall retain a landscape architect, registered forester, plant ecologist or other qualified professional acceptable to the Planning Director to reevaluate the entire revegetation program during the spring following initial planting. If deemed by the Planning department to be unsuccessful, additional revegetation will be required not later than the immediately succeeding fall season. The revegetation program shall include periodic inspection and upgrading as necessary. All plantings shall be maintained or replanted for the life of the project. 5.4.1.2.M. Culverts, ditches, trash racks, etc. shall be regularly cleaned and maintained in order to keep these facilities operational and reduce the possibility of overflow and resultant erosion siltation impacts.	

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TABLE 1.5-3: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SERWTP FACILITIES PLAN COMPONENT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.4.1.2. (continued)	5.4.1.2.N. Where road alignment traverses hillsides, the road surface shall be sloped toward the hillside to prevent rilling and erosion of downslope areas and fills. 5.4.1.2.O. Road surfaces shall be compacted to at least 95% relative compaction, and all road fills shall be compacted to at least 90% relative compaction. Roads shall be constructed to result in minimal disturbance of soils and vegetation within the project area. Use of out-sloping and water bars shall be incorporated in the design to reduce erosion.	
WATER RESOURCES		
5.4.2.1. Construction at the treatment plant would require extensive modifications of the site in the vicinity of the existing facilities. Care would have to be exercised to ensure that on-going operational performance is not impaired. (I)	No mitigation is required.	I
5.4.2.2. Interference with sludge disposal or utilization and reuse of wastewaters consists primarily of incompatible pollutants which can be concentrated in sludge or by reuse techniques such as land disposal of treated wastewater. Disposal of amounts of priority pollutants in effluent or sludge in excess of RWQCB requirements would be a significant impact. (S)	5.4.2.2.A. Monitoring of the effluent should be continued and the program expanded to include the sampling of priority pollutants annually and monthly for metals and other inorganic constituents. 5.4.2.2.B. The project sponsors would comply with all requirements of the CVRWQCB and the State DWR Division of Water Rights. No discharge of hazardous materials shall be allowed in ground or surface waters.	I
5.4.2.3. Based on the one sample of sludge analyzed, which showed that the sludge has low concentrations of chemical constituents when compared with national sludge quality data, no adverse impact on groundwater from solubilization of trace metals is expected. (I)	5.4.2.3. (Recommended.) Implement measures for controlling sludge disposal including DOHS recommended practices for land spreading.	I

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TABLE 1.5-3: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SERWTP FACILITIES PLAN COMPONENT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.4.2.4. Treated wastewater effluent stored in the reservoir may indirectly recharge the groundwater basin and result in changes in local water quality. (PS)	5.4.2.4. LACOSAN shall continue existing well water monitoring program.	I
5.4.2.5. Effluent runoff from the land disposal areas, if not properly managed, could cause surface contamination of local drainage ways. (I)	No mitigation is required.	I
5.4.2.6. Flooding potential in the project area is minimal except in the unlikely event that the existing reservoir dam were to fail. Should such an event ever occur, water would flow down the creek through Burns Valley to Clear Lake causing minor flooding. Failure of the dam would be a significant impact. (PS)	5.4.2.6. LACOSAN shall continue to perform periodic dam inspections and shall maintain freeboard limits.	I
5.4.2.7. Nutrients contained in treated wastewater could create algal growths which could change water quality in the reservoir and create odors during reservoir drawdown. (I)	5.4.2.7. See Impact 5.4.4.2 for mitigation measures.	I
5.4.2.8. Stormwater runoff from the SERWTP could potentially cause contamination of surrounding surface waters in local drainage ways and Clear Lake. If provisions of the NPDES Permit are adhered to, any impacts from stormwater runoff would be less than significant. (I)	5.4.2.8.A. The general stormwater discharge permit requires industrial dischargers, which includes sewage treatment plants, to: (1) eliminate illicit discharges of stormwater to stormwater systems; (2) develop and implement a stormwater pollution prevention plan; and (3) perform monitoring of discharges to stormwater systems.	I

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TABLE 1.5-3: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SERWTP FACILITIES PLAN COMPONENT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.4.2.8. (continued)	5.4.2.8.B. Drainage plans shall be prepared by a registered civil engineer and submitted to the Lake County Flood Control District and Department of Public Works for approval. All drainage improvements shown on the approved plans shall be implemented into the project. 5.4.2.8.C. Prior to the issuance of grading permits, the LACOSAN shall submit an on-site and downstream off-site drainage plan for the approval of the Lake County Flood Control District. This plan shall include hydraulic calculations on and off-site, and shall address the existing capacity of watercourses and impacts of development using 10 year criteria. Drainage structures shall be designed with adequate capacity for full development of the project site. 5.4.2.8.D. Drainage plans shall distribute storm runoff and channel it to existing natural waterways only to the extent that it will not increase water head to the point of unnatural channel abrasion, nor carry excessive siltation which might adversely impact water quality. Energy dissipators and collection devices to reduce the erosion force of unnatural runoff shall be installed if required by county or state agency representatives.	
BIOLOGY		
5.4.3.1. Construction of the proposed SERWTP facilities is not expected to significantly impact any wildlife species or its habitat within the SERWTP treatment plant boundaries. (I)	No mitigation is required.	I
5.4.3.2. Operation of the proposed SERWTP facilities could have an adverse effect on the biotic resources in the project area if a spill occurs. The spilled effluent water would drain to Burns Valley Creek and to Clear Lake. (PS)	5.4.3.2 Nutrient loads of effluent disposed to surface waters should be minimized and the project should comply with CRWQCB and California Department of Fish and Game requirements and recommendations regarding water quality.	I

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TABLE 1.5-3: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SERWTP FACILITIES PLAN COMPONENT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
<u>AIR QUALITY</u>		
5.4.4.1. The estimated nitrogen dioxide emissions of 235 lb NO _x /day and the 158 lb TSP/day indicate that the construction of proposed SERWTP facilities will require a LCAQMD Authority to Construct since the New Source Review limits are surpassed by nitrogen dioxide and the Total Suspended Particulate emissions as outlined in LCAQMD Rule 602. (PS; ST)	5.4.4.1.A. The construction contractor shall comply with dust control procedures required by the LCAQMD. 5.4.4.1.B The LACOSAN shall obtain an Authority to Construct and maintain a Permit to Operate from the Lake County Air Quality Management District (LCAQMD). All conditions of the LCAQMD Authority to Construct and Permit to Operate are herein referenced and made part of this project description. 5.4.4.1.C. The LACOSAN shall comply with all applicable local, state and federal laws and regulations regarding air contaminants. This requirement includes, but is not limited to, emissions of suspended particulates, carbon monoxide, hydrocarbons, odors, and toxic or obnoxious gases and fumes. 5.4.4.1.D. The LACOSAN shall utilize best available air emissions control technology as necessary to minimize emissions subject to the approval of the Lake County Air Quality Management District. *Residual Impacts: The impacts of TSP would be insignificant. Impacts related to NO_x emissions would remain significant after mitigation.	S*
5.4.4.2. The proposed improvements to the facility will result in greater reliability in maintaining the sewage treatment operations within standards and will result in a reduced likelihood of odor generation. (B; LT)	No mitigation required.	B

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TABLE 1.5-3: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SERWTP FACILITIES PLAN COMPONENT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.4.4.3. There is a potential for odor generation from soils upon excavation during the civil construction of proposed improvements. (UI)	5.4.4.3. The soils engineer should evaluate the potential for odor generation upon excavation and mitigation measures should be developed and implemented if deemed necessary by the LCAQMD.	I
5.4.4.4. New pumps and operation support equipment will be electrically powered. The emissions associated with their use are considered to be minor and will not significantly impair achieving regional air quality goals. (I)	No mitigation is required.	I
NOISE		
5.4.5.1. Construction at the treatment plant site for the excavation of the various facilities, demolition of some existing facilities and transportation to and from the site would increase existing noise levels. The incremental increase over background noise levels created by these activities is estimated at 86 dBA at 50 ft. (S; ST)	5.4.5.1. Construction noise can be reduced by ensuring that the equipment uses proper mufflers and that the construction activities occur only during acceptable hours as specified in the Lake County Zoning Ordinance section 41.11. See also Mitigation in Section 5.2.5. *Residual Impacts: Implementation of Mitigation 5.4.5.1 would reduce noise during periods of particular annoyance to residents, but noise levels would remain significant at other times.	S*
5.4.5.2. The proposed additional wastewater processing equipment at the SERWTP will generate operational noise which will add incrementally to the existing noise levels. Since the closest neighbors are 2,000 ft away, background noise levels caused by the additional equipment and activities at the site are estimated to be below 55 dBA, Ldn. (I)	5.4.5.2 (Recommended) Generating equipment which creates the least noise should be considered in the selection of aeration equipment. Equipment should be selected on the basis that it should not result in noise levels greater than 45 dBA at the SERWTP boundary if it is to operate at night.	I

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TABLE 1.5-3: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SERWTP FACILITIES PLAN COMPONENT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
<u>CULTURAL RESOURCES</u>		
5.4.6.1. Because of the extensive previous analysis at the SERWTP site, it is not anticipated that new cultural resources would be encountered during facilities construction. However, if resources are present, their disturbance would constitute a potentially significant impact. (PS)	5.4.6.1.A. Should archaeological materials be discovered during development, all activity should be temporarily halted in the vicinity of the finds and a qualified archaeologist shall be retained to evaluate the finds and to recommend mitigation procedures if necessary. 5.4.6.1.B. The LACOSAN shall contact a designated member of the Native American community acceptable to the Lake County Planning Department prior to grading, trenching or excavation. 5.4.6.1.C. All grading, trenching or excavation shall be conducted in the presence of a qualified archaeologist. Should any cultural or archaeological resource be discovered, all work shall halt in the vicinity of the find(s) until the archaeologist determines the significance of the resource and recommends mitigations. Mitigation measures, if necessary, shall be implemented subject to the approval of the Planning Department. 5.4.6.2.D. Alterations to cultural site shall be subject to the review and approval of the Lake County Cultural Resource Commission unless waived by the Planning Director consistent with Article 21-38.4 of the Lake County Zoning Ordinance.	I
<u>VISUAL</u>		
5.4.7.1. The proposed SERWTP facilities would be constructed immediately adjacent to the existing facilities in an area previously disturbed by construction activities. Therefore, significant visual impacts are not anticipated. (I)	5.4.7.1.A. (Recommended) Architectural features and landscaping of the new facilities should be submitted to Lake County and City of Clearlake Planning Departments for review.	I

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TABLE 1.5-3: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SERWTP FACILITIES PLAN COMPONENT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.4.7.1. (continued)	5.4.7.1.B. (Recommended) Trees should be planted in the irrigation buffer area to help reduce drift of aerosols and improve plant area appearance, and should be protected effectively from grazing animals. There should be continued maintenance to ensure that the landscaping at the SERWTP is maintained, watered and pruned, and the attractiveness of the facilities is maintained by painting etc. 5.4.7.1.C. The following mitigation conditions shall also be applied: The permittee shall submit a detailed landscape plan meeting zoning ordinance standards for review and approval by the Lake County Planning Director; and, irrigation and the placement of landscape plants within the dripline area of oaks shall be avoided. 5.4.7.1.D. Development of the site shall maximize the retention of existing vegetation and the protection of trees on the site. The landscape plan shall show all trees over 4 inches in diameter at 3 feet in height in the proposed development area, and indicate which will be retained and which are proposed for removal. No development or irrigation shall occur within the dripline of all remaining trees unless specifically approved in the landscape plan.	
<u>LAND USE</u>		
5.4.8.1. Construction at the SERWTP would convert 10 acres from other uses to facilities. (I)	No mitigation is required.	I
5.4.8.2. Implementation of the proposed project would result in compliance with CRWQCB Waste Discharge Requirements and lifting of the building moratorium now in effect. Development may then take place in accordance with County and City planned growth, with related changes in land use. (B)	No mitigation is required.	B

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TABLE 1.5-3: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SERWTP FACILITIES PLAN COMPONENT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
<u>SOCIOECONOMICS AND PUBLIC FACILITIES</u>		
5.4.9.1. Implementation of the proposed facilities improvements would allow lifting of the existing moratorium on new connections and permit planned growth consistent with the Lake County and City of Clearlake General Plans. (B)	No mitigation is required.	B
<u>ENVIRONMENTAL CONTAMINATION HAZARDS</u>		
5.4.10.1. The estimated risks on an annual basis for the existing use of chlorine at the SERWTP is considered insignificant. (I)	5.4.10.1.A. (Recommended) The most important precaution is the proper handling of the chemicals and the proper maintenance of equipment. Operator training in this regard is therefore very important. 5.4.10.1.B. (Recommended) The chlorination/sulfur dioxide facilities should be located as far from any residences as feasible. 5.4.10.1.C. (Recommended) Nearby residents should be educated regarding chlorine odors and what to do if chlorine odors or an alarm are noticed. 5.4.10.1.D. Prior to storage, a chlorine leak detector shall be installed which will be transmitted by a telephone dialer to the Fire Protection District office and the Lake County Sheriff's Department. An emergency airpack for entrance into the operations room in the event of a chlorine leak shall be available on-site. 5.4.10.1.E. All areas designated for liquid fuel storage shall include secondary containment features equal to at least 150% of the fuel storage tank volume in compliance with Uniform Fire Code Section 79.508. No liquid fuels shall be stored on the property until these containment features have been completed and approved by the Lake County Environmental Health Department and OSHA. At no time shall liquid fuel storage take place outside of a designated and contained fuel storage area.	I

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TABLE 1.5-3: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SERWTP FACILITIES PLAN COMPONENT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.4.10.1. (continued)	5.4.10.1.F. The permit holder shall contractually obligate all associated contractors and their subcontractors to conduct a vehicle inspection of each truck hauling toxic or hazardous materials prior to leaving the project site.	
<u>TRAFFIC AND CIRCULATION</u>		
5.4.11.1. There would be short-term increases in vehicular activity associated with the construction of the proposed facilities. There would be construction employees coming to the sites and the transport and use of heavy equipment in the form of a grader, a bulldozer, a scraper, a loader and necessary haul trucks. (S; ST)	5.4.11.1.A. (Recommended) The local residents should be notified in advance of the construction schedule of the possible inconveniences they may incur as a result of the construction activities. Proper road signs and signal personnel should be utilized to ensure that public and occupational safety is maintained during construction.	I
	5.4.11.1.B. (Recommended) Movement of heavy equipment should be scheduled to avoid commute hours on Highway 53 and school bus hours.	
	5.4.11.1.C. (Recommended) Repair of any damage to roads from truck traffic or equipment should be done immediately.	
	5.4.11.1.D. All parking and access areas shall be continuously maintained in good repair throughout the life of the project.	
	5.4.11.1.E. LACOSAN shall obtain all required encroachment permits from DPW, Caltrans and the City of Clearlake.	
	5.4.11.1.F. The project sponsors shall be responsible for repair of any direct verifiable damage to public roadways resulting from construction or operation of this project.	

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TABLE 1.5-3: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO THE SERWTP FACILITIES PLAN COMPONENT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
5.4.11.1. (continued)	5.4.11.1.G. The LACOSAN and all subcontractors operating under the authority of this project shall comply with speed limits and all other traffic laws on public roadways. Construction-related truck traffic shall avoid school busing hours. 5.4.11.1.H. All extra-wide and slow-moving vehicles shall be preceded by a flag car while on public roadways. The California Highway Patrol shall be notified of hazardous waste transport schedules by the permit holder. 5.4.11.1.I. The LACOSAN shall install necessary traffic signs and/or striping as recommended by the Lake County Department of Public Works and the City of Clearlake.	

ENERGY AND MATERIALS

5.4.12.1. Due to the improvements to the SERWTP which will accommodate future growth, the electrical consumption is expected to increase by about 20% - 35%. This would be an insignificant increase.	No mitigation is required.

TABLE 1.5-4: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO ALTERNATIVES TO THE PROPOSED PROJECT

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
<u>Alternate Route A-1 and A-2</u>		
Impacts for the project design alternative would be similar to those for the proposed project in the areas of Geology, Soils and Seismicity; Biological Resources, Air Quality, Noise, Cultural Resources, Visual Resources, Socioeconomics and Public Facilities, Traffic and Circulation, and Energy and Materials.		
Impact 5.2.1.1 also applies to this alternative. (S)	Mitigation Measures 5.2.1.1 A-K also apply.	I
6.3.2.2. Silt generated by construction would be conveyed down the corridor to Dam Road and from there into the Clear Lake Outlet Channel (CLOC). (PS)	Mitigation identified in Section 6.3.1 also applies to this impact.	I
Impacts 5.2.10.2 through 5.2.10.4 would also apply to this alternative route.		
<u>Alternate Route B</u>		
Impacts for the project design alternative would be similar to those for the proposed project in the areas of Air Quality, Noise, Cultural Resources, Visual Resources, Land Use, Socioeconomics and Public Facilities, Traffic and Circulation, and Energy and Materials.		
6.3.1.1. Construction of the alternate crossing could result in significant erosion hazard and a hazard of stream erosion undermining the pipeline. (PS)	Mitigation measures 5.2.1.1.A through K would apply to this segment.	I

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TABLE 1.5-4: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO ALTERNATIVES TO THE PROPOSED PROJECT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
6.3.2.3. Construction of the pipeline at this alternate location could result in significant short term silt deposition in Clayton Creek. (S)	Mitigation measures identified for the proposed project, including Mitigation 5.2.2.1, should also be applied to this alternate crossing.	I
6.3.3.1. Construction of the proposed alternate route potentially could affect northwestern pond turtles and habitat of the black-shouldered kite. The impact is potentially significant but of short term. The impact on the habitat is less than significant unless northwestern pond turtles are present. If that species is present, Impact 5.2.3.2 would apply to this site. Similarly, this area may provide habitat for the black-shouldered kite, as discussed in Impact 5.2.3.6. The impact and mitigation measures already apply to the proposed crossing of Clayton Creek, and are assumed to be equally applicable to this alternative. (PS; ST)	Mitigation 5.2.3.2.A and B and Mitigations 5.2.3.6.A and B would apply to this site.	I
Impacts 5.2.10.2 through 5.2.10.4 would also apply to this alternative route.		
<u>Alternate Route C</u>		
There are no significant environmental impacts associated with this alternative.		
Impacts for the project design alternative would be similar to those for the proposed project in the areas of Hydrology and Water Quality, Air Quality, Noise, Cultural Resources, Visual Resources, Land Use, Socioeconomics and Public Facilities, Traffic and Circulation, and Energy and Materials.		

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TABLE 1.5-4: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO ALTERNATIVES TO THE PROPOSED PROJECT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
This alternative would have the beneficial effect on Visual Resources of preserving several large conifers and deciduous trees along the east side of the road. (B)		
Impacts 5.2.10.2 through 5.2.10.4 would also apply to this alternative route.		
<u>Alternate Route D</u>		
Impacts for the project design alternative would be similar to those for the proposed project in the areas of Biological Resources, Air Quality, Noise, Cultural Resources, Visual Resources, Land Use, Socioeconomics and Public Facilities, Traffic and Circulation, and Energy and Materials.		
6.3.1.2. Construction in this alignment would likely be subject to high erosion hazards similar to those described in Impact 5.2.1.1. (S)	Mitigation Measures 5.2.1.1.A through K also would apply to this segment.	I
6.3.2.4. Construction of the pipeline at this alternate location could result in potentially significant erosion, with silt deposition ultimately in Big Canyon Creek. (PS)	Mitigation measures included under Section 6.3.1, and as part of the proposed project, including Mitigation 5.2.2.1, also would apply to this impact.	I
Impacts 5.2.10.2 through 5.2.10.4 would also apply to this alternative route.		

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TABLE 1.5-4: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO ALTERNATIVES TO THE PROPOSED PROJECT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
<u>Alternate Route E</u>		
There are no significant environmental impacts associated with this alternative.		
Impacts for the project design alternative would be similar to those for the proposed project in the areas of Air Quality, Noise, Cultural Resources, Visual Resources, Land Use, Socioeconomics and Public Facilities, Traffic and Circulation, and Energy and Materials.		
Impacts 5.2.10.2 through 5.2.10.4 would also apply to this alternative route.		
<u>Alternate Route F</u>		
Impacts for the project design alternative would be similar to those for the proposed project in the areas of Air Quality, Noise, Cultural Resources, Visual Resources, Land Use, Socioeconomic and Public Facilities, Traffic and Circulation, and Energy and Materials.		
6.3.1.3. Because this route ascends a steep slope with erodible soils, erosion hazards would be high, as described in Impact 5.2.1.1. (PS)	Mitigation Measures 5.2.1.1.A through K also would apply to this segment. Additionally, double debris fences should be installed on both sides of the ridgeline. Following construction, all debris entrapped in the fences should be collected and removed to a suitable spoil disposal site.	I

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TABLE 1.5-4: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO ALTERNATIVES TO THE PROPOSED PROJECT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
6.3.2.5. The impacts on runoff and water quality of this alternative would be less than significant for the portion in the Bear Canyon Access Road to the Bear Canyon Power Plant, but potentially significant for the portion between the power plant and the NCPA M-Pad. (PS)	Careful slope stabilization methods and revegetation should be required to ensure that the erosion and silt generation would be minimized (see Section 6.3.1).	I
6.3.3.2. The project alternative would contribute to permanent cumulative loss of mixed chaparral and montane hardwood habitat of the Cooper's hawk and sharp-shinned hawk. As with Impact 5.2.3.11, construction of this alternate would contribute to the potentially significant cumulative impacts on these habitats of the Cooper's hawk and sharp-shinned hawk. <i>Napa lomatum</i> also may be present and lost due to construction. (PS;CUM)	Mitigation Measures 5.2.3.5 and 5.2.3.7 also would apply to this alternative. Preservation of the plants is recommended, but not required.	I
Impacts 5.2.10.2 through 5.2.10.4 would also apply to this alternative route.		
<u>Alternate Route G</u>		
There are no significant environmental impacts associated with this alternative.		
Impacts for the project design alternative would be similar to those for the proposed project in the areas of Air Quality, Noise, Cultural Resources, Visual Resources, Land Use, Socioeconomics and Public Facilities, Traffic and Circulation, and Energy and Materials.		

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TABLE 1.5 4: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO ALTERNATIVES TO THE PROPOSED PROJECT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
Impacts 5.2.10.2 through 5.2.10.4 would also apply to this alternative route.		
This Alternate Distribution Pipeline Route would have the beneficial impact of avoiding lane closures at the busy NCPA gate. (B)	No mitigation is required.	
<u>All Alternate Pipeline Routes</u>		
6.3.10.1. If the alternative routes are near any of the sites listed in Table 4.11.2-2, project construction could expose workers to hydrocarbon vapors, and could interfere with ongoing clean-up activities. (PS)	6.3.10.1.A Prior to excavating near a site under remediation, the Lake County Division of Environmental Health shall be consulted. Department recommendation shall be followed or the pipeline rerouted around the contaminated area.	I
<u>Alternate Site For Childer's Peak Regulating Tank</u>		
Impacts for the project design alternative would be similar to those for the proposed project in the areas of Geology, Soils and Seismicity, Hydrology and Water Quality, Biological Resources, Air Quality, Noise, Cultural Resources, Visual Resources, Land Use, Socioeconomics and Public Facilities, Traffic and Circulation, and Energy and Materials.		
Construction of this site would require a greater amount of grading, including possibly blasting, as compared to the proposed site. The cut into the hillside to create a pad for the tank, would introduce some potential slope instability. (PS)	As with the proposed project, at least three exploratory borings should be drilled to assess the variability of subsurface conditions. The proposed 10-foot high 1.5:1 slopes probably would be stable and pose minimal hazard for the proposed tank. Additional mitigation is not necessary.	I

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TABLE 1.5-4: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO ALTERNATIVES TO THE PROPOSED PROJECT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
The impacts on hydrology and water quality would be similar to those of the proposed project, but possibly greater in intensity because of the greater amount of grading and related silt generation. Additionally, cuts in the hillside could encounter seeps of groundwater draining from the slopes of Childer's Peak. (PS)	Mitigation measures for the proposed project, including Mitigation 5.2.2.1, would also apply to this alternative. Additionally, if seeps are encountered during grading of the site, proper drainage features should be constructed to collect the flow of groundwater and channel it in a controlled manner to the drainage system.	I
6.3.3.3. The project would result in the potential loss of two special status plant species. (PS)	Mitigation 5.2.3.9 also would apply to this alternative.	I
<u>Lake Diversion Pumps and Pipeline on Pier</u>		
Impacts for the project design alternative would be similar to those for the proposed project in the areas of Geology, Soils and Seismicity; Biological Resources, Air Quality, Cultural Resources, Land Use, Socioeconomics and Public Facilities, Traffic and Circulation, and Energy and Materials.	No effective mitigation is possible. *Residual Impact: The impacts on water quality from construction of the pier probably would be approximately similar in kind but somewhat greater than those of the proposed project.	PS*
6.3.2.1. The driving of piles for the pier would substantially increase turbidity of water locally. The impact would be potentially significant but of short-term duration, probably on the order of about one month. (PS: ST)		
6.3.5.2. Construction of the proposed pier would result in significant short-term noise related to pile driving. (S: ST)	6.3.5.2. Limit pile driving activities to the hours of 8:00 a.m. to 5:00 p.m., Monday through Saturday. *Residual Impact: Implementation of Mitigation 6.3.5.2 would reduce the relative degree of annoyance of the noise but would not affect noise levels.	PS*

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TABLE 1.5-4: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO ALTERNATIVES TO THE PROPOSED PROJECT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
6.3.7.1. The alternative pier and pumphouse would result in a significant alteration of the visual environment. The impact is unavoidable. (S)	No effective mitigation is possible. Residual Impact: The pier would have to be constructed and lighted so as to visible to boats. The impact is unavoidable.	S*
<u>Bear Canyon Single Pump Station</u>		
Impacts for the project design alternative would be similar to those for the proposed project in the areas of Geology, Soils and Seismicity, Air Quality, Cultural Resources, Land Use, Socioeconomics and Public Facilities, Traffic and Circulation, and Energy and Materials.		
6.3.5.1. Operation of one large pump station at the foot of Bear Creek Road (rather than a series of five smaller pump stations up to the Y-Pad tank) could result in a significant noise impact since this larger pump station would not be enclosed (as proposed). The nearest residence would likely experience noise levels in excess of 50 dBA, Ldn from the pumps at this station. (S; LT)	6.3.5.1. If this alternative design component is chosen, re-design the pump station so that the pumps would be enclosed.	I
The primary impact would be the loss of several large trees and Valley Oak Woodland habitat similar to Impact 5.2.3.13. These trees may provide habitat for Cooper's hawk and sharp-shinned hawks, and impacts would be the same as those described for Impact 5.2.3.7. (PS)	Related Mitigation 5.2.3.13 and 5.2.3.7 would apply to the site.	I

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TABLE 1.5-4: SUMMARY OF IMPACTS AND MITIGATION MEASURES RELATED TO ALTERNATIVES TO THE PROPOSED PROJECT (Continued)

ENVIRONMENTAL IMPACT	MITIGATION	LSAM
The proposed facilities would be located immediately adjacent to a well-travelled highway. They would be visible in the foreground views of travellers in both directions on SR175. The proposed facilities would contrast strongly with the existing landscape. (I) <u>One-way Surge Tank in the Geysers</u> There are no significant environmental impacts associated with this alternative.	No mitigation is required.	I
The tank would be another industrial type feature in the landscape that already has substantial modification for facilities of the geothermal industry. The proposed site is located in a seldom-seen area for the public. (I) <u>By-Pass Pipeline at the SERWTP</u> There are no significant environmental impacts associated with this alternative.	No mitigation is required.	I

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- Impact 5.4.5.1. Construction at the SERWTP site for the excavation of the various facilities, demolition of some existing facilities and transportation to and from the site temporarily would increase existing noise levels to 86 dBA at 50 feet. This is estimated to impact the closest residence, during peak construction, at 54 dBA.
- Impact 5.3.6.2. With the project, steam production in the Southeast Geysers would decline more slowly than it would without the project and the occasional noise events and complaints that accompany geothermal development activity would decline more slowly as well. Since the current, cumulative noise impact of geothermal development activity in the Southeast Geysers is significant, the project's effect of continuing this activity would also have a significant long-term indirect noise impact on the nearest residents.

1.5.2 GROWTH INDUCEMENT

Growth inducement may constitute an adverse impact if the growth is not consistent with the land use plans and growth management plans and policies of the area affected. The proposed expansion of wastewater treatment facilities and the disposal of treated effluent are actions that remove a primary growth obstacle in the SERWTP service area, therefore this project would be growth inducing. However, implementation of the proposed project would allow lifting of the existing moratorium on new connections and permit planned growth, consistent with the Lake County and City of Clearlake General Plans. Therefore, growth inducement in the City of Clearlake and Lower Lake areas would be a beneficial, as opposed to an adverse impact. The proposed disposal of sewage from the Middletown WTP would not be growth inducing. There would be no effect on growth in Sonoma County.

1.5.3 CUMULATIVE IMPACTS

A cumulative impact assessment can be based on a list of reasonably foreseeable future projects in the project area or on a general projection of future growth. Section 7.4 of the EIR/EIS contains information for both approaches.

Construction of the listed approved and pending projects and the proposed project would result in the following potentially significant short-term cumulative impacts:

- Erosion hazards and silt generation, particularly in the Clearlake area. As a major construction project in Clearlake, it would be one of the major sources of short-term erosion combined with that of the other projects. Mitigation measures for erosion control would be applied to these projects and would substantially reduce erosion problems to an acceptable level.
- The exposure of residents to the earthquake hazards of the region due to the anticipated increase in population in the region;

- Potentially significant cumulative silt generation;
- Substantially increased use of water resources for domestic, commercial and industrial uses;
- Substantial generation of wastewater;
- The disturbance of a significant area of open space in Lake County and associated habitats;
- The loss of natural vegetation and wildlife habitat in both the SERWTP service area and in the county as a whole, specifically, the permanent reduction of habitat of the northwestern pond turtle, red-legged frog, foothill yellow-legged frog, California horned lark, loggerhead shrike, black-shouldered kite, Cooper's hawk and sharp-shinned hawk.
- The cumulative loss of individual plants including listed and candidate plant species, and other special status plant species;
- Air quality degradation related to construction of approved and pending projects in the service area. The timing of these projects are uncertain, and thus the impacts may not occur concurrently.

1.6 ENVIRONMENTALLY PREFERRED ALTERNATIVE

Section 1505.2(b) of NEPA requires that the Record of Decision must identify all alternatives that were considered . . . "specifying the alternative or alternatives which were considered to be environmentally preferable." The environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in NEPA, Section 101. This may be interpreted to mean the alternative that causes the least damage to the biological and physical environment and/or which best protects, preserves and enhances historic, cultural and natural resources. The lead agency is not required to select the environmentally preferred alternative as the preferred project under Council on Environmental Quality regulations, as other factors such as schedule, cost, technology and policy considerations may be considered. However, such considerations should be entered into the BLM's Record of Decision when the preferred alternative is not also the environmentally preferred alternative.

For the proposed project, the environmentally preferred alternative is the project as proposed with inclusion of Alternative Route F. Alternative Route F (stations 121.0-124.0) would replace the proposed segment of the route requiring construction of a new road between the Bear Canyon Access Road and the M-Pad with a route that trends up the hill behind the Bear Canyon Power Plant to the M-Pad. Use of Alternative F would substantially reduce the amount of grading and

reduce the amount of vegetation disturbance which provides habitat for some sensitive species of wildlife. It would eliminate the need for placing a substantial fill in an intermittent creek canyon, with consequent losses of riparian values and short-term impacts on water quality. Alternative F would present some constraints for access for purposes of inspection of the alignment. It would not provide as good access to the pipeline for the response to a potential leak or spill resulting from a break as that provided by the proposed project. It would have some visual impact, regarded as insignificant.

1.7 RESPONSIBLE PARTIES AND AGENCIES EXPECTED TO USE THIS EIR/EIS

1.7.1 PROJECT SPONSORS

The project sponsors, which include companies and/or agencies participating in the project, are the Lake County Sanitation District (LACOSAN), Calpine Corporation, Northern California Power Agency and Unocal Corporation. Pacific Gas and Electric Company (PG&E) is participating to the extent that it would purchase effluent-derived steam from Calpine and Unocal.

1.7.2 PROJECT OPERATORS

The project operators include the Lake County Sanitation District (LACOSAN) with responsibility for operating the SERWTP, Lake Diversion Facilities, Middletown Wastewater Treatment Plant Pump Station, and secondary response for systems operation regarding the flow of treated effluent from the SERWTP into the Geysers Effluent Pipeline.

Calpine Corporation, Unocal and Northern California Power Agency (NCPA) share responsibility for operation of the project with regard to injection of the effluent into the geothermal reservoir. NCPA has been delegated primary responsibility for monitoring and control of the effluent systems operation in the Geysers Effluent Pipeline. NCPA, Unocal and Calpine Corporation each have responsibility for operation of their separate injection programs in the Southeast Geysers.

PG&E has responsibility for supplying power to operate all components of the system.

All construction costs will be shared by LACOSAN, Calpine, NCPA, Unocal and PG&E as well as other federal and state funding sources.

1.7.3 CEQA AND NEPA CO-LEAD AGENCIES AND COOPERATING AGENCIES

The CEQA lead agency is LACOSAN.

The NEPA lead agency is the BLM, Ukiah District.

The U.S. Department of Energy is a cooperating federal agency. The State of California Energy Commission is a cooperating state agency. The U.S. Department of Commerce/Economic Development Administration, the U.S. Department of Agriculture/Rural Development Administration and the U.S. Environmental Protection Agency are also possible cooperating agencies as they will use this EIR/EIS to support a decision on whether to fund the project. The State of California Water Resources Control Board is also a potential cooperating agency.

1.7.4 PERMITTING AGENCIES AND AGENCIES EXPECTED TO USE THE EIR/EIS

Agencies expected to use the EIR/EIS include all agencies with permitting or authorization approval. These include federal, state and local governments. Additional agencies expected to use the EIR/EIS include trustee agencies, which have an advisory responsibility, and funding agencies. Table 1.7-1 lists each of the agencies and their respective roles.

1.7.5 PROJECT PLANNERS AND ENGINEERS

Project planning has been provided by Criterion, Engineers and Planners, Inc., Portland, OR.

Preliminary engineering and design has been provided by Dewante and Stowell Engineering, Sacramento, CA; Eco:Logic Consulting Engineers, Roseville, CA; and Veizades & Associates Consulting Engineers, San Francisco, CA.

Environmental analysis and planning has been provided by Environmental Science Associates, Inc., San Francisco, CA, and by Goddard and Goddard Engineering, Lucerne, CA., with the assistance of the following consultants: Sonoma State University Academic Foundation, Cultural Resources Facility; GeothermEx. Inc.; Michael J. Dwyer Consulting Engineering Geologist; Jan Newton Ph.D.; and Golder Associates, Inc.

TABLE 1.7-1: RESPONSIBLE PARTIES AND AGENCIES EXPECTED TO USE THE EIR/EIS

<u>Action Requiring Permit/Consultation</u>	<u>Agency</u>	<u>Permit or Approval</u>	<u>Statutory Authority</u>
Federal			
Right of Way on Public Land for a Project Related to Development in a Federal Geothermal Lease	BLM	Right-of-Way Grant	Federal Land Policy and Management Act
Drilling of New Injection Wells	BLM	Geothermal Drilling Permit	Steam Act 43 CFR 3260
Conversion of Existing Wells to Injection	BLM	Geothermal Sundry Notice	Steam Act 43 CFR 3260
Grant of ROW/Lease Fluid Injection	BLM	Land Use permit Injection permit	Federal Land Policy and Management Act; Title 43, Subchapter C Part 3000, Geothermal Steam Act
Fill Material Placement or Dredging	Army Corps of Engineers	<i>Informal</i> Consultation, Nationwide permit possible	Sec. 404 Clean Water Act, 33 U.S.C. Sec. 1344; Executive Order 11990 (Protection of Wetlands) & Order 11988 (Flood Plain Management)
Disturbance of Special Status Plants and Animals	U.S. Fish and Wildlife Service	<i>Informal</i> Consultation, No permit foreseen	Fish and Game Code Sec. 2080-2085
Disturbance of Cultural Resources	Advisory Council on Historic Preservation	Consultation; Memorandum of Agreement	National Historic Preservation Act Section 106
"	Native American Heritage Commission	Consultation	
Construction of Pipeline and Pump Stations - Worker Safety	Occupational Safety & Health Administration	Compliance with OSHA Regulations	29 CFR 1910 29 CFR 1926
Funding	U.S. Department of Energy	No permit; DOE is a cooperating agency	

(Continued)

TABLE 1.7-1: RESPONSIBLE PARTIES AND AGENCIES EXPECTED TO USE THE EIR/EIS
(Continued)

<u>Action Requiring Permit/Consultation</u>	<u>Agency</u>	<u>Permit or Approval</u>	<u>Statutory Authority</u>
Funding	U.S. Department of Commerce/Economic Development Administration	No Permit: EDA is a potential cooperating agency	-
Funding	U.S. Department of Agriculture, Rural Development Administration	No Permit: RDA is a potential cooperating agency	-
Funding	U.S. Environmental Protection Agency	No Permit: EPA is a potential cooperating agency	-
State			
Crossing of State Highway ROW	CA DOT (Caltrans)	Encroachment Permit	Streets and Highways Code Secs. 660-734
Disturbance of Streamcourse and Lake Bottom	State Lands Commission	County Lakebed Management encroachment permit required for pier	
Disturbance of Streamcourse and Lake Bottom	CA Dept. of Fish and Game	Stream /Lake Alteration Agreement	Fish and Game Code Secs. 1600-1607
Disturbance of Special Status plants and animals	CA Dept. of Fish and Game	<i>Informal</i> Consultation No permit foreseen	CA Endangered Species Act: Fish and Game Code Sec. 2080-2085
Discharges into Waters of the State - Hydrostatic Test Water	Central Valley Regional Water Quality Control Board	Permit to Discharge	Porter Cologne Act
" - Construction -related Pollutants	"	National Pollutant Discharge Elimination System Stormwater Permit for Construction	Clean Water Act
Discharges into Waters of the State - Hydrostatic Test Water	North Coast Regional Water Quality Control Board	Permit to Discharge	Porter Cologne Act

(Continued)

TABLE 1.7-1: RESPONSIBLE PARTIES AND AGENCIES EXPECTED TO USE THE EIR/EIS
(Continued)

<u>Action Requiring Permit/Consultation</u>	<u>Agency</u>	<u>Permit or Approval</u>	<u>Statutory Authority</u>
" - Construction -related Pollutants	"	National Pollutant Discharge Elimination System Stormwater Permit for Construction	Clean Water Act
Fluid Injection	California Division of Oil and Gas & Geother- mal Resources	Notice of Intent Responses to Written Orders	CA Code Title 14, Division 2
Air Pollutant Emissions for Construction and at Pump Stations	Lake Co. AQMD	Authority to Construct Permit to Operate	Clean Air Act; CA Health and Safety Code, Sec. 39000-43834
Air Pollutant Emissions for Construction	Northern Sonoma County APCD	Authority to Construct Permit to Operate	Clean Air Act; CA Health and Safety Code, Sec. 39000-43834
Funding	California Energy Commission	No Permit: CEC is a cooperating agency	-
Funding	State Water Resources Control Board	No Permit: SWRCB is a potential cooperating agency	
Local			
Construction and Operation	Lake County	Building Permits Grading Permits Access Easements Encroachment Permits	Lake County Ordinances
Construction and Operation	Sonoma County	Building Permits Grading Permits Access Easements Encroachment Permits	Sonoma County Ordinances
Construction and Operation	City of Clearlake	Building Permits Access Easements Use Permits in Streets	City Ordinances

(Continued)

TABLE 1.7-1: RESPONSIBLE PARTIES AND AGENCIES EXPECTED TO USE THE EIR/EIS
(Continued)

<u>Action Requiring Permit/Consultation</u>	<u>Agency</u>	<u>Permit or Approval</u>	<u>Statutory Authority</u>
Sale of Lake Diversion Water	Yolo County Flood Control and Water Conservation District	Sale Agreement	

SOURCE: Environmental Science Associates, Inc., 1994

2.0 DESCRIPTION OF THE PROPOSED PROJECT

2.1 OVERVIEW AND BACKGROUND TO THE PROJECT

The proposed project is a plan to:

- (1) expand the plant capacity and wastewater treatment facilities at the Southeast Regional Wastewater Treatment Plant located near the City of Clearlake, California, as mandated by a Cease and Desist Order issued by the Central Valley Regional Water Quality Control Board,
- (2) transport the effluent mixed with diverted lake water in a 26-mile pipeline to The Geysers, adding in effluent from the Middletown Wastewater Treatment Plant, and
- (3) inject the effluent into The Geysers steam field to produce steam used in power generation.

The following sections of this chapter present the background to the project and a description of the project. For purposes of analyzing the environmental effects of the project in this EIR/EIS, the three primary components of the project are described: (1) the Geysers Effluent Pipeline Project Component; (2) the Southeast Geysers Effluent Injection Program Plan Component; and (3) the Southeast Regional Wastewater Treatment Facilities Plan Component. This chapter also describes eventual abandonment or reuse of the proposed project facilities as well project economics and financing.

2.1.1 EXISTING AND PROJECTED WASTEWATER GENERATION

The primary reason for proposing the project is the need to provide additional wastewater treatment capacity for the Clearlake and Lower Lake areas. The existing Southeast Regional Wastewater Treatment Plant (SERWTP), located north of Clearlake, began operation in 1975. The plant is owned and operated by the Lake County Sanitation District (LACOSAN). The installed plant capacity is 1.49 million gallons per day (mgd) and can handle peak flows up to 2.75 mgd. Secondary treatment is provided using an oxidation ditch biological treatment system and chlorine disinfection of the treated wastewater. The treated wastewater which is available for disposal is termed "effluent". The effluent is stored in a reservoir adjacent to the treatment plant and is discharged to a land disposal system through spray irrigation for part of the year. The irrigation system currently is not adequate to dispose of all of the effluent volume under certain conditions (to be described later).

2.0 Description of the Proposed Project

2.1 Overview and Background to the Project

Growth in the service area of the SERWTP since the facilities were installed has increased wastewater generation to a point that the demand is at or over the available capacity of the plant. Opportunities for approximately 70 new hook-ups to the wastewater collection system remain; these likely will be permitted within six to eight months. At that time, additional hook-ups cannot be permitted. In fulfilling its delegated responsibility for wastewater treatment plant permitting under the federal Clean Water Act, the California Regional Water Quality Control Board (CRWQCB) issued a Cease and Desist Order in 1991 to LACOSAN, citing treatment and disposal deficiencies. That order forbids hook-ups which would put wastewater received at the plant over installed treatment plant capacity and approved effluent discharge capacity. The CRWQCB ordered LACOSAN to provide additional capacity for the SERWTP service area and placed a moratorium on building and new hook-ups in the service area until an approved plan is in place and facilities for both treatment and disposal of wastewater are constructed.

The City of Clearlake and the County of Lake project that growth in the SERWTP service area will far exceed currently installed SERWTP capacity. Current estimates of growth indicate that there will be a need for a treatment capacity exceeding 3.0 mgd average within the next 30 years. In order to achieve this volume of wastewater treatment, new facilities for the SERWTP would have to be constructed. These are described in Section 2.5; they were subjected to environmental evaluation in a previous Draft EIR published in 1991 (Goddard & Goddard, 1991), the results of which are incorporated into this EIR/EIS.

The expansion of the SERWTP would provide new facilities to treat wastewater using standard engineering design to achieve acceptable levels of treatment at the plant. The more difficult problem is management and ultimate disposal of the treated wastewater effluent. Existing spray fields near the SERWTP cannot accommodate significant expansion or added volumes of effluent. Various alternatives to effluent disposal have been investigated; these are summarized in Section 3.2. The project proposed and evaluated in this EIR/EIS is the preferred alternative. It would transport treated effluent through a constructed pipeline to The Geysers.

The secondary cause for proposing the project at this time is the opportunity to enhance steam production at The Geysers which has been in decline since 1987. The apparent cause of the decline is the reduction in steam reservoir pressure as a result of the unavailability of sufficient injection water to adequately replace the amount of steam being produced. The proposed wastewater effluent would be a new source of water to compensate for this decline. The project

2.0 Description of the Proposed Project

2.1 Overview and Background to the Project

would allow continued geothermal energy production in the southeast Geysers at higher production levels than would occur otherwise.

Studies conducted by and for the County of Lake, Calpine Corporation (Calpine), Unocal and the Northern California Power Agency (NCPA) established a combined lake water and wastewater effluent flow of about 7.8 mgd could be cost effectively conveyed to the southeast Geysers steam field from the SERWTP (Dewante & Stowell Engineers, *et al.*, 1992). 7.8 mgd would provide a flow of 5,400 gallons per minute (gpm). The sources of this volume of flow would vary over time. As proposed for this project, the volume of flow in the pipeline would come from three sources: (1) effluent from the SERWTP; (2) effluent from the Middletown Wastewater Treatment Plant (MWTP); and (3) supplemental water diverted from Clear Lake.

LACOSAN has entered into an Agreement in Principle with Calpine, NCPA, Unocal and Pacific Gas & Electric Company (PG&E) to provide an annual average flow of 5,400 gpm in the proposed effluent pipeline. This is the minimal flow rate that the project engineers determined is cost effective for constructing and operating the proposed pipeline. The proposed effluent pipeline system would be designed to supply a flow of 5,400 gpm to The Geysers. It includes 5,300 gpm from the SERWTP and the lake plus an additional 100 gpm from the MWTP.

In order to maintain the volume needed to operate the pipeline, water will be drawn from Clear Lake and added to the effluent stored in the SERWTP reservoir or piped directly to the Geysers in a bypass to the booster pumps. This supplemental water, termed "make up water", will be delivered on a schedule described in Section 2.3.2. As SERWTP and MWTP effluent flows rise, the need for Clear Lake make up water would decline.

2.1.2 KEY ACTIONS LEADING TO THE PROPOSED PROJECT AND IDENTIFICATION OF ALTERNATIVES

The project has been proposed at this time because of a series of events and circumstances that have developed in both the LACOSAN service area of the SERWTP and in The Geysers. The key considerations related to these events and circumstances are summarized here to provide a general background to the proposed project.

The SERWTP is owned and operated by LACOSAN. Between 1974 and 1975, the collection system was installed that serves the City of Clearlake, the community of Lower Lake and rural areas within the SERWTP service area. Recognizing the need to plan for growth in the service

2.0 Description of the Proposed Project

2.1 Overview and Background to the Project

area, LACOSAN in 1984 prepared an Expansion Capacity Study that identified the available options to meet the needs for wastewater treatment and disposal in the region. In 1986, LACOSAN prepared a Facility Plan for the SERWTP and an EIR on the plan. However, implementation of the plan did not occur. Deficiencies in wastewater treatment and overflows occurred as population in the service area grew.

The existing SERWTP has nominal design capacity of 1.49 million gallons per day (mgd) and can handle peak flows up to 2.75 mgd. Secondary treatment of wastewater is performed at the plant and the effluent is directed into a 540-acre-foot reservoir adjacent to the plant. The effluent is drawn from the reservoir and sprinkle-irrigated on 244 acres of range land during the hot dry summer and dry periods in winter. There is an emergency overflow spillway to a tributary creek to Burns Valley Creek, which flows through the City of Clearlake and discharges into the lake. Such overflows have occurred in the past. These overflows have resulted in a violation of the CRWQCB permit for the plant which mandates that effluent be confined to the existing land disposal areas. At present the sprinkle irrigation system is not adequate to dispose of all of the effluent (when combined with precipitation run-off into the storage reservoir). Overflows from this condition also lead to discharge into Clear Lake. The discharge of wastewater into Clear Lake is prohibited by the CRWQCB's Basin Plan for the lake and by County of Lake ordinance. In addition, significant problems in infiltration and inflow (I/I) also occurred in the sewer system.

As a result of the deficiencies noted above, in March 1991, the California Regional Water Quality Control Board (CRWQCB) issued a Cease and Desist Order to LACOSAN. The order allowed only 250 additional hook-ups to the sewer system and it specifically placed a moratorium on additional growth until the deficiencies were corrected. At this time, there were approximately 6,600 sewer connections in the service area. The Cease and Desist Order remains in effect at present.

In 1991, LACOSAN with the assistance of Dewante and Stowell, Consulting Engineers, undertook the preparation of the Southeast Regional Wastewater System Improvement Facilities Plan. The plan identified specific actions and facilities needed at the SERWTP for correcting the deficiencies cited by the CRWQCB and for ensuring increased plant capacity to accommodate long range population growth in the service area. The specific elements of the plan are presented in this EIR/EIS.

2.0 Description of the Proposed Project

2.1 Overview and Background to the Project

While the construction of proposed wastewater treatment facilities at the SERWTP was conventional and relatively uncontroversial, the issue of ultimate disposal of the effluent proved more difficult to resolve and it produced considerable controversy. LACOSAN in its 1991 facilities plan (and in the previously prepared EIR) investigated a range of options for ultimate disposal of the effluent. These are summarized in this EIR/EIS. One of the options was the proposal to transport the effluent in a pipeline to The Geysers, although that was not the preferred alternative. As noted, discharge to Clear Lake is prohibited. Land application proved infeasible because of cost of land, injection into adjacent wells looked infeasible because of limited permeability of the rock, and conflicts with future development. Other alternatives also were investigated which appeared to present unacceptable risk and were constrained by unknown conditions. Discharge of the treated effluent into Cache Creek at Peach Tree Crossing was initially selected as the preferred alternative for disposal by the LACOSAN Board of Directors, and subsequently replaced by the proposed project.

To meet its responsibility for environmental review under CEQA, LACOSAN with the assistance of the firm of Goddard and Goddard Engineering prepared an EIR on the 1991 facilities plan. The Draft EIR (State Clearinghouse EIR No. 86-021101) was issued for public review and comment in September 1991. That Draft EIR has been incorporated into this EIR/EIS without change in the analysis, findings and mitigation measures (some format changes have been made and the EIR was disaggregated to allow integration into the various sections of this document).

The proposed discharge of treated effluent into Cache Creek produced a very large response from the downstream water users in Yolo County. Numerous comments on the proposed plan and its environmental impacts were received during public review of the Draft EIR. The Lake County Planning Commission directed staff to inform the LACOSAN Board of Directors about the biological and water quality studies that would be needed to adequately respond to comments on the Draft EIR. Additionally, the Planning Commission indicated that if the LACOSAN Board wanted to proceed with the Peach Tree Crossing disposal alternative, then additional focused environmental studies should be undertaken. Responses to comments on the Draft EIR were not prepared, pending LACOSAN's reconsideration of the effluent disposal plan. The EIR on the Southeast Regional Wastewater System Improvement Facilities Plan was neither completed nor certified.

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2.1 Overview and Background to the Project

In February and July 1992, the Lake County Planning Department, Resource Management Division, (with the assistance of Criterion Planners/Engineers, Dewante and Stowell Engineers and Max Walenciak, P.E.) initiated further investigations into the engineering and economic feasibility of disposing the SERWTP effluent in The Geysers. A comparison of possible costs and environmental problems potentially associated with the Cache Creek disposal plan and the conceptual Geysers disposal plan indicated that the latter alternative would prove possible and perhaps preferable to the originally proposed plan. Moreover, there was an active interest on the part of the geothermal industry to obtain the effluent provided that costs for construction of the 26-mile pipeline and related facilities would be shared.

The basis for the industry's interest was the well-documented recent decline in steam production in The Geysers and the projection of further substantial declines in steam production and power generation in the future. These declines have been attributed to production of the resource in the steam field which has no significant recharge. The reduction in the resource appears to be related more to the loss of a sustained supply of reservoir fluid rather than loss of the energy source (hot rock). Field production in The Geysers peaked in 1987 and has declined significantly since that time. In response, the steam field operators and power supply industry in The Geysers investigated the potential for increasing steam production through enhanced injection. The industry has had a 25-year history of injecting cooling tower condensate that was prohibited from being discharged into surface waters. The injection wells are several thousand to over 10,000 feet deep. Initial investigations of enhanced injection in the late 1980's indicated an excellent potential for positive response in the steamfield. As a result, broader programs for enhanced injection occurred throughout The Geysers with substantial success. The principal limitation was, and remains, the lack of an available, dependable sustained supply of water for use in injection.

Because LACOSAN has a potentially available and continuous supply of wastewater, the geothermal industry has a potential source of water to meet its injection needs. Significantly, the wastewater supply would be dependable and sustainable, as it would increase as growth occurs in LACOSAN's service area. For these reasons, LACOSAN and four industry partners (Calpine, NCPA, Unocal and PG&E) entered into Agreements-in-Principle regarding construction and operation of a pipeline for delivery and use of treated effluent to the Southeast Geysers. The Agreements indicated that costs would be shared for design, construction and operation of a pipeline system delivering 5,400 gpm of effluent to The Geysers.

2.0 Description of the Proposed Project

2.1 Overview and Background to the Project

In 1992, LACOSAN retained Criterion Engineering and Dewante and Stowell Engineers to develop a plan for constructing The Geysers Effluent Pipeline. In conjunction with that plan, an EIR/EIS is required to be prepared as noted in the Initial Study prepared for the project. The requirement for the EIR stems from LACOSAN's requirement to comply with CEQA for major public improvement projects. The EIS requirement stems from part of the pipeline construction in federal lands and the plan to inject fluids in federal lands in the Southeast Geysers managed by the U.S. Bureau of Land Management, and because of funding provided by the U.S. Department of Energy, and possibly other federal agencies. In July 1993, the LACOSAN Board of Directors tentatively adopted the Geysers Disposal alternative as the preferred disposal plan for effluent from the SERWTP.

LACOSAN also considered the possibility of providing a back-up disposal system to the project that included upgrade of the SERWTP to tertiary treatment of wastewater and disposal of the effluent in either created wetlands, discharge into the Clear Lake Outlet Channel and other options. The back-up disposal system was abandoned for several reasons: (1) there is a very low probability of the need for a back-up system or substantial future system modifications; (2) back-up disposal systems are not required by the federal or state environmental regulations and, in fact, no other wastewater treatment systems in California have back-up disposal plans; (3) the various elements of a back-up system and its effects would be too speculative to effectively evaluate in this EIR/EIS. This is because system modifications would not be implemented for at least 10 years and possibly longer. The technology available in the future as well as its cost feasibility for LACOSAN cannot be predicted at this time. In addition, the regulatory requirements at that future date may be substantially different from those in place at present; (4) the final agreements between LACOSAN and the geothermal industry will include provisions for the participants to provide funds for system modifications if they become necessary. In the event that modification is needed, the geothermal industry would provide a two-year advance notice that they could no longer take the water.

This EIR/EIS describes these various project components as part of a program of actions and includes an evaluation of their environmental impacts.

2.1.3 LOCATION OF PROPOSED FACILITIES

Most of the proposed facilities, including the SERWTP facilities, Clear Lake diversion pipeline and pumps, main effluent pipeline and pumps, are located in Lake County, California, between

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2.1 Overview and Background to the Project

Clear Lake and the southeast Geysers (Figures 2.1.3-A - 2.1.3-E). The effluent injection part of the project is located in the southwestern portion of Lake County and northeastern part of Sonoma County. A majority of the project located in The Geysers is within federal lands managed by the U.S. Bureau of Land Management (BLM) and a smaller portion is located on lands administered by Lake County and Sonoma County.

Figure 2.1.3-A provides an overview schematic map of the project facilities locations. Figures 2.1.3-B - E provide a larger scale map of the project facilities. These facilities are described in detail in Sections 2.3, 2.4, 2.5 and 2.6.

2.1.4 PRIMARY COMPONENTS OF THE PROPOSED PROJECT

2.1.4.1 SOUTHEAST GEYSERS EFFLUENT PIPELINE PROJECT COMPONENT

The primary component of the project is the proposed pipeline to carry effluent from the SERWTP to The Geysers (Figure 2.1.3-A). The project analyzed in this EIR/EIS is based on the preliminary design for the project. Final engineering design will be completed later, but is not expected to change substantially in concept or location from that presented herein.

Proposed Facilities

Proposed facilities for this component include the following.

Main Geysers Pipeline

Geysers Effluent Pipeline: The 26-mile main effluent pipeline would be a 138,500 feet long, 24-inch inside diameter for most of its length, force main, placed both above ground and underground in various segments to convey effluent from the SERWTP to the terminus in The Geysers; isolation valves on the main pipeline would be spaced at approximately two-mile intervals.

Twenty-four-inch diameter pipeline extension from the SERWTP reservoir to the six operating pumps and surge tank: Approximately 730 feet long, located entirely within the SERWTP yard; this would be a suction pipeline drawing effluent from the reservoir.

SERWTP pumps: Up to six turbine pumps, each would be 200 horsepower and have a 900 gpm output capacity; they would pump the effluent through the pipeline from the SERWTP to the Childers Peak Regulating Tank; an hydropneumatic surge tank would be ancillary to the pump station. A seventh pump may be installed as a back-up.

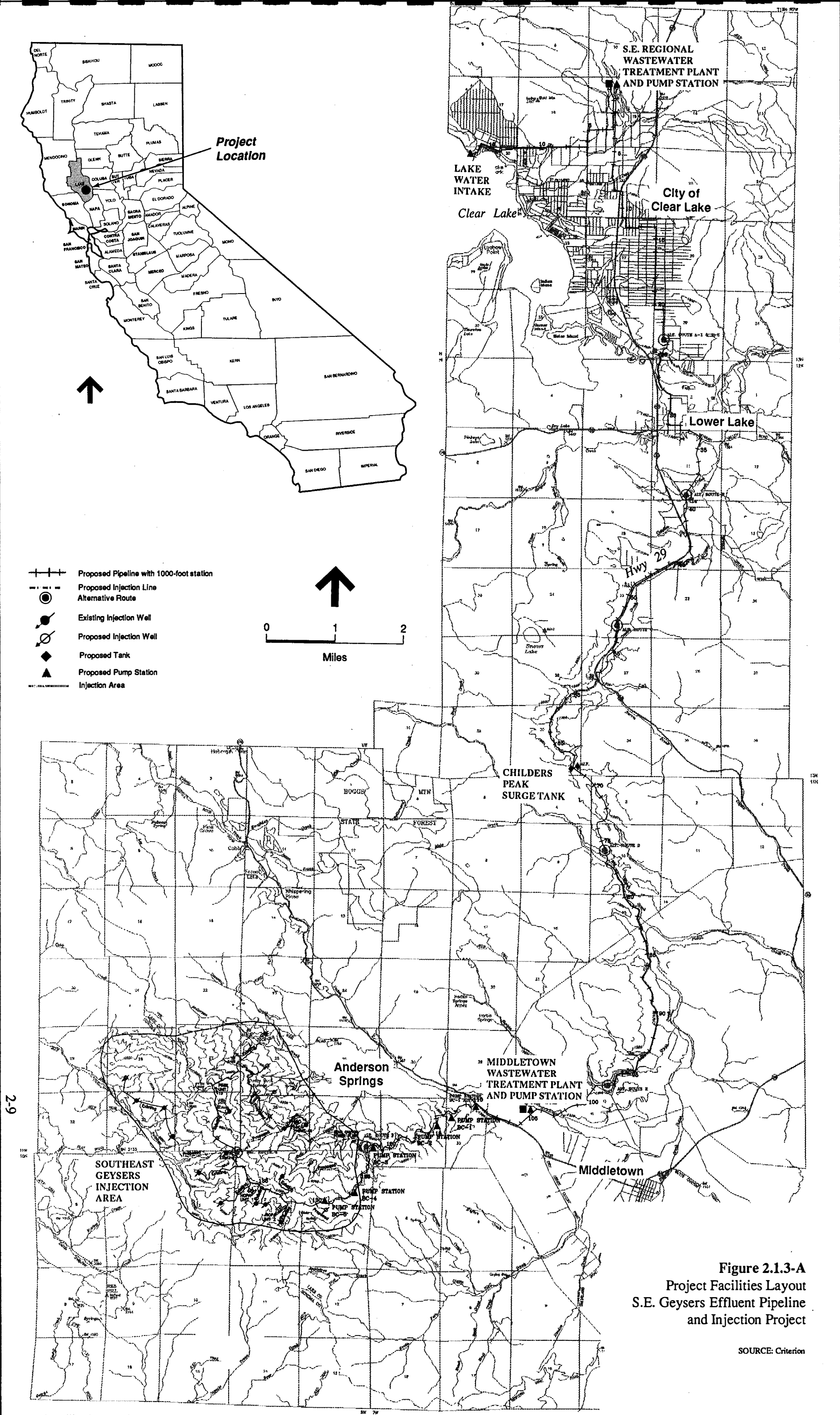


Figure 2.13-A
 Project Facilities Layout
 S.E. Geysers Effluent Pipeline
 and Injection Project

SOURCE: Criterion



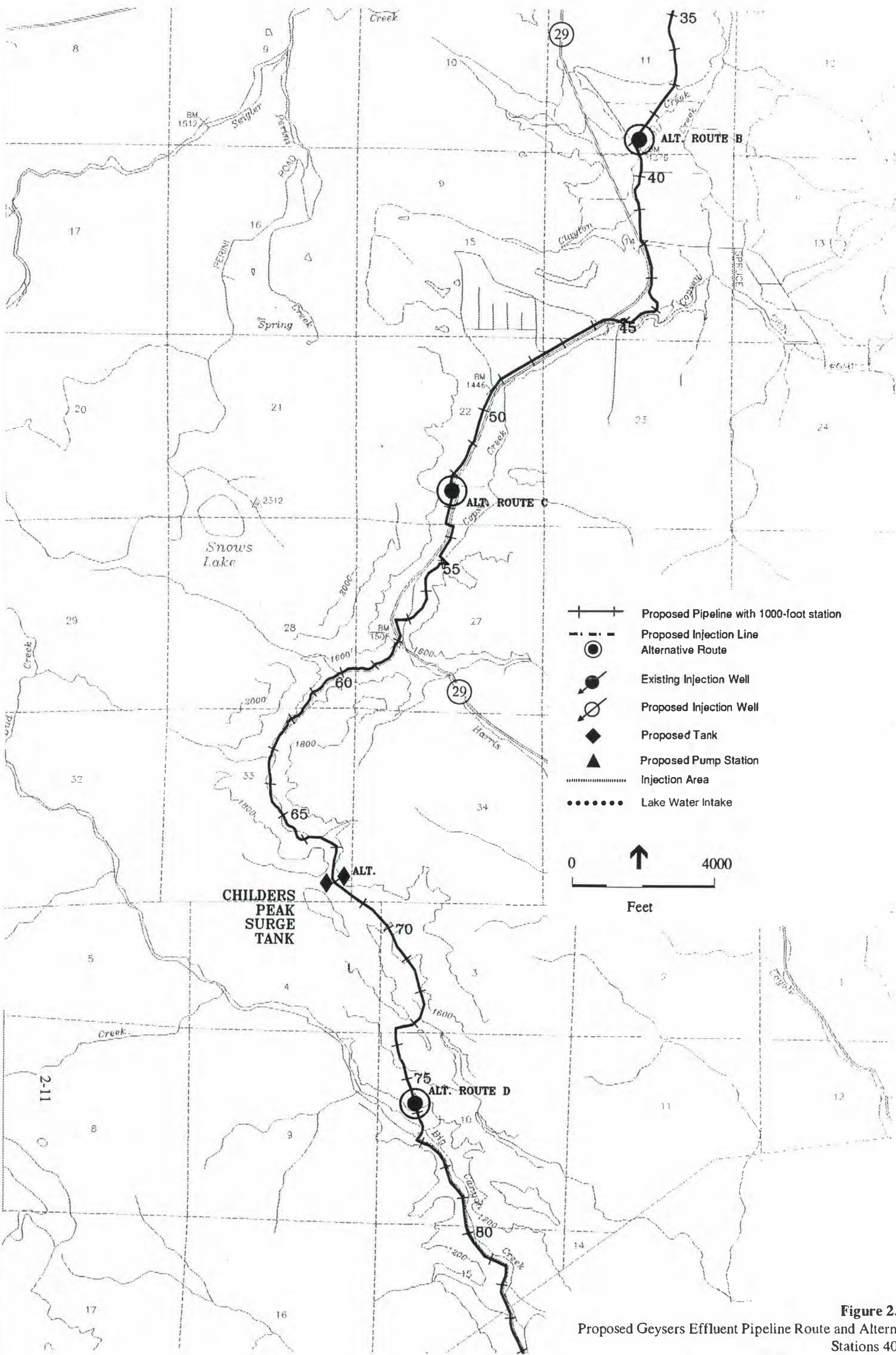
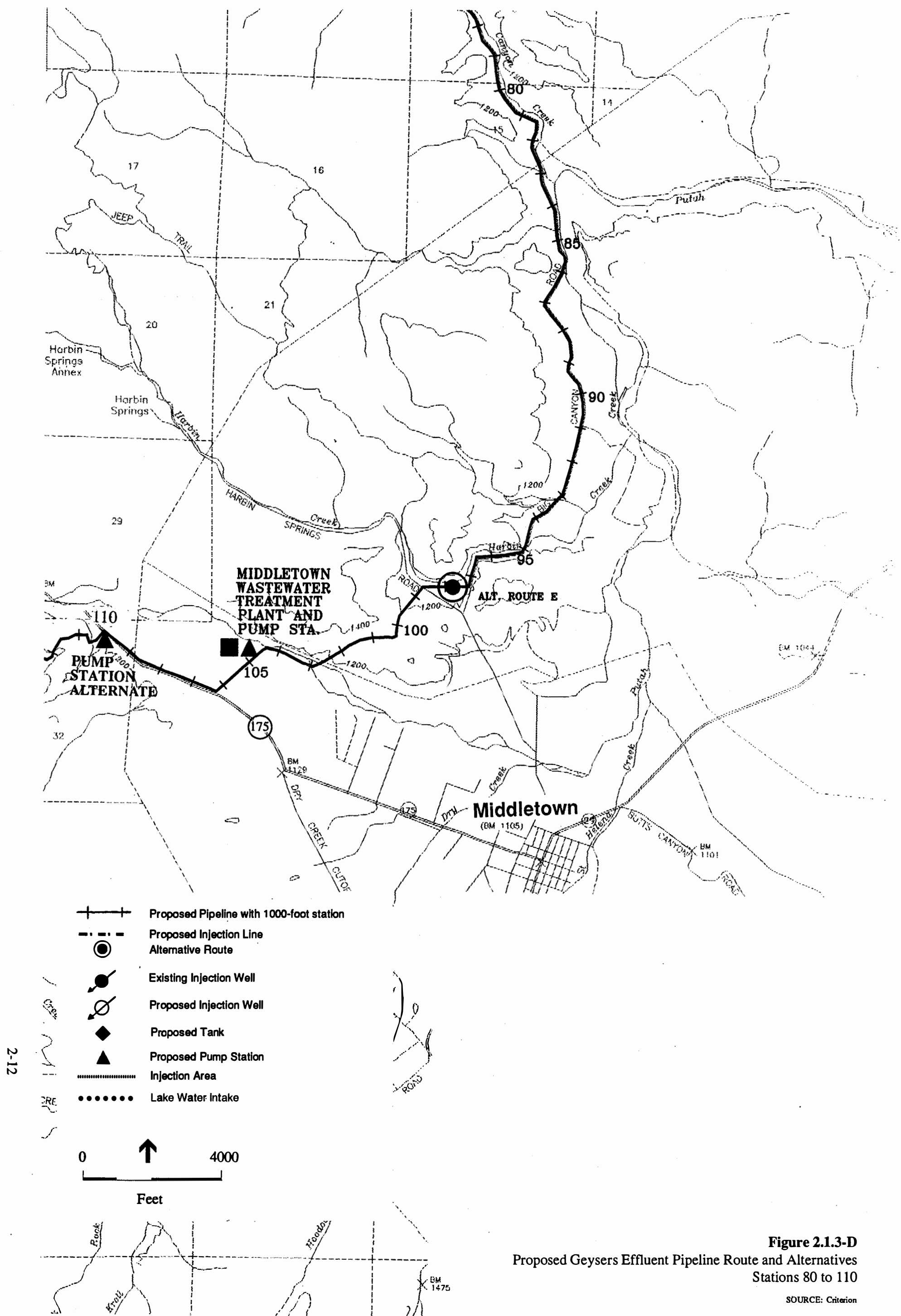
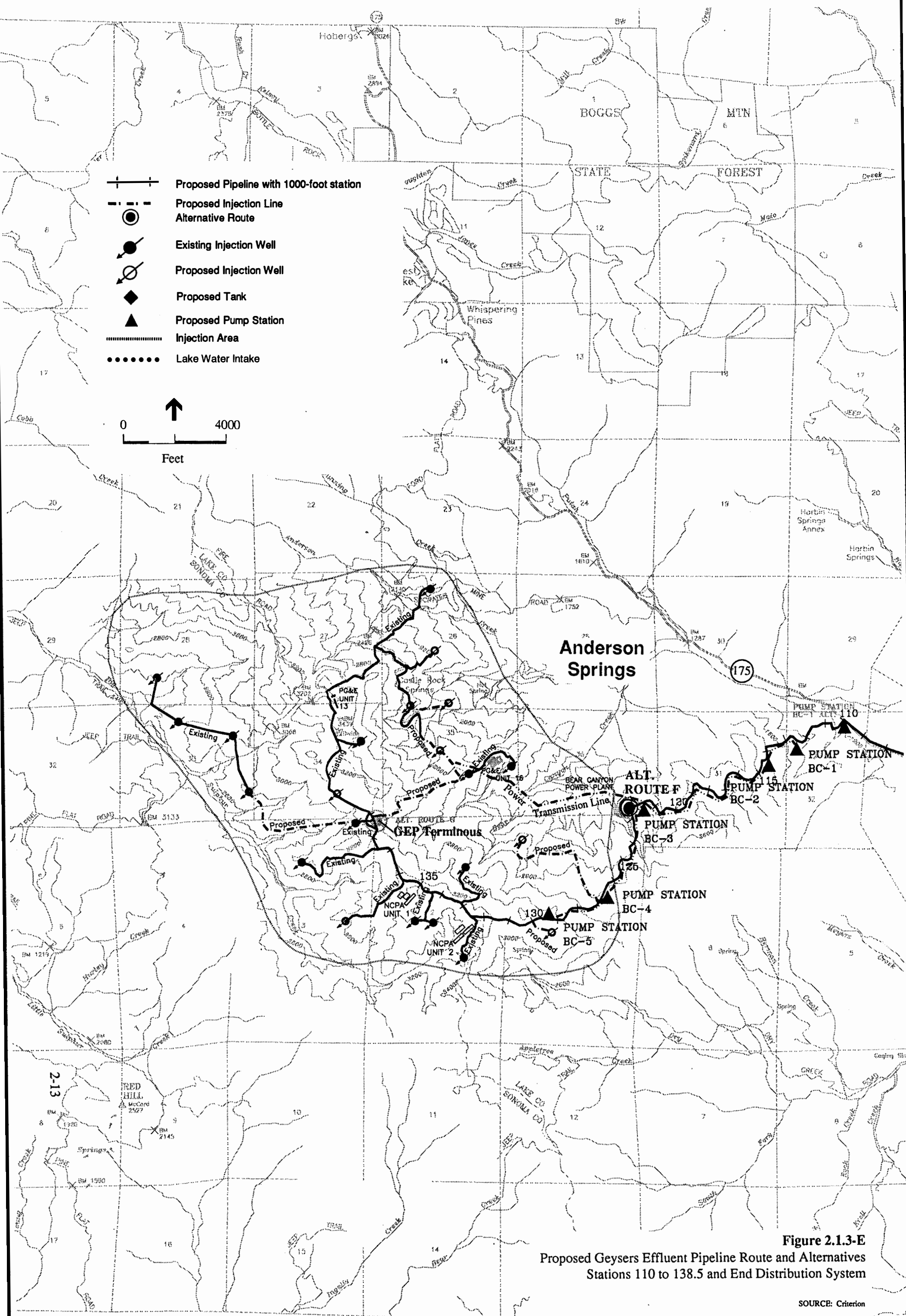


Figure 2.1.3-C
Proposed Geysers Effluent Pipeline Route and Alternatives
Stations 40 to 80

SOURCE: Criterion





2.0 Description of the Proposed Project

2.1 Overview and Background to the Project

Childers Peak Regulating Tank: The steel tank would have a capacity of approximately 620,000 gallons; it would be 60 to 70 feet in diameter and 24 to 32 feet high; it would be constructed above ground on a site below Childers Peak at about 1,800 feet above mean sea level (msl); it would serve to provide the activating control water level for the SERWTP pumps and to provide surge suppressing storage of effluent.

Middletown Wastewater Treatment Plant (MWTP) facilities: Includes two pumps, suction and discharge pipeline, surge control tank, connection valve into the main Geysers Effluent Pipeline, and power supply facilities; all facilities would be located in the MWTP yard.

Bear Canyon Pump Stations: Five pump stations to lift the effluent from approximately elevation 1,470 feet above msl to the high point of 3,330 feet msl in The Geysers: each station would have three operating centrifugal pumps with 250-horsepower motors and, combined, have a 5,400 gpm output capacity; the pumps would be located on 30-by-80-foot pads in an industrial-type building; a surge tank would be constructed for the first pump station. A fourth back-up pump also may be installed at each pump station.

Y-Pad Injection Fluid Tank: This would be a 100,000-gallon steel tank constructed above ground on a concrete pad partially cut into the hillside on the south side of the NCPA Y-Pad in The Geysers at about 3,365 feet msl; it would control the flow of injectate to some of the secondary distribution pipelines and serve for storage of effluent and condensate. The tank would be located near the terminus of the Geysers Effluent Pipeline.

Geysers Secondary Pipeline System

Secondary distribution pipelines at The Geysers to carry the effluent as injection fluid from the main pipeline to 15 existing and 7 future well heads where injection into the steam field would occur; the main pipeline to near the Calpine/NCPA boundary would be steel or polyethylene pipe buried along the road; several new polyethylene or steel pipelines buried in existing roads or above ground would be used to convey the effluent to the well-heads, as well as use of existing injection lines; the secondary pipelines vary in diameter from 8 inches to 16 inches. (No new wells are proposed to be constructed as part of this project although some production wells may be converted to injection wells.)

Lake Diversion: Make up Water Supply Facilities

Lake Intake Structure: This would be a wire-wound screened intake feature to draw in water and an air purge system for purging debris from the intake; it would be located on the bottom of Clear Lake (elevation 1,295 msl) at a depth of approximately 30 to 35 feet below mean lake level (elevation 1,330); the underwater pipeline would be placed on the lake bottom anchored to concrete collars and would extend approximately 300 feet to the diversion pump station on the lake shore. Within 50 to 100 feet of the shoreline, the intake pipeline would be buried for the remaining distance to the pump station. The exposed underwater pipeline and intake screen would be protected by rock riprap along side and over it.

Lake Diversion Pump Station: Three vertical turbine pumps, each 125 horsepower, with a capacity of 2,060 gpm at a total developed head of 160 feet; the pumps would be installed over the suction chamber; the pumps and ancillary air compressor and surge arrestor would be housed in a sound-proof building located at the lake shore.

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Lake Diversion Pipeline: This would be a 16,600-foot PVC pipeline, 24 inches in diameter; isolation valves would be placed at approximately two-mile intervals; it would be placed underground for its entire length from the lake shore to the SERWTP reservoir; the pipeline capacity will be up to 8.9 mgd.

Pipeline outlet structure: A 24-inch outlet pipe would be constructed at the bottom of the SERWTP reservoir.

Main Pipeline Ancillary Facilities

Bear Canyon to M-Pad Connector Road: new road and pump station pad located between the Calpine Bear Canyon Access Road and the NCPA M-Pad; the road would be approximately 15-20 feet wide, 2,400 feet long, with a widened area for the pump station (Station No. BC-3); the road would include 1.5:1 (horizontal to vertical) cut slopes, 2:1 fill slopes, and a 180-foot-wide and 60-foot-high fill placed for the crossing of an unnamed creek with a crib wall; the creek would be placed in a culvert.

Power supply line in The Geysers: This would be a 21 kilo-volt (kv) 26,000 feet long power line located in a right of way between an existing line near PG&E Unit 16 and the Bear Canyon Access Road; the power line would be constructed on wooden poles immediately adjacent to an existing 230 kv line between PG&E Unit 16 and the Bear Canyon Power Plant; upon reaching the Bear Canyon Access Road, it would split, running along the roadside to the five pump stations for the pipeline; provides power to the five Bear Canyon Pump Stations.

Power supply line at the SERWTP: A small 12 kv line, less than 200 feet long, would be constructed on poles within the SERWTP yard to supply power to the four pumps for the pipeline.

Flow control, monitoring and telemetry system: A distributed control system (DCS) would consist of remote terminal units (RTUs) located at the SERWTP pump station and a master RTU in The Geysers; the computerized control station would be located at the NCPA control center; the DCS would control flows on a 24-hour basis by controlling the pumps at the SERWTP pump station and the Bear Canyon pump stations; these are regulated in response to pipeline flow pressure requirements and system demand from The Geysers steam field; water levels in the Childers Peak Regulating Tank would determine the activation or shut down of the pumps; a fiberoptic line would be run from the Childers Peak Regulating Tank to the NCPA control center to transmit information on the water level in the tank.

General Operation of the Pipeline System

The overall system would operate to deliver an annual average of 5,400 gpm in the pipeline to The Geysers. This is the equivalent of approximately 7.8 mgd. The proposed operations involve: (1) the diversion of make up water from Clear Lake to the SERWTP; (2) the collection of effluent from the SERWTP reservoir combined with the addition of make up water from Clear Lake; (3) the collection of effluent from the MWTP; (4) conveyance of the effluent in the main

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pipeline to the terminus in The Geysers; and (5) flow of effluent in the secondary distribution lines to the well-heads for injection. These are presented in summary fashion below and discussed in greater detail in Section 2.3.4. (Injection operations are treated separately in Section 2.4.)

(1) Clear Lake Diversion. A project design effluent volume conveyance capacity has been established at 7.78 mgd. This is the volume that is needed to maintain a design flow of 5,300 gpm from the SERWTP to the point in the pipeline where additional effluent from the MWTP is added to the system. To maintain a design flow of 5,300 gpm from the SERWTP, water would be drawn from Clear Lake for a period of 25 years. The volume of water taken from Clear Lake would exceed that volume of effluent generated by the SERWTP. As the Clearlake and Lower Lake areas grow and effluent volumes continue to increase, the need for make up water would decrease over time. If community growth occurs at a faster rate than estimated, the diversion of raw lake water for the project would be reduced earlier than projected. However, lake water diversions would be expected to occur throughout the 25-year design life of the project. The water would be purchased from the Yolo County Flood Control and Water Conservation District, which owns the upper part of the lake. Table 2.1.4.-1 presents the estimates of average annual flows derived from the various flow sources in the system.

TABLE 2.1.4-1: ESTIMATES OF AVERAGE ANNUAL FLOWS BY COMPONENT

Year	Flows (mgd)			Total
	Lake	SERWTP	Middletown	
1996	6.24	1.40	0.14	7.78
2000	6.03	1.60	0.15	7.78
2010	5.62	2.00	0.16	7.78
2020	5.21	2.40	0.17	7.78
2021	5.09	2.52	0.17	7.78

SOURCE: Eco:Logic Engineers, 1994

Under average seasonal rainfall conditions and assuming projected effluent volumes from the SERWTP, the average withdrawal from Clear Lake would be 6.24 mgd in 1996, eventually

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dropping to 5.09 mgd in 2021. This equates to an annual average withdrawal of approximately 6,994 acre-feet (af) per year in 1996, and 5,705 af per year in 2021. Withdrawals of this amount in 1996 equate to approximately 0.61 percent of the volume of Clear Lake at mean lake level, and 4.66 percent of the portion of the lake water owned by Yolo County. Another way of viewing this is by the theoretical reduction in lake level. The actual effect of reduction is dependent on the level of the lake when water is extracted. For low level or zero on the Rumsey Gauge the reduction would be about 2.0 inches. For the "mean" lake level, this amounts to 1.91 inches. For a full lake level, the amount would be about 1.8 inches for maximum withdrawal. In each case this represents a theoretical drawdown assuming no replacement by inflow or recharge.

Actual rates of withdrawal will depend on the amount of effluent derived from the SERWTP; the latter would vary annually, seasonally, monthly and daily, depending on weather conditions. Actual rates estimated on the low end would be 6,600 af in 1996 (assuming above average wet winter conditions) to a high end estimate of 7,950 af in 1996 (assuming a drought).

Pumping would occur each day of the year, except possibly for an approximate 30-day period during the August/September period of algae bloom in Clear Lake. To offset the period when pumps were turned off during the algae bloom, the pumps would operate at higher through-put volumes during the months preceding and following the algae bloom. A 10 to 15 percent increase in pumping would be likely during the period of over-pumping, that is 5,940 to 6,210 gpm would be conveyed in The Geysers Effluent Pipeline. A large portion of the volume of diverted lake water would be pumped into the SERWTP reservoir to meet the pipeline conveyance demand during the algae bloom period. About a three month period of high through-put pumping from Clear Lake is anticipated each year. All three pumps would operate 24 hours each day all year. During the wet period months, pumping would be reduced. The timing and amount of lake water withdrawal would depend on the water level in the SERWTP storage reservoir (see Section 2.3.2.1).

A single suction line extending into the lake would draw water into the pipe and then into a suction chamber. From there, the water would be pumped in the 24-inch pipeline to the SERWTP reservoir. It would discharge into the bottom of the effluent reservoir, where it would mix with the effluent from the SERWTP. No facilities are planned for treating the make up water. The sole controls on make up water quality would be the screening at the intake in the lake and shutting down the pumps during periods of poor water quality in the lake.

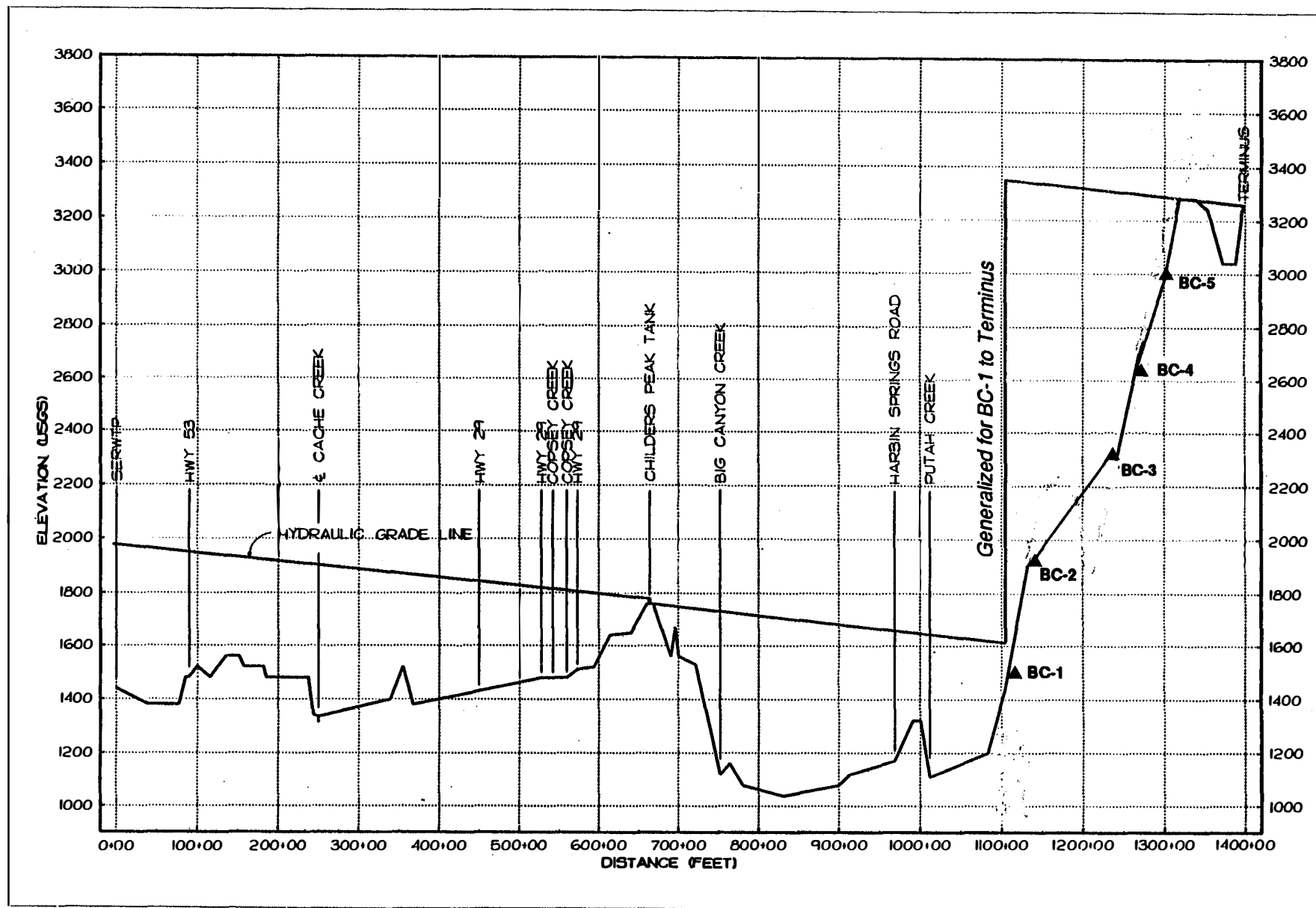
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(2) Effluent Collection and Pumping at the SERWTP. Effluent from the SERWTP at present is stored in a large reservoir adjacent to the plant. The water is drawn off the reservoir and used for spray irrigation. For the proposed project, the reservoir would be used to receive both the effluent from the SERWTP and the make up water diverted from Clear Lake. The volume of SERWTP effluent varies substantially monthly, seasonally and annually. Sustained SERWTP influent flows of 3 mgd to 4 mgd already occur over many days in succession during unusually wet weather periods. Average anticipated flows in 1996 would be 1.40 mgd, rising to 1.60 mgd by the year 2000 and to 2.52 by the year 2021 (Eco: Logic Engineers, 1994). As system effluent flows vary, adjustments in diversions from Clear Lake will be made to maintain flows directed into the Geysers Effluent Pipeline. The system is designed to maintain a constant nominal discharge flow of 5,400 gpm into the Geysers Effluent Pipeline at all times (24 hour per day, 365 days per year). Occasional shut down periods would occur for maintenance.

The combined SERWTP effluent and make up water in the reservoir would be drawn off through a proposed 24-inch outlet, in addition to an existing 18-inch outlet. A proposed 24-inch pipeline extension of the outlet to the pumps would convey water to the pumps. Up to six pumps, each with an output capacity of 900 gpm, would operate to maintain a continuous nominal flow of 5,400 gpm in the pipeline. A seventh back-up pump also may be installed to maintain constituent flow in the pipeline while normal pump maintenance occurs. The pumps would convey water in approximately 68,000 feet (12.9 miles) of the Geysers Effluent Pipeline to the Childers Peak Regulating Tank, which is located at an elevation of 1,800 feet msl. (Figure 2.1.4-A) The Childers Peak facility is located at the high point in the segment of pipeline between the SERWTP and the MWTP. Under the project design, gravity flow would occur south of Childers Peak to the first Bear Canyon pump station, and sufficient head in the system will be present to provide optimal placement of the next pumps (Pump Station BC-1) at an elevation of approximately 1,470 feet msl along the Bear Canyon Access Road.

(3) MWTP Effluent Intake. The main effluent pipeline passes through the MWTP, located west of Middletown at elevation 1,140 feet msl. At this location, effluent generated by the MWTP would be added to the flow in the main pipeline. A pump station would draw suction from the existing effluent discharge or storage ponds using an existing pipe. A relatively constant discharge of MWTP effluent will be added through a valve to the flow in the pipeline. In 1995, it is anticipated that 0.14 mgd average wet weather flow would be added to the system; this would rise to 0.17 mgd by the year 2020. The addition of the MWTP flow would raise the total flow in the Geysers Effluent Pipeline to 5,400 gpm.



SOURCE: Dewante and Stowell Engineers, and Veizades & Associates, Engineers, 1993.

Southeast Geysers Effluent / 920586 ■

Figure 2.1.4-A
Southeast Geysers Effluent Pipeline Hydraulic Profile

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The storage ponds at the MWTP also would be used to accommodate large fluctuations in effluent from the Middletown system, as well as flows that may occur at the SERWTP. There is sufficient storage capacity at the MWTP to handle peak system flows.

(4) Conveyance to the Terminus. The combined lake water and effluent flow from the SERWTP and MWTP in the Geysers Effluent Pipeline would be by gravity (under hydraulic head from Childers Peak together with pumped flow from the MWTP) to an elevation of approximately 1,470 feet msl, at which would be located the Bear Canyon Pump Station No. 1 (BC-1). At this location, ownership and responsibility for operation of the system is transferred from LACOSAN to the other parties to the project, that is, Calpine Corporation, NCPA and Unocal.

This segment of the pipeline presents the greatest rise in elevation to reach the terminus. The highest elevation of the Geysers Effluent Pipeline is 3,300 feet msl (Figure 2.1.4-A), with the nearby Y-Pad Injection Fluid Tank located at the high point of the entire system at 3,336 feet msl. Five pump stations, placed at approximately equal vertical intervals would lift the 5,400 gpm flow of diluted effluent into The Geysers, conveying it to the pipeline terminus located at an existing sedimentation basin adjacent to the NCPA Plant No. 1. A subsidiary pipeline would draw water from the pipeline and direct it into the Y-Pad Tank, located at the NCPA Y-Pad about 1,500 feet from the pipeline terminus. The Y-Pad Injection Fluid Tank would have a 100,000 gallon storage capacity and would receive flows of both effluent from the Geysers Effluent Pipeline and condensate from NCPA's existing operating system. The tank would be used to regulate flow of effluent to some of the distribution lines for injection.

(5) Effluent Distribution to Injection Well Heads. Under the Project Agreement, ownership of the effluent would be equally divided between NCPA, Unocal and Calpine. A flow of 1,800 gpm would be distributed by NCPA to seven of its existing wells used for injection and two existing wells that are not currently being used for injection. Delivery of effluent to Calpine would occur at the terminus of the main pipeline. Calpine would initially distribute its flow of 1,800 gpm to three or four existing production wells which would be converted to injection wells, and with optimal flow to four existing injection wells. Unocal would distribute its 1,800 gpm flow of effluent to four existing injection wells.

The overall operating system for the entire pipeline is driven by the demand for injection fluids in The Geysers and requirements for maintaining pressure in the pipeline. Demand would be based on steamfield operations determined by and controlled through the existing monitoring

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and flow control systems of NCPA, Unocal and Calpine. At present, overall demand for injection water would be able to absorb all the effluent produced by the SERWTP and MWTP. On a daily basis of injection, the demand may fluctuate, and these fluctuations would be reflected in the overall operation of the system for storage in the SERWTP reservoir, the Childers Peak Regulating Tank and the Y-Pad Injection Fluid Tank. Additionally, adjustments in make up water withdrawals from Clear Lake would be made to ensure even flows and efficient operating conditions of the pipeline. This would be accomplished by a computerized monitoring system, termed the distributed control system (DCS), that would convey information by telemetry to the central control station at the NCPA control center related to the water levels in the tanks, line pressure, valve positions and flows at discharge points. Overall control of the system is handled by control of the pumps at each of the key locations for effluent input to the system (the Clear Lake diversion pumps, the SERWTP main pumps for the Geysers Effluent Pipeline, and the MWTP pumps). The Bear Canyon pumps would be regulated by water levels in the Childers Peak Regulating Tank. Remote control of all the pumps would occur from the central control station at the NCPA control station. The entire system would be computerized, with a computerized back-up system at the SERWTP to ensure continued operations if the primary monitoring and control system were to fail.

The monitoring system also would identify abnormal operating conditions, such as a sudden increase of pressure in the pipeline or high or low water level in the Childers Peak Surge Tank. A low water level might indicate a loss of pressure in the pipeline because of failure. The system would provide an alarm to the central control station.

2.1.4.2 SOUTHEAST GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT

This component of the project entails the ultimate disposal method of the effluent by deep injection into The Geysers steam field.

Proposed Facilities

The new facilities for this component include the valves that would be installed at existing well-heads that are not currently being used for injection. Secondary distribution lines for conveying the effluent to the well-heads are discussed under 2.1.4.1.

General Operation of the Effluent Injection Program

This EIR/EIS evaluates the initial effluent injection strategy proposed by Calpine, NCPA and Unocal. It is anticipated that monitoring of the effects of the injection program on steam production over time will lead to modifications of the program, including both the selection of the wells to be used for injection and the rates of injection to those wells.

The injection program is based on the assumed conveyance of 5,400 gpm of effluent in the Geysers Effluent Pipeline. This will be divided equally between Calpine, Unocal and NCPA, each of which will distribute the effluent to its own wells. The injection area includes the steam fields operated by Calpine which supplies PG&E Units 13 and 16. There are no plans at present to use project effluent to supply steam to the Bear Canyon Power Plant although injection of effluent into the Bear Canyon Area may occur after 1998. The NCPA injection area includes steam fields for Plant Nos. 1 and 2. The Unocal injection area includes steam fields supplying PG&E Units 18 and 20. The proposed 5,400 gpm of injection would approximately double the current rate of injection in this part of The Geysers by Calpine, Unocal and NCPA.

The injection method is the same as that used in current injection operations using power plant cooling tower condensate and collected storm water runoff from well pads and power plant sites. In basic concept, the effluent would be injected into deep wells, where it would migrate through fractures and pores in the hot reservoir rock, heating and flashing into steam. The steam flow derived from the injection fluid would increase steam pressure in the geothermal reservoir, thereby increasing the output of existing production wells. Existing pipelines gather the steam and direct it to the power plants.

Initially, NCPA would inject the effluent (mixed with condensate and rainwater) into seven existing injection wells and later adding two new injection wells. The injection rate at NCPA wells would depend on conditions in the geothermal reservoir as determined by the operator. The NCPA wells would receive between 200 gpm to 1,800 gpm as an average annual rate of flow (NCPA also would add other sources of water for injection, such as rainwater, raising the upper rate of injection to 2,000 gpm). The injection intervals are typically on the order of 3,000 feet to over 10,000 feet deep. The amount of effluent injection at each well would vary.

Three or four existing and possibly five new Calpine injection wells would receive between 200 and 1,800 gpm as an average annual rate of flow. The injection intervals are typically on the

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order of 2,400 feet to over 8,000 feet deep. The amounts of effluent injection at each well would vary and effluent will likely be mixed with power plant condensate prior to injection into some wells.

Four existing Unocal injection wells would receive between 200 and 4,000 gpm (adding in other sources) as an average annual flow rate. The injection intervals are typically on the order of 2,800 to over 9,000 feet deep.

The annual energy production related to this 5,400 gpm of effluent injection is anticipated to be between approximately 197,100 and 657,000 Mega-Watt hours (MWh).

As part of the proposed project, Calpine, Unocal and NCPA would monitor spring waters that are used as major sources of drinking water near the project area, if requested. While contamination of groundwater is considered unlikely, periodic monitoring of spring water would provide information about changes in water chemistry, if such were to occur. Similarly, Calpine, Unocal and NCPA would continue to carry out mandatory injection well monitoring to ensure that injection fluids do not contaminate groundwater resources. The project sponsors also would participate in a program of information development and dissemination about seismic activity in the Southeast Geysers in conjunction with other monitoring programs conducted by the U.S. Geological Survey.

2.1.4.3 SOUTHEAST REGIONAL WASTEWATER TREATMENT PLANT FACILITIES PLAN COMPONENT

The proposed project consists of capacity improvements to the SERWTP treatment facilities. Effluent would be secondarily treated.

Proposed filtration facilities consist of a chemical coagulant aid/feed mix system and single or multi-media filters. The effluent would be filtered by passing it through a filter system after the addition of a chemical to increase the removal of solids (coagulant aid). Coagulant aid chemicals would be either polymer or aluminum sulfate (alum), both commonly used for this purpose in domestic water supply treatment systems. Filters would be conservatively sized and have backup units for dependability.

Under normal conditions, the oxidation ditch process would be operated on a continuous year-round basis to produce a high quality secondary effluent with BOD and suspended solids

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concentrations expected in the 10 to 20 mg/l range. This effluent would be conveyed into the existing reservoir for storage. Prior to actual disposal, stored effluent would be disinfected.

Proposed treatment facilities improvements include:

1. a separate septage/grease receiving structure
2. grit chamber improvements
3. replacement of the existing comminutor with a mechanically cleaned bar screen
4. ditch distribution box
5. oxidation ditch improvements
6. clarifier splitter box
7. a new secondary clarifier
8. a new return/waste sludge pump station
9. effluent flow metering additions
10. chlorine contact pipeline additions
11. sludge drying beds or
12. belt filter press facility
13. oxidation ditch

2.2 PROJECT SPONSORS' OBJECTIVES, PURPOSE AND NEED

2.2.1 PROJECT SPONSORS' OBJECTIVES

The project sponsors have identified four primary objectives of the project.

Objective No. 1. Resolve treatment and disposal deficiencies at the SERWTP.

This objective specifically is intended to achieve compliance with California Regional Water Quality Control Board (CRWQCB) waste discharge requirements. The goal is to achieve both required levels of treatment of wastewater and an environmentally acceptable method of disposal of the treated wastewater in a long-term fashion.

Achievement of the objective would enable the CRWQCB to lift the 1991 Cease and Desist Order and the associated building moratorium.

Objective No. 2. Provide additional capacity at the SERWTP to accommodate growth in the SERWTP service area.

This objective is intended to provide expansion of facilities at the SERWTP which would allow new hook-ups in the City of Clearlake, the communities of Lower Lake and Middletown and other areas in the county within the existing service area. The expanded facilities are intended to supply additional capacity for wastewater treatment and disposal for planned growth in the service area to the year 2025.

Achievement of the objective would enable continued growth and development to occur in the service area.

Objective No. 3. Use effluent from the SERWTP and MWTP as injection fluid in the Southeast Geysers geothermal steam field in order to increase the current steam mass and thereby bring power production at existing power plants to a level closer to their installed plant capacity.

This objective specifically addresses the problem of declining steam production in The Geysers. The decline in steam production in recent years has resulted in reduced power generation at existing power plants. Without the addition of a new source of fluid for injection, continued substantial declines in steam production are anticipated. The project sponsors' objective is to inject the effluent into the geothermal reservoir to replenish the mass produced as steam and to

mine additional heat from the reservoir rock. In so doing, the goal is to increase the delivery of steam to six existing power plants. The project would slow the rate of decline in steam production in the geothermal reservoir and extend the operating life of both the steam field and the power plants.

Achievement of the objective would allow PG&E, Calpine, Unocal and NCPA to continue to operate their plants closer to their installed capacity and for a longer period of time than would otherwise be possible under the anticipated continued decline in the steam field.

Objective No. 4. Retain and create jobs for the local economy by providing infrastructure to support jobs.

A primary goal is to retain the existing base of employment in both the SERWTP service area and in the Southeast Geysers. As a rural county with significant and chronic unemployment, a primary objective is to provide facilities that will permit growth and diversification of the employment base through commerce, industry and tourism. As the geothermal industry in the Southeast Geysers faces a significant projected decline in production of geothermal steam-generated power in the future, a primary objective is to obtain a new source of injection water that would ensure continued operation of the steam fields and power plants. Additionally, as a significant construction project, the objective is to provide jobs for local construction workers.

Achievement of the objective would result in greater employment in both the short term and long term. Additionally, achievement of the objective would ensure continued revenues to the federal government (BLM), State of California and County related to steam and power production in the Southeast Geysers, as well as tax revenues related to employment, taxes on goods and services and overall improved local economy.

2.2.2 PURPOSE AND NEED

2.2.2.1 LACOSAN

The purpose and need for the project with respect to LACOSAN's statutory authority are the same as Objective Nos. 1 and 2. LACOSAN is required by law to take action on the Cease and Desist Order of the CVRWQCB. By approving and proceeding with the project, LACOSAN would bring wastewater management in the SERWTP service area into compliance with its permit requirements. In addition, by approving the project, LACOSAN would ensure that future

growth in the SERWTP service area would be served by wastewater treatment facilities. The assurance of continued growth in the County is consistent with goals and objectives of the County General Plan and the City of Clearlake General Plan.

2.2.2.2 BLM

The purpose and need of the project with respect to the BLM's statutory authority are related to Objective No. 3. Pursuant to the Geothermal Steam Act of 1970, the BLM is authorized to issue leases for geothermal resource development on federal lands within The Geysers Known Geothermal Resource Area (KGRA). As provided by the Code of Federal Regulations, Title 43, Chapter 11, Part 3000, the BLM makes available KGRA lands for lease and, in return, the U.S. Minerals Management Service receives royalties on the resource production. The proposed project per se would not alter existing lease terms or the rates for royalties established in the leases issued to NCPA, Unocal and Calpine. However, in conjunction with Objective 3, the project's purpose would be to continue production of the geothermal resource and thereby ensure the long-term payment of royalties to the federal government. It is likely that NCPA would apply for a royalty rate reduction in order to proceed with the project.

Laws and policies of both the federal government and the State of California support the establishment and maintenance of a reliable electric power supply to meet existing and future needs, and encourage the provision of an economical supply of electricity to the customers. The proposed project would be responsive to these needs for low-cost energy and projected growth demand for new energy. The project would add to the base load of power provided by NCPA and PG&E to their customers. The use of electric energy is expected to increase in California. The State of California Energy Commission (CEC) recently forecast that the state will need about 21,500 MW per year to meet future demand (CEC, 1992). The proposed project would be one source of power to meet a part of that demand. Additionally (and significantly), this project-related power could be generated without the need for creating new power plants of equivalent output or transmission lines, as these infrastructures already are in place. The U.S. Department of Energy is a cooperating agency for the project, providing part of the funding for its construction.

2.3 GEYSERS EFFLUENT PIPELINE PROJECT COMPONENT

This section provides a detailed description of the main pipeline and related facilities, the system operating strategy, and the proposed construction plan for the facilities. Except where cited otherwise, the information in this section is derived from the Southeast Geysers Effluent Project Preliminary Design Report, April 1994, prepared by EcoLogic Engineers, Dewante and Stowell Consulting Engineers and Veizades and Associates Engineers.

2.3.1 PROJECTED EFFLUENT FLOW RATES

One of the primary objectives of the project is to provide a long-term, reliable, and cost-effective disposal plan for SERWTP effluent. A secondary objective is the use of treated wastewater effluent from the MWTP for a greater overall economic benefit than the current pasture crop irrigation disposal system. Therefore, the project involves use of combined effluent flows from both the SERWTP and the MWTP for ultimate disposal as injection fluid in the southeast Geysers steam field. When received in the steam field, the effluent would be used as a resource fluid for managing steam production in the southeast Geysers.

Studies conducted by and for the County of Lake, Calpine Corporation, NCPA and Unocal established that a minimal water flow of about 7.8 mgd (equivalent to 5,400 gpm) could be cost effectively conveyed from the service area of the SERWTP and the Middletown WTP and injected into the southeast Geysers steam field. The service area of the SERWTP includes the City of Clearlake, the community of Lower Lake and surrounding areas. The SERWTP currently has approximately 6,880 sewer connections; Middletown has about 2,000 residents. Current average annual wastewater flows at the SERWTP and MWTP total less than 1.71 mgd. Negotiations with the Yolo County Flood Control and Water Conservation District (YCFCWCD) will result in an agreement to provide supplemental water to the wastewater flow by a diversion from Clear Lake to yield the 7.8 mgd objective.

Current financing arrangements for the project would provide for the nominal 7.8 mgd flow conveyance and in a 24-inch inside diameter main pipeline, named here the Geysers Effluent Pipeline.

Projections of average annual effluent flow rates from the various water supply sources were presented in Table 2.1.4-1. Wastewater flow projections are drawn from current facility planning documents for the two treatment and disposal systems. The intent of the project is to

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2.3 Geysers Effluent Pipeline Project Component

reclaim 100 percent of the effluent from both treatment plants, and to supplement that combined flow to achieve a nominal 7.8 mgd using diversions from Clear Lake. For preliminary design purposes, a design conveyance capacity for combined lake diversion and SERWTP flows of 5,300 gpm (7.66 mgd) is established. The MWTP effluent flow would be additional to this amount, such that the nominal average annual injection flow rate at The Geysers would be 5,400 gpm (7.8 mgd). A design flow rate of 5,400 gpm has been established in an Agreement in Principle between the project sponsors. Briefly stated, if the project is approved by the LACOSAN Board of Directors and funding is made available, a final agreement would be written in which LACOSAN would guarantee delivery of 5,400 gpm of water to the combined operators of The Geysers steam field and power plants (Calpine Corporation, NCPA, Unocal and PG&E) for a period of 25 years. After 25 years the agreement could be extended for 5-year intervals or terminated.

Wastewater flow rates in the collection systems of both wastewater treatment plants vary throughout any year depending on a number of factors, the principal of which is wet season infiltration and inflow. Sustained SERWTP influent flows of 3 to 4 mgd can and do occur over many days in succession during unusually wet weather periods. Significant retention capacity is available at the SERWTP reservoir. Similarly, the MWTP has adequate capacity to store its wastewater effluent to absorb such peak system flows.

Effluent flow projections presented in Table 2.1.4-1 are for average annual flows expected during average (mean) weather conditions. Daily flows and weekly and monthly averages would be expected to vary somewhat. The system wastewater flow variations would be taken up by adjustments in lake diversions, that is, when SERWTP and MWTP effluent flows decline, the supply of water to the system from Clear Lake generally would increase (see Section 2.3.2.1). The overall operating strategy would be to maintain a constant flow in the Geysers Effluent Pipeline of 5,400 gpm. This rate of flow would occur at all times, except for periods when the flows in the pipeline would be shut off for maintenance of the pipeline, in response to emergency conditions, in drought periods for which lake withdrawals would be prohibited or in periods of higher pumping preceding or following a shutdown of the lake diversion pumps because of algae bloom.

2.3.2 MAKE UP WATER DIVERSION FROM CLEAR LAKE

Insufficient effluent supply would be available from the combined SERWTP and MWTP to maintain the consistent flow of 5,400 gpm in the Geysers Effluent Pipeline. As development occurs in the SERWTP and MWTP service areas and more wastewater is generated, the dependence on diversions from Clear Lake would decrease. As Table 2.1.4-1 indicates, the combined effluent flows would not equal the flow from the Clear Lake diversion during the project's operating life. The YCFCWCD has indicated its preliminary agreement to provide through a sale agreement up to 7,950 af/yr for the proposed diversion.

2.3.2.1 LAKE WATER WITHDRAWAL AND SCHEDULE

Water withdrawal rates from Clear Lake will vary throughout each month and throughout each year depending on the supply of wastewater effluent from the SERWTP to its storage reservoir.

Average, Minimum and Maximum Withdrawal Rates

Based on projected average annual flows expected from the SERWTP under average seasonal rainfall conditions, average water withdrawal rates would be as presented in Table 2.3.2-1. These rates assume flow needed to maintain constant 5,400 gpm flow in the Geysers Effluent Pipeline assuming projected wastewater flows from the SERWTP. Average withdrawal rates would vary from about 6.3 mgd in 1996 dropping to about 5.1 mgd in 2021. These diversions are based on a projected 1996 average annual SERWTP flow of approximately 1.40 mgd, and a 2021 average annual flow of approximately 2.52 mgd, as projected in Table 2.1.4-1.

If seasonal rainfall conditions are substantially greater and LACOSAN on-going collection system maintenance and repair efforts have less effect in reducing system infiltration and inflow, then SERWTP effluent flows could be much greater. Based on 1-in-100 year wet season conditions, the average annual SERWTP flow could be as much as 1.8 mgd in 1996. This would reduce the need for diverting lake water. Under the reduced lake withdrawal scenario, an averaged annual lake diversion of about 5.86 mgd to yield a 7.78 mgd total flow.

Maximum annual lake diversion rates would result from minimum SERWTP flows. Using the SERWTP average annual flow of 1.08 mgd, during the 1991 dry year, the maximum averaged annual diversion rate would be as follows:

$$7.78 - (1.08 + 0.14) = 6.56 \text{ mgd}$$

TABLE 2.3.2-1: CLEAR LAKE DIVERSION WITHDRAWAL RATES

	Year	
	1996	2021
Average Withdrawal Rate		
Daily (mgd)	6.3	5.1
Monthly (af/mo)	580	475
Yearly (af/yr)	6,990	5,700
Minimum Withdrawal Rate		
Daily (mgd)	0	-
Monthly (af/mo)	550	-
Yearly (af/yr)	6,685	-
Maximum Withdrawal Rate		
Daily (mgd)	8.9 ^(a)	
Monthly (af/mo)	850 ^(a)	
Yearly (af/yr)	7,353 ^(b)	-

- (a) The maximum withdrawal would occur for several months to compensate for the period when the pumps would be shut down during the algae bloom period.
- (b) The yearly rate of withdrawal is based on the projected average annual maximum of 6.56 mgd.

SOURCE: Eco:Logic Engineers, 1994

Under preliminary agreement with the YCFCWCD, withdrawal would not exceed 7,950 af/yr.

Maximum monthly and daily lake diversion rates would result from the minimum SERWTP flow conditions and in the optional case of over-pumping during clear water months in the lake. The higher rates of diversion would enable interruption of diversion pumping during the algal bloom period, assumed to last about one month in August/September. In order to avoid significant oversizing of diversion pumps and piping, a three month period of over-pumping is proposed if this method of water quality control is utilized to avoid drawing in algae.

The maximum monthly and daily diversion rates would be approximately a third greater than the maximum average rates. Peak diversion pumping rates are not expected to exceed the above daily rate under any circumstances.

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2.3 Geysers Effluent Pipeline Project Component

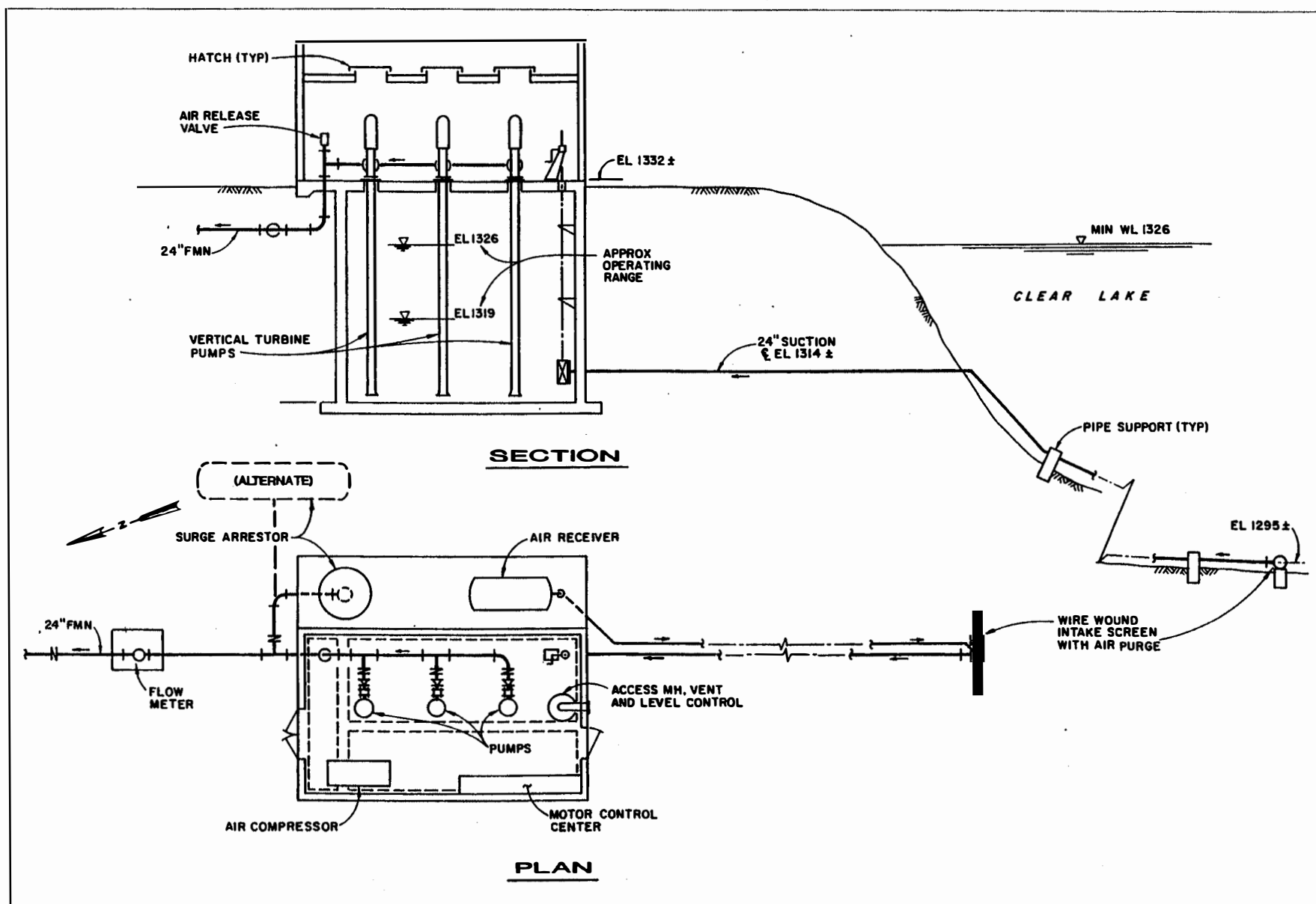
A pre-set detailed schedule for daily lake water diversions cannot be established because it would depend on effluent flow rates in the SERWTP at a given time and the timing in any given year of excess diversions used to avoid algal bloom conditions in Clear Lake. As noted, increased withdrawals would occur in advance of and following the lake algal bloom, and the pumps would then be shut off until the bloom conditions subside. Under this optional mode of operation over-pumping from the lake and in The Geysers Effluent Pipeline could increase 10 to 15 percent above the average annual rate of pumping. This is from 5,940 gpm to 6,210 gpm above the 5,400 gpm average. Because of the depth of the lake diversion intake, it is not anticipated that algae intake would be sufficient to cause a shut-down. However, in the event such a shutdown were to occur, over-pumping would provide an optional method to ensure that the 5,400 gpm average annual flow rate guaranteed in the Agreements would be achieved. Additional periods of pump shut down could occur when the Geysers Effluent Pipeline pumps have been shut off for routine maintenance of the pipeline and pumps or if injection operations in The Geysers were slowed or halted temporarily.

2.3.2.2 LAKE DIVERSION INTAKE AND PUMP FACILITIES

Lake Diversion Pump Station and Intake Structure

The lake water diversion would be accomplished using three vertical turbine pumps housed in a structure on the lake shore. A variety of possible pump types were evaluated in the pre-design phase. The project engineers determined that vertical turbine pumps provide the most practical, efficient and cost effective type for the proposed situation. Each pump would have a capacity of about 2,060 gpm at a total developed head (TDH) of about 160 feet. The pumps would be located directly over the suction chamber, and would be housed in a sound-proof building. Figure 2.3.2-A presents a plan and elevation view of the proposed three vertical turbine pumps and intake.

Vertical turbine pumps located either on shore or on a pier are both feasible alternatives. The construction of a pier that would extend far enough out into the lake for adequate suction at minimum lake surface elevations would create a permanent surface structure (and associated impacts discussed in Section 6). Although locating a suction structure on the shore and extending suction lines out into the lake would involve short term disturbance of the lake bottom during construction, once completed, there would be little surface evidence that a pumping system was in place. For this reason, an on shore location is the preferred pumping arrangement.



SOURCE: Dewanto and Stowell Engineers

Southeast Geysers Effluent / 920586 ■

Figure 2.3.2-A
 Lake Diversion Intake and Pump Station
 Plan and Elevation

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2.3 Geysers Effluent Pipeline Project Component

A single suction line would extend approximately 300 feet out into the lake to a point below the low historical water elevation in the lake. The intake structure would be located on the lake bottom (elevation 1,295 msl) at a depth of approximately 30 to 35 feet below the mean lake level (elevation 1,330 msl). Self cleaning screens, such as a wire wound screen with air purge system, would be constructed on the end of the suction line for fish protection as well as to keep debris out of the pumps.

The proposed suction line would be a 24-inch diameter pipe constructed underground from the pump station onshore until it reaches the open lake bottom at elevation 1,314 feet msl. From that point, it would drop in elevation following the lake bottom to the terminus and intake at elevation 1,295 msl. The pipe would be anchored in place with concrete collars and protected by rock riprap.

The pumps, motor control center, air compressor, air receiver and surge arrestor would all be housed in an enclosed structure or shielded from view. Equipment would be located in an industrial-type structure (about 15 feet by 25 feet) with the surge arrestor mounted on a contiguous concrete slab on a purchased parcel of land which is a vacant lot at 13409 Lakeshore Drive.

Lake Diversion Pipeline

Water drawn into the lake intake and pipeline would be pumped through an 24-inch pipeline that would convey it to the SERWTP storage reservoir. The total length of pipeline from the lake diversion pump station to the SERWTP storage reservoir would be 16,600 feet. The pipeline would have a maximum pressure class rating of 200 pounds per square inch (psi), and would accommodate a normal average annual flow condition of 6.3 mgd. The pipeline would be capable of conveying up to 8.9 mgd for several months to enable a one month diversion shutdown during the annual algal bloom period in Clear Lake.

Pipeline materials of construction would be selected from the following listing:

- C-906 PVC (Class 150 or 200) with gasket joints
- Cement lined and coated steel cylinder pipe, Class 200 with gasket joints.
- Ductile iron, Class 150 with gasket joints.
- High density polyethylene

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Final construction materials would be selected in the final design phase.

Isolation valves would be spaced at approximately two-mile intervals. Blowoff valves, air release valves, thrust blocks, and miscellaneous fittings also would be provided. The pipe would be buried for its entire length. Diversion pumps would have discharge check valves. In addition, discharge into the SERWTP reservoir would be through a flap gate with an anti-siphon inlet control structure. This would prevent effluent in the reservoir from flowing back into the lake diversion pipeline and into Clear Lake.

The route of the proposed lake diversion pipeline would be as follows (following the direction of water flow, however, station are numbered in the reverse of the flow direction, with 0.0 at the SERWTP). (The numbers in parentheses refer to the numbered station which are stated in 1,000-foot intervals from the initiation point 0.0 at the SERWTP; thus, 5.2 would indicate a position 5,200 feet from the SERWTP. Reference to the lake diversion station is identified by 'M' preceding the station number.)

After crossing the lot on which the pump house would be located, the pipeline would enter Lakeshore Drive heading southeast, located in the street. The street turns left and heads uphill. The route would follow one of two alternate routes here: (a) continue in Lakeshore Drive uphill following the right turn, or (b) the pipe would turn right into Lower Lakeshore Road running southeast in the street to the point where it meets Kern Street, and there turning left and running uphill to re-join Lakeshore Drive.

The pipeline route would continue southeasterly in Lakeshore Drive, but continuing straight ahead, crossing Lakeshore Drive and entering Manakee (Lakeshore Drive turns southerly here, going off the route) - and immediately turning left. The pipeline would continue easterly on Manakee Avenue to Huntington into which it would make a left turn, running northeasterly in the street. It would continue on this route following Huntington to where it turns into Arrowhead Road (M 11.6). The pipeline would cross under Arrowhead Road and run easterly in the road shoulder on the north side of street (the shoulder is bounded by open fields in this area). This entire segment is located in relatively flat and gently sloping land.

The pipeline would follow the road alignment of Arrowhead Road, crossing as it merges into Burns Valley Road and continuing eastward on the latter in flat land. Burns Valley Road turns off the route, and the pipeline continues straight ahead easterly on Reid Lane to where the road turns north (M 7.5). The pipeline route continues easterly off the road, trending onto flat private farmland about six or seven feet north of and paralleling the fence line (property line) in open pasture lands (passing walnut trees located to the south of the fence line). The route continues easterly in flat land until reaching Smith Lane (M 6.3), at which point it turns northerly.

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The pipeline would be located in the flat west shoulder of Smith Lane near existing fences. Smith Lane is a dirt road. It continues north to near a residence on the west side of the road. At that point (M 5.1), it would cross the road, entering private property, then run easterly seven to eight feet north of and along the fence line in flat pasture land. The route crosses two small drainages, then ascends a gentle slope and would bend southerly to avoid some of the large oak trees in the woodland. The route continues easterly in flat land and crosses another dirt road and an intermittent stream that drains from the north. Continuing easterly, the route crosses a fence into the lot of a private residence, following easterly in the flat dirt road to Robin Lane (M 3.1; this is also the effluent pipeline route and would be located five feet to the east of the lake diversion pipeline).

At Robin Lane the route turns left, running northerly in the dirt road and occupying the same ROW as the effluent pipeline. The overall combined ROW will be five to six feet wide, with a 30 to 36 inch cover. The diversion water pipe continues northerly in Robin Lane, passing an existing gate. Although undeveloped, Robin Lane continues northerly. The pipe would remain in the road easement through an existing orchard. The pipe will cross Pond Lane, entering the flat, open spray irrigation fields of the SERWTP, and would run directly north to the reservoir.

An outlet structure would be located at the high point in the line adjacent to the reservoir. A 24-inch gravity flow pipeline would extend from this structure down to the bottom of the reservoir, at which point concrete or rock rip rap erosion protection would be provided. The outlet will discharge into the bottom of the reservoir to discourage algae production.

The outlet structure at the SERWTP is located at elevation 1,440 msl. As the lake diversion pump station is at elevation 1,330 msl, the total lift would be about 110 vertical feet.

An alternative plan to by-pass the SERWTP reservoir is described in Section 3.1.

2.3.3 GEYSERS EFFLUENT PIPELINE AND RELATED FACILITIES

The main pipeline of the project is the Geysers Effluent Pipeline, which would convey effluent and make-up water from the SERWTP to The Geysers. The pipeline and all the directly related facilities to it are described in this section. The Geysers Effluent Pipeline is designed to maintain a nominal constant flow rate of about 5,400 gpm to The Geysers, with about 5,300 gpm of this pumped from the SERWTP reservoir.

Treated wastewater at the SERWTP currently is diverted into the large reservoir north of the plant for temporary storage. This arrangement would continue as part of the project (see Section 2.5). The SERWTP effluent would mix with the raw (untreated) lake diversion water in the reservoir before being drawn into the Geysers Effluent Pipeline.

2.3.3.1 SERWTP OUTLET PIPE EXTENSION LINE AND PUMP STATION

Reservoir Outlet Pipeline Extension

An existing 18-inch diameter outlet from the storage reservoir is used at present to draw effluent from the reservoir. This structure would be used as part of the project for these same purposes. This outlet would need to be supplemented with additional pipe capacity since unacceptably high flow velocities would result at the design conditions. The additional capacity would be provided by a new 24-inch pipe constructed through the existing reservoir dam. Use of a vacuum priming system would enable locating the new pipeline at approximately mid-height in the dam, rather than near its base. A single 24-inch diameter buried pipeline extension from a junction of the new 24-inch and the existing SERWTP reservoir outlet would be constructed for the project. It would be approximately 730 feet long, located entirely within the SERWTP yard on its eastern side. This would be a suction pipeline drawing effluent from the reservoir and conveying it to the pump station, where the effluent would enter the pump barrels.

SERWTP Pump Station

The design criterion for the pipeline conveyance system consists of a fairly constant SERWTP pump station discharge flow of about 5,320 gpm (7.7 mgd) between the SERWTP and the MWTP. Pumping head and pipeline pressure ratings can be kept to a minimum for single pump station conveyance from the SERWTP to the Middletown area using the Childers Peak intermediate high point as a control elevation. An optimum balance of the number and size of pump and motor units would result in the following design criteria:

Number of Pumps (maximum)	7 (6 operating, 1 back-up)
Output capacity, each pump	900 gpm
Total dynamic head (TDH)	580 ft
Motor size	200 hp
Motor speed	3,600 rpm
Pump type	Vertical turbine

Vertical turbine pumps are proposed because of the high discharge pressures required for the project.

A minimum 900-cubic-foot hydropneumatic air chamber at the discharge side of the SERWTP pump station would be installed for surge control. The pump station would be located within the SERWTP yard. SERWTP Pump Station facilities would consist of up to six operating pumps,

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2.3 Geysers Effluent Pipeline Project Component

and motor units, suction and discharge piping and valving, an electrical feed transformer, electrical switchgear and a motor control center and a pipeline surge control tank. A seventh pump may be installed as a back-up to ensure that six pumps would remain operational at all times. A prefabricated or block-wall building enclosure would be provided for the electrical switchgear and motor control equipment.

Allowing for ample room for vehicular access, the layout of the pump station facilities would require a site area of up to about 0.3 acre.

The existing SERWTP site is located at the north end of Burns Valley. Existing plant structures and facilities would be improved and expanded as a companion project to the Southeast Geysers Effluent Pipeline Project (see Section 2.5). Additional expansion improvements must be accommodated in the future, perhaps including facilities to upgrade the level of treatment from the current secondary level to tertiary level with nutrient removal. Allowing for these possible improvements, the location for the SERWTP pump station would be as shown in Figure 2.3.3-A. Plan and elevation diagrams for the pump station are shown in Figure 2.3.3-B. Some fill grading may be required to protect the site from surface runoff conditions as it is in the general vicinity of existing sprinkler irrigation disposal areas.

2.3.3.2 GEYSERS EFFLUENT PIPELINE TO BEAR CANYON PUMP STATION NO. 1

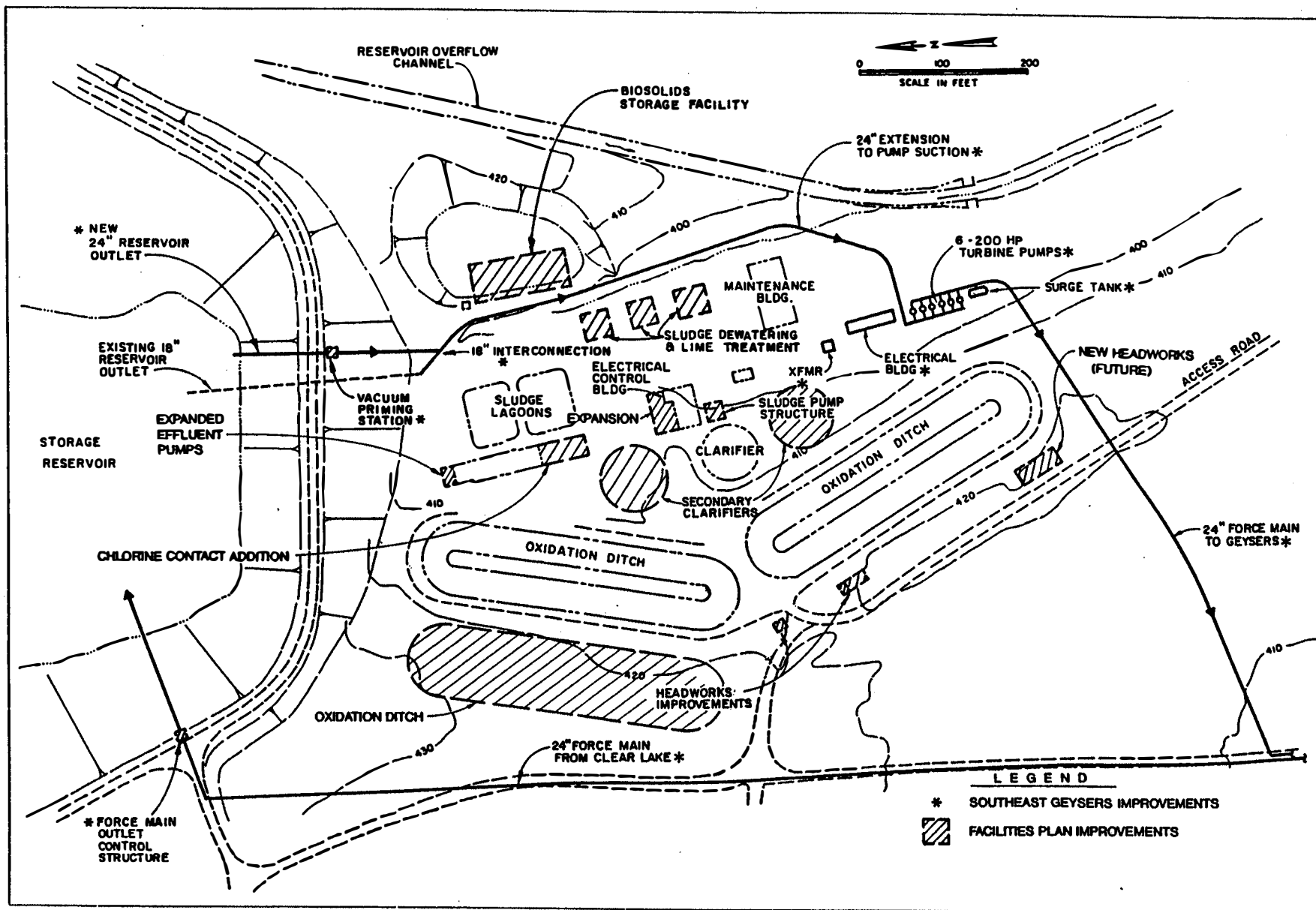
The Geysers Effluent Pipeline would be a 24-inch inside diameter pipeline. It would have an exterior diameter of approximately 26 to 28 inches. Depending on pressure conditions in different segments, the pipeline would be constructed of the following materials:

- Cement lined and tape coated steel pipe with rubber gasket or welded joints for pressure conditions up to 350 psi.

- Cement lined and tape coated steel pipe with welded joints for pressure conditions over 350 psi.

- Cement lined and bare exterior Type A606 weathering steel with welded joints on exposed piping at aerial segments.

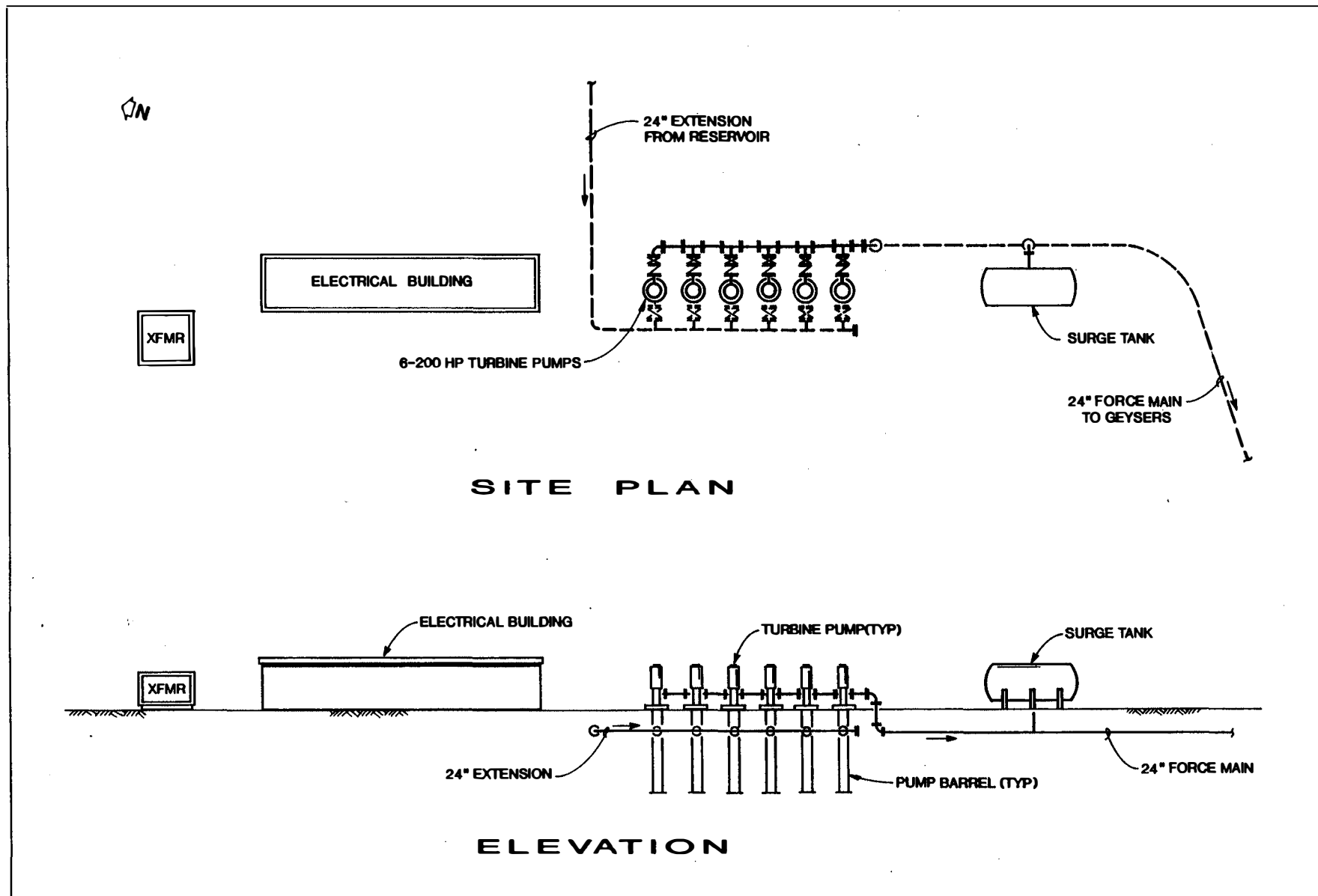
Consideration would be given in detailed final design for the possible use of high density polyethylene (HDPE) pipe in the vicinity of Childers Peak where pressure conditions will be below 200 psi. The use of this pipe may offer some cost savings compared to steel piping.



SOURCE: Dewante & Stowell Engineers (1991)

Southeast Geysers Effluent / 920586 ■

Figure 2.3.3-A
Location of Proposed Facility Improvements at the SERWTP



SOURCE: Dewante and Stowell Engineers

Southeast Geysers Effluent / 920586 ■

Figure 2.3.3-B
 SERWTP Pump Station Plan and Elevation Diagrams

2.0 Description of the Proposed Project
2.3 Geysers Effluent Pipeline Project Component

Pressure conditions within the main pipeline to Bear Canyon Road would range from less than 200 psi in the vicinity of Childers Peak to nearly 400 psi along Big Canyon Road south of Childers Peak. Flows in the pipeline would be controlled by up to six pumps at the SERWTP. Manual isolation valves would be provided at approximately two-mile spacing along the pipeline to facilitate maintenance. Bolted manhole access ports would be provided on either side of isolation valves for entry into the pipeline for maintenance purposes. Blowoff connections would be made at low points in the line, air release valves will be provided at high points in the line, and thrust blocks and miscellaneous fittings would be provided as necessary.

The pipeline would be below ground in an excavated trench and would have a minimum three feet of cover for approximately 101,000 feet between the SERWTP and the first Bear Canyon Pump Station (BC-1). The pipeline would be placed above ground on support structures for approximately 12,000 feet between these same points. No special protection is proposed for above-ground segments of the pipeline since the steel wall thickness (about 1/2 inch) combined with the protection offered by the A606 steel is considered by the project engineers to be suitably durable. With this pipe-wall thickness, falling trees, or all but the most severe rock slides and landslides, would be expected to result in minor damage without causing breakage or leakage of the pipeline.

Pipeline Route

The following route description follows the direction of flow, using station numbers in parentheses with 0.0 located at the SERWTP. Refer also to Figures 2.1.3-A through E.

The effluent pipeline exits the SERWTP site, crosses Pond Lane and follows southerly in Robin Lane in the same ROW as the lake diversion water pipeline, but approximately 5 feet to the east of it. Robin Lane is a flat dirt road, but is paved farther south in the block beginning north of the Burns Valley Creek crossing (station 4.4). The pipeline would be located near the western edge of Robin Lane, crossing under the road as it approaches Burns Valley Creek. The pipeline would cross the deeply entrenched Burns Valley Creek below the stream channel (this would be a trench- excavated crossing) just upstream of the culvert bridge. The pipeline would recurve westerly and be located again in Robin Lane within the street. The area is flat with orchards to either side. Robin Lane currently ends in a cultivated orchard - but the public ROW continues through the orchard southerly up a gentle incline.

Robin Lane makes a small jog at Bowers Road and the pipeline route continues southward in Brown Road. Brown Road is a dirt surface and dips gently southward into a low swale. The pipeline route continues southerly and uphill in Brown Road to Olympic Drive, at

2.0 Description of the Proposed Project

2.3 Geysers Effluent Pipeline Project Component

which intersection the pipe would turn left running northeasterly across Olympic Drive and in the uphill shoulder for a short distance to Fillmore.

The route makes a right turn into Fillmore. Fillmore is a steep dirt-surfaced road. It climbs southward and uphill, past the large water tank (7.8). Just south of the tank, the route turns left and easterly in Polk Street. Continuing eastward, the route crosses Highway 53. It continues eastward and uphill to Pine Avenue. The route makes a right turn heading southward in Pine Avenue (dirt-surfaced road), past residences and crossing small ephemeral drainages. At Davis Avenue, the route turns left heading east in Davis a short distance. On Davis at Cedar, it crosses a small drainage, but the pipeline would stay in Davis Street fill material.

The route makes a right turn on Cedar, heading southward to 43rd Avenue, then making a left turn, heading easterly. The road alignment stops where it goes down a ravine. The pipeline would head across the ravine, continuing easterly in 43rd to Irving Avenue (14.0). At Irving it turns right and heads southerly in the dirt-surface road. There is a crossing of Molesworth Creek (15.5), and a crossing of an unnamed creek (17.9). The route continues southward in the road to 17th Avenue, where it turns left (easterly) (20.1). The route continues easterly in 17th Avenue to Boyles Avenue.

The route makes a right turn into Boyles Avenue and continues to the end of the road at the top of the hill (23.0). There is a steep drop off to the south toward the Clear Lake Outlet Channel. The route continues straight overland through chaparral and downhill until a house is encountered (23.4). There are three alternatives possible here. The preferred route continues south along the east side of the fence line of the house, around the house, then bending westward to the owner's private driveway. The route then follows in the driveway downhill and south to Dam Road. Two alternatives (Alternative Routes A-1 and A-2) in this short segment are described in Section 3.

The pipeline route enters Dam Road, turning right and running in the uphill shoulder along Dam Road. At Lake Street, the route makes a left turn southward along the eastern side of the street, coming above ground just below the guard rail.

The crossing of the Clear Lake Outlet Channel (25.0) would be a bridge hanging: either hung on the eastern side of the bridge or placed through the hollow bridge structure. The outlet channel is within the City of Clearlake city limits, but the south bank forms the City boundary. Immediately after the bridge crossing the pipe goes underground again.

The route continues southerly in Lake Street: it will be either in the road or in the western edge of the road. Lake Street parallels Seigler Creek, which is located just to the west. In Lake Street, the route continues south through residential areas of Lower Lake to 2nd Street. It makes a left turn, heading easterly in 2nd Street to Mill Street. The route makes a right turn into Mill, heading southerly and slightly uphill to Morgan Valley Road (32.2).

The route turns left into Morgan Valley Road, which is a major County highway. The pipe could be in either shoulder of the road. It would continue easterly to just past the intersection of a small dirt surface road (33.8). The route turns right here to enter the easement of a small power transmission line in an open field. The route stays in the

2.0 Description of the Proposed Project

2.3 Geysers Effluent Pipeline Project Component

easement, running uphill into the woodland. The route runs mostly to the west of the transmission line through a cleared area in the woodland, but also may have to go east of it, thereby widening the cleared area. Continuing uphill, the easement breaks onto a private dirt access road. The route stays in the road, continuing southerly and uphill through grasslands and oak woodlands. The route crosses a saddle and continues southerly in the road to just above a farm. At that location (36.6), the route leaves the road, crosses the creek, and then heads straight downhill across an agricultural field to a private dirt road that leads to the farm house. The route trends across a field, following along a power transmission line located close on the western bank of Clayton Creek. The route bends slightly westerly as it approaches Clayton Creek Road to avoid some deeply eroded trenches of the creek bank.

The crossing of Clayton Creek (39.1) would be on piers immediately adjacent to the downstream (north) side of the bridge. An alternative crossing (Alternate Route B) is described in Section 3. After Clayton Creek, the pipeline follows in Clayton Creek Road. It could be placed at the road's edge, but cables buried in the road may have to be moved. The route continues south around a low hill with Clayton Creek on the west. The route passes in the road through an industrial development area in Excelsior Valley and crosses Spruce Grove Road. Here the road name changes to Riata Road, which parallels Highway 29. The pipeline would be in the road or at its edge, trending along the east side of a low hill. The route leaves the road in a wooded area where it bends left. The route continues straight ahead and up a cleared area to the fill of Highway 29 (45.0).

The crossing of Highway 29 would be bored through the fill. Highway 29 is on raised fill. The boring will occur on the diagonal relative to the highway, coming out at the base of a hill in a deep swale between the highway fill and adjacent slope. A little to the south, there is another stream crossing at a culvert that goes under Highway 29. The stream is steeply incised. The pipeline would daylight here and cross over the top of the constructed culvert.

The pipeline route stays on the west side of Highway 29 but back from the road and behind the fence to avoid the Caltrans ROW. At about station 7.0, the route comes back into the Caltrans ROW, but immediately adjacent to and east of the fence line. After station 48.7 it veers east of the Caltrans ROW (where Highway 29 makes a broad bend) and goes up the old highway in the road. Following the old road, it comes back closer to Highway 29, but stays behind the fence line and out of Caltrans' ROW, going uphill and down over some low hills. At about the Murphy Springs road sign, it would cross either over the hill or at its base. At station 51.3, the route again follows in the old road. Where the old road bends back toward Highway 29, the pipe stays in the old road and continues to about 53.0, where it turns sharply left, crossing directly eastward under Highway 29. The crossing may be ditched or bored. After the crossing, it makes an immediate sharp right turn and then continues southerly on the east side of Caltrans ROW (inside the ROW and west of the fence). An alternative crossing (Alternate Route C) is described in Section 3.

The route continues southerly and turns left just north of the access road to the El Roble Grande Ranch (just north of the gate). It would cross the driveway and head eastward straight down the road to the bank of Copsey Creek (54.6). Copsey Creek is deeply incised here. The crossing here would be direct. The pipeline would emerge from the

2.0 Description of the Proposed Project

2.3 Geysers Effluent Pipeline Project Component

bank. This would be a span crossing, probably with support piers, located about 100 feet south of the bridge. After the crossing, the pipeline would go underground again into the opposite bank.

After crossing the creek, the pipe would turn left and enter the private dirt road that hugs the hill on the east, staying in the road or closer to a fence. Staying in the private road, it would continue southerly then westerly, crossing Copsey Creek again. This would be a ditched crossing, with pipeline placed underground. It would continue up the road, making a sharp left turn, and the pipe would continue southerly in the private road. At the south end of the horse riding areas, the route leaves the private road, crosses a deep gully, and enters the Caltrans ROW of Highway 29 on its east side, following this southward for a short distance. It again crosses Highway 29 at station 58.0.

After crossing the highway, the route continues up the valley of Copsey Creek in a private dirt road, eventually crossing Copsey Creek at station 59.6, and following the dirt road that runs along Sweet Springs Creek. The route stays in the road, usually placed on the inside edge of the roadway, as there are steep slopes on the road's west side that drop directly into Sweet Springs Creek.

At station 62, the route leaves the road, where it crosses Sweet Springs Creek. It cuts off the road and goes to the left across country (no access road exists in this segment). The route heads straight up the valley of Sweet Springs Creek, repeatedly crossing the Creek's meanders that wind across the valley floor. In this area, the pipeline would be above ground on piers as it heads up the valley. At about station 65.0, the route heads easterly up the valley, finding the site of an old abandoned road that runs adjacent to the creek. The pipeline would stay in the old road, climbing to the head of the valley. The route would cross the saddle of the ridge and at station 66.8, effluent would be directed into the Childers Peak Regulating Tank (see Section 2.3.3.3).

Effluent would flow by gravity in the pipe from the Childers Peak tank to the first Bear Canyon Pump Station (BC-1) (station 66.8 to 112.5). The pipe would continue south and downhill from the tank. The pipe would be above ground and on piers and at the edge of the road that runs along the east side of the valley. This is an existing rough road that would be widened and improved to accommodate an access road to the Childers Peak Tank. Continuing downhill in the road, at station 72.5 the pipeline would have to go underground because of a bend in the road. After passing under the road, the pipe would daylight and span an unnamed creek. On the opposite bank, it again would be above ground and alongside a dirt road going slightly uphill in a westerly direction, then dropping over a saddle to a south-facing slope, heading first westerly, then making a large bend and heading southerly in the road.

At station 74.5, the road divides and each route could take the pipeline. The preferred route heads westerly, then bends southerly. An alternate route (Alternate Route D) for this segment is described in Section 3.

The pipeline would stay adjacent to the road as it drops steeply down to Big Canyon. The road and pipeline route make a bend and drop down a steep hill to Big Canyon Creek. Upon entering the valley floor, the pipe would go underground and cross Big Canyon

2.0 Description of the Proposed Project

2.3 Geysers Effluent Pipeline Project Component

Creek (76.6). This would be a ditched crossing. The project access road also would have an Arizona-type crossing (dip with cobble lining where it crosses the watercourse). The road and pipe route would rise up the opposite stream bank, crossing the low river terrace to Big Canyon Road.

At Big Canyon Road, the pipe would make a left turn and be in the road or the shoulder for a long distance. The road parallels Putah Creek for some distance, and the route would cross Cockerell Creek (84.5). For this stream crossing, the pipe would leave the road, crossing the fence line just west of the existing culvert, crossing the stream (ditch crossing) and back up to the road on the south side of creek. This type of crossing would be repeated again just down the road (avoiding some trees along the creek).

At station 94.5, the route crosses Harbin Creek. The pipeline would cross the creek on the down-stream side of the bridge. This would be a ditched crossing, placed a few feet downstream of the bridge. After crossing the stream, it would rejoin the road and stay in the road or in the shoulder. At station 97.0, the route leaves the west side of the road and goes westerly across the edge of a pasture along its northern edge. It would continue westerly, and south of the oak trees, until it intersects the Harbin Springs Road. An alternate to this pasture crossing (Alternate Route E) is described in Section 3.

The route runs briefly along the north side of Harbin Springs Road in the shoulder, then turns left and crosses the road at about station 98.5. Crossing the fence line, it runs southwesterly uphill across a cow pasture, heading directly up hill to the fence and road gate, then up a dirt road. The route follows southerly up a rocky road with an entrenched stream on its east side and steep rocky cliffs on its west side. At station 100, the route enters the lower end of a meadow area following the road as it bends westward. The pipeline route continues up the road to the saddle, then drops down the steep, long slope to Putah Creek.

There would be a ditched crossing of Putah Creek (102.5). The route ascends the southern bank of Putah Creek and continues across the meadow area avoiding big oak trees. It would enter a private dirt road heading southwesterly, then turn right heading northwesterly through the meadow. It would bend slightly toward the creek, but remain back from the under-cut bank, then bend westerly to a dirt road, crossing the property line and onto the Middletown Wastewater Treatment Plant (MWTP) property (104.2). After passing the (MWTP) fence line, the route enters an existing road and turns left, heading southwesterly in the road along the edge of the ponds. The road is dirt first, then paved. The connection from the MWTP Pump Station would be made along the paved section. Just north of the road's intersection with Highway 175, the pipeline would turn right and parallel the road, but located in the spray fields north of the highway. The route continues northwesterly paralleling the highway in MWTP land.

At station 109.5, the pipeline would turn left crossing Highway 175 at the Bear Canyon Access Road. It would cross the highway just above the culvert under the highway and enter into the broad open area. An alternative pump station would be located in this area (see Section 3). The pipeline would head uphill in the road. At about station 110.5, it would cut a tight hairpin turn, crossing over land, and re-enter the roadway on the uphill side of the bend. It would stay in the road until it reaches the first Bear Canyon Pump

2.0 Description of the Proposed Project
2.3 Geysers Effluent Pipeline Project Component

Station (BC-1) at 112.5. Section 2.3.3.5 provides a description of the alignment from Pump Station BC-1 to the Geysers.

The route alignment described in this EIR/EIS is a preliminary plan for the route. Some adjustments may occur prior to completion of the final alignment plan in response to environmental sensitivities, final design requirements and land acquisition considerations.

2.3.3.3 CHILDERS PEAK REGULATING TANK

Located at station 66.8, the Childers Peak Regulating Tank is at the highest point in the pipeline route (ca. 1,800 feet msl) until it reaches the Bear Canyon pump stations and heads up into The Geysers. The probable site is on the south side of the saddle in a somewhat open and gently sloped area. An alternate site would be just south of the saddle but more to the east so that it would be fitted into the topographic bowl (see Section 3.1.2.2) The access would be along the road coming up from the south.

The regulating tank will be constructed along the main pipeline route near Childers Peak to provide a controlled water level for operation of the SERWTP pumps. In addition, a relatively constant head suction supply would be provided for the Bear Canyon pumps. The storage tank would have approximately 620,000 gallons capacity, exposed to atmospheric pressure. It would be provided with level sensing and telemetry equipment (solar panel operated). It is expected that the tank would be of welded or bolted steel construction, provided with venting and overflow protection. The tank would provide surge protection as well as storage.

The tank size would be 60 to 70 feet in diameter and 24 or 32 feet in sidewater depth. It would be situated on a site encompassing about 0.3 acre. A final "footprint " near Childers Peak has not been selected, pending design surveys and geotechnical investigations. The site will also be used for spoils disposal for excess soil from construction in the pipeline segment between Highway 53 and Big Canyon Road.

2.3.3.4 MIDDLETOWN WASTEWATER TREATMENT PLANT PUMP STATION

As noted in Section 2.1.4, the MWTP will provide an additional supply of effluent to the Geysers Effluent Pipeline. This would range from an average annual flow of 60,000 gpd in 1996 to 180,000 gpd in 2021. The addition of MWTP effluent would raise the flow of effluent delivered to the Geysers to 5,400 gpm.

2.0 Description of the Proposed Project

2.3 Geysers Effluent Pipeline Project Component

The MWTP Pump Station would draw suction from the storage pond through existing piping and convey a constant flow into the main pipeline as it passes adjacent to and across the southeasterly boundary of the MWTP site. Design criteria for the pump facilities would be as follows:

Number of Pumps	2
Output capacity, each pump	250 gpm
Total dynamic head (TDH)	540 ft
Motor size	50 hp
Motor speed	3,600 rpm
Pump type	Vertical turbine

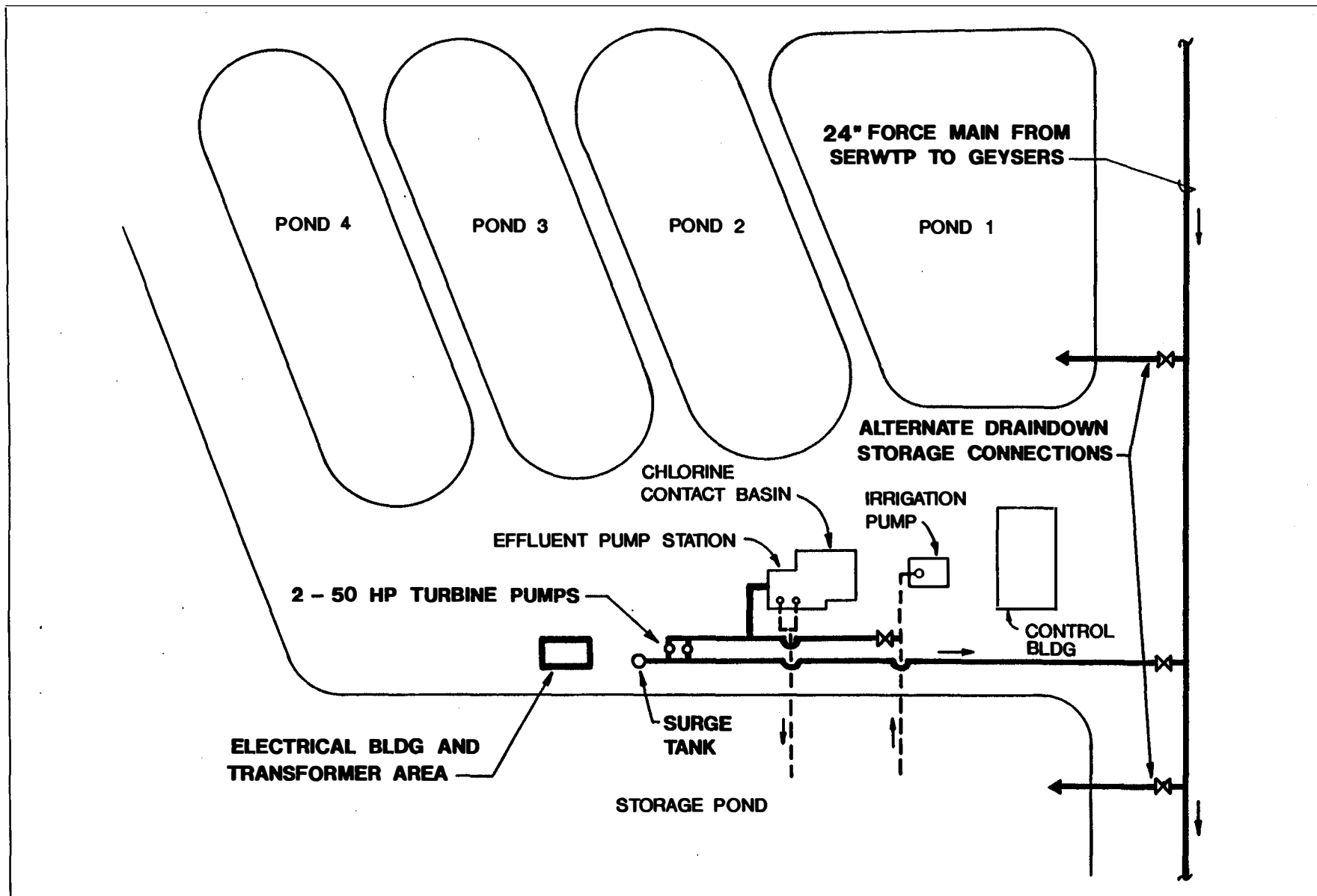
With the main pipeline pressure conditions maintained relatively constant by the Childers Peak Regulating Tank and typically consistent flow rates, the discharge pressure of the MWTP pumps would be relatively constant. Pump operation will be governed by water level in the MWTP effluent ponds.

The MWTP Pump Station facilities would consist of two pump and motor units, suction and discharge piping and valving, an electrical feed transformer, electrical switchgear and a motor control center, and pipeline surge control tankage. A prefabricated or block-wall building enclosure would be provided for the electrical switchgear and motor control equipment. A site area of about 0.1 acre would be required for these facilities. The MWTP also would be a spoils disposal site for excess construction soil.

The existing MWTP facilities were constructed in 1992 and ample capacity for wastewater flow increases was provided. However, storage capacity is currently limited due to some short-term construction problems that have been identified. Eventually storage capacity would be available to handle flows during periods of temporary shut-down and for maintenance. A reasonable layout for the MWTP Pump Station would be as shown in Figure 2.3.3-C. From this location, connections to effluent piping from the outlet of the storage pond, and the chlorine contact basin can be readily made.

2.3.3.5 GEYSERS EFFLUENT PIPELINE AND PUMP STATIONS TO THE SOUTHEAST GEYSERS STEAM FIELD

The MWTP, at elevation 1,140 msl, is the lowest point of the Geysers Effluent Pipeline. Beyond the MWTP, the pipeline route again climbs in elevation, making the steepest and greatest elevation gain of the pipeline (from 1,140 feet to 3,300 feet). However, the relationship in



SOURCE: Dewante and Stowell Engineers

Southeast Geysers Effluent / 920586 ■

Figure 2.3.3-C
Middletown WWTP Pump Station Layout

2.0 Description of the Proposed Project

2.3 Geysers Effluent Pipeline Project Component

elevation between the Childers Peak Regulating Tank and this segment of the pipeline is such that hydraulic head provided by the drop in elevation of the pipeline will efficiently raise the water to a level well above the MWTP. To make efficient use of this "stored energy" (termed hydraulic head), the first pump station along the Bear Canyon Access Road would be located at an altitude of 1,470 feet msl. This pump station is called Bear Canyon Pump Station No. 1 (BC-1).

Significantly, the BC-1 pump station also is the location of the transfer in ownership after construction of the Geysers Effluent Pipeline and the effluent, as well as the change in responsibility for operation of the system from LACOSAN to the industry partners. The industry partners are the project sponsors who are field operators and power plant owners and also are the partners of the Agreement; the industry partners include Calpine Corporation, the Northern California Power Agency (NCPA), and Unocal Corporation. An alternate transfer point at the Highway 175 - Bear Canyon Access Road intersection is considered in Section 3.

Pipeline to The Geysers

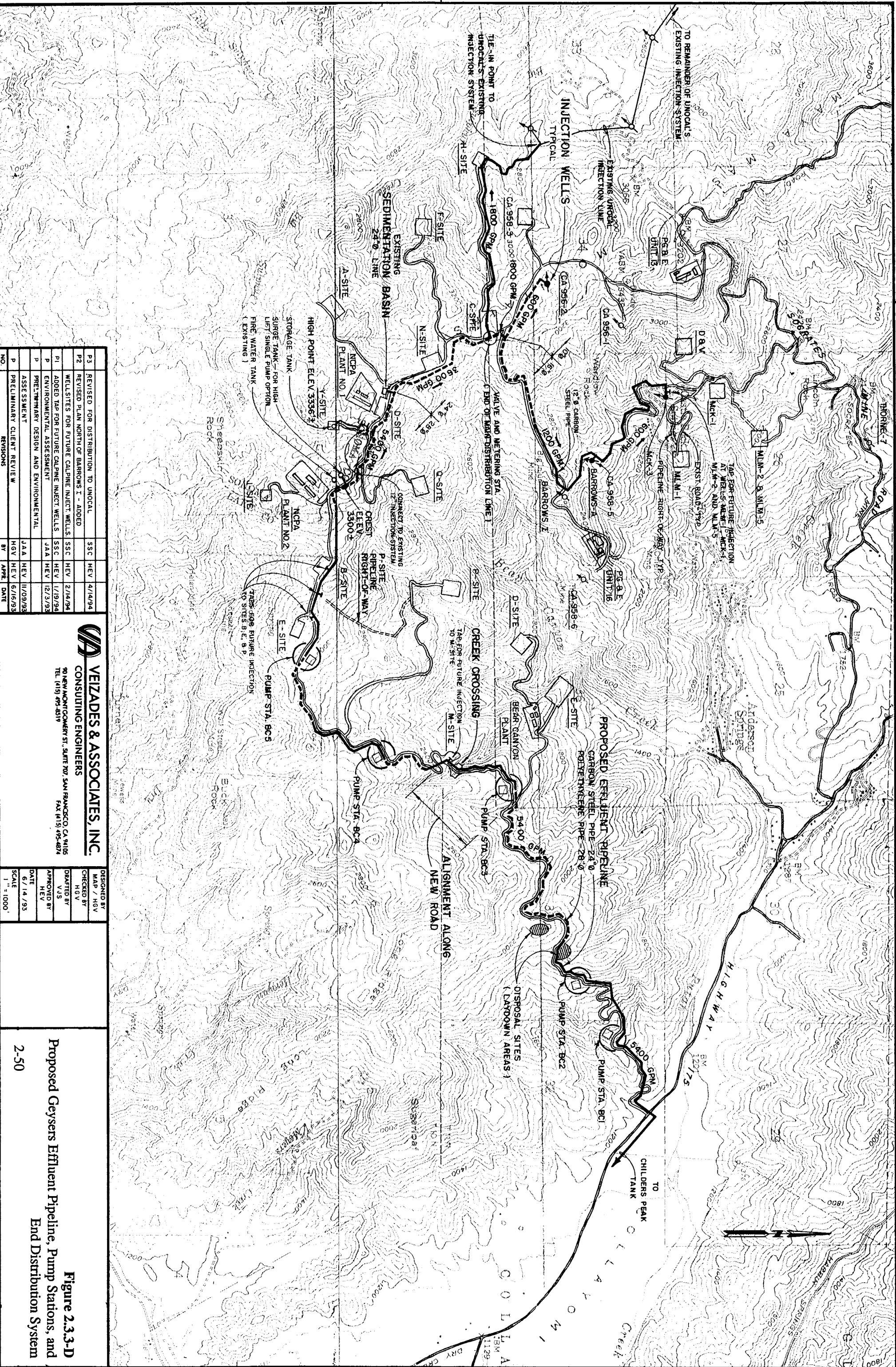
At most times, a constant flow of 5,400 gpm would be provided by LACOSAN in the Geysers Effluent Pipeline at BC-1. This rate of flow would be maintained in the pipeline to The Geysers steam field to the high point at elevation 3,330 feet msl. Depending on the location, the pipeline design would be either:

welded carbon steel, internally cement coated, with a protective exterior wrapping, and a 24-inch inside diameter, or

polyethylene, fusion butt-welded, and having a 28-inch outside diameter.

The design type changes as it goes up hill into The Geysers (see Figure 2.3.3-D). The polyethylene pipe mostly would be used for the segments where the pressure is less than 160 psig. For either design, it would be an underground pipeline with a minimum three-foot cover.

To lift water up to The Geysers, five pump stations would be located along the pipeline. Pump Station BC-1 would be located on a pad adjacent to the Bear Canyon Access Road at station 112.5. The pipeline in this segment would be 24-inch diameter carbon steel. After leaving Pump Station BC-1, the pipeline would be located in the road for a short distance. As a general rule, the pipeline would stay near the outside of the road at roadcuts and near the inside of the road at roadfills. At about station 113.0, the pipeline would head straight uphill off a large bend in the road (to avoid following three hairpin turns in the road). It follows a former skid trail just to the north of the road. At station 113.8, it returns to the



P3	REVISED FOR DISTRIBUTION TO UNOCAL	SSC	HEV	4/14/94
P2	REVISED PLAN NORTH OF BARROWS 1 - ADDED WELLSITES FOR FUTURE CALPINE INJECT WELLS	SSC	HEV	2/14/94
P1	ADDED TAP FOR FUTURE CALPINE INJECT WELLS	SSC	HEV	1/19/94
P	ENVIRONMENTAL ASSESSMENT	JAA	HEV	12/3/93
P	PRELIMINARY DESIGN AND ENVIRONMENTAL ASSESSMENT	JAA	HEV	11/09/93
P	PRELIMINARY CLIENT REVIEW	HGV	HEV	6/16/93
NO.	REVISIONS	BY	DATE	

VEIZADES & ASSOCIATES, INC.
CONSULTING ENGINEERS
90 NEW MONTGOMERY ST., SUITE 707 SAN FRANCISCO, CA 94105
TEL. (415) 495-8319 FAX (415) 495-8874

DESIGNED BY	MAP / HGV
CHECKED BY	HGV
DRAFTED BY	VJS
APPROVED BY	HEV
DATE	6/14/93
SCALE	1" = 1000'

Figure 2.3.3-D
Proposed Geyers Effluent Pipeline, Pump Stations, and End Distribution System
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2.0 Description of the Proposed Project

2.3 Geysers Effluent Pipeline Project Component

road, making a sharp turn southerly. It would stay in the road to Pump Station BC-2, located at station 114.4 at an altitude of about 1,920 feet msl. From Pump Station BC-2, the pipeline would remain in the Bear Canyon Access Road to the point where a new road is proposed as part of the project. Approximately 1,500 linear feet beyond BC-2, the pipe would change in design to 28-inch outside diameter polyethylene construction. This design would alternate with 24-inch inside diameter carbon steel to the terminus at the NCPA C-Site.

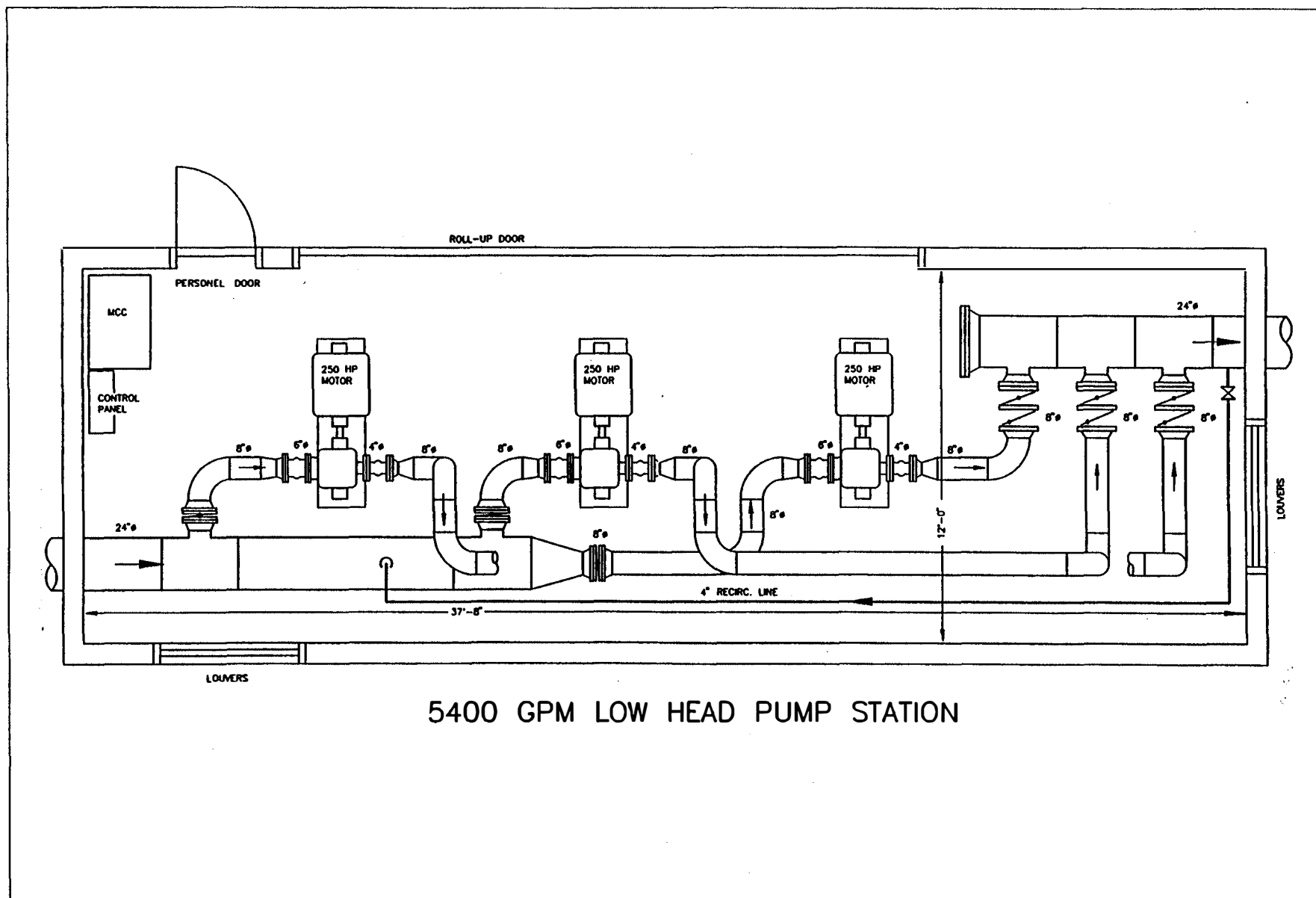
The new road connecting the Bear Canyon Access Road and the M-Pad (see Section 2.3.3.9) would carry the pipeline, with the pipe buried in the road. The third pump station would be located along the road uphill of the Bear Canyon Power Plant. Pump Station BC-3 would be located at station 123.0, at an elevation of about 2,300 feet msl. The pipeline will follow in the new road to the NCPA M-Pad. An alternate pipeline route (Alternate Route F) following the Bear Canyon Access Road, and that would not require a new road, is described in Section 3. At about station 124.0, the pipeline would exit the M-Pad on the southeastern side and head straight up a steep slope to avoid two hairpin curves in the road. The route emerges onto the road, turns right and then continues in the NCPA access road uphill toward Pump Station BC-4.

Pump Station BC-4 is located adjacent to the road at elevation 2,640 feet msl and station 126.0. A tap valve would be located at about station 127.0 for a secondary pipeline to the P-Pad. The pipeline would continue in the road to Pump Station BC-5, located at station 130.0 at an elevation of 3,010 feet msl. On exiting the fifth pump station, the pipeline would follow the NCPA road along the ridgeline. Tap valves would be constructed for future connections to secondary pipelines to the E-Pad and the B-Pad. Just west of the NCPA Plant No. 1, the pipeline drops to a 24-inch diameter (3,600 gpm capacity) and continues in the road to the NCPA C-Site, which is the terminus of The Geysers Effluent Pipeline (station 138.5). (The pipeline continues as a secondary distribution line with a 16-inch diameter to the Calpine leasehold boundary and a 12-inch inside diameter to the Unocal leasehold.)

At station 134.4, a valve would be installed to connect an existing 12-inch pipeline to the NCPA Y-Pad. This tap would be used to direct effluent to the Y-Pad Injection Fluid Tank at elevation 3,365 feet msl (bottom of the tank).

Bear Canyon Pump Stations

As noted above, there are five pump stations located along the Bear Canyon Access Road and NCPA access road. The pump stations would operate in series. Each station would have three split case, double end-suction centrifugal pumps. The three pumps would operate continuously. In addition, a fourth pump may be installed as a back-up for periods when one of the three operating pumps is shut down for maintenance. Each pump would have 250 horsepower motors and deliver 1,800 gpm. Each of the five pump stations is similar in design. A layout of a typical pump station is presented in Figure 2.3.3-E. Each pump station would be constructed on a



SOURCE: Veizades & Associates, Inc.

Southeast Geysers Effluent / 920586 ■

Figure 2.3.3-E
Typical Bear Canyon Pump Station Layout

leveled pad measuring 30 feet by 80 feet. Pump Station BC-1 would have an hydropneumatic surge protection tank installed on the suction side of the pumps. Tank size would be about 1,650 cubic feet capacity. Each pump station would be enclosed in an industrial-type building, with roof ventilator, personnel door and roll-up door. No exterior lighting would be provided. A parking space would be provided for maintenance personnel.

An alternate pump station concept is described in Section 3.

2.3.3.6 MISCELLANEOUS PIPELINE FEATURES

Thrust Restraints

All angle points greater than 5 to 7 degrees, either vertically or horizontally, require thrust restraints. Thrust restraints would be provided in one of three ways; 1) concrete thrust block poured against undisturbed soil, 2) welded joints, if all joints are welded, no other restraint is necessary; or if a number of joints on each side of the angle point are welded, that is all that would be required; 3) other methods, such as retainer glands for ductile iron pipe or tie rods.

Blow-offs

At all major low points, a blow-off would be installed consisting of a 4 to 6 inch outlet with a gate valve, and a pipe section with a T that would be capped or plugged with a screwed fitting. This would allow connection of a pipe or hose in the future to drain a section of pipeline.

Air Release and Vacuum Valves

At all major high points, a combination air release vacuum valve would be installed to allow escape of air that accumulates in the pipeline. This combination valve would be installed in a vault that is under ground, and would be on top of, or along side, the pipeline.

Isolation Valves

Isolation valves would be installed along the pipeline at strategic locations. It is estimated that the maximum reach might be up to 2 miles, depending on the topography. An isolation valve would be installed in a vault with a small diameter valved bypass pipeline.

2.0 Description of the Proposed Project

2.3 Geysers Effluent Pipeline Project Component

The purpose of the small diameter (4 to 8 inch) outlets and gate valve are to bypass the flow from one side of the valve to the other or to empty the pipeline into water trucks. At the upstream end of a reach that has been isolated, the small diameter valve would be opened to allow air to enter the line.

Telemetry Cables

In certain areas, a telemetry cable would be provided, consisting of a 2-inch PVC conduit that would be buried along the top side of the buried pipeline. Pull boxes would be installed at angle points and at about 500-foot intervals.

When a telemetry cable is to be installed along an aerial reach of pipeline, the cable would be installed within a 1-inch steel conduit that is welded to the exterior of the aerial pipe.

2.3.3.7 Y-PAD INJECTION FLUID TANK

The tank would be a 100,000-gallon steel tank of bolted or welded construction (Figure 2.3.3-F). It would be epoxy coated. The intended purpose of the tank is both storage of effluent, combined with condensate collected from NCPA power plant cooling towers and rainfall, and control of flow for injection fluids to the NCPA wells.

The tank would be constructed on a pad located at the south side of the NCPA Y-Pad (Figure 2.3.3-F) on land administered by the BLM. It would be located on a bench approximately 30 vertical feet above the Y-Pad to allow better gravity flow to the secondary distribution lines to the injection wells. To achieve an adequate foundation area for the tank, it would be necessary to cut back the hillside adjacent to the Y-Pad and lay fill material in front of the existing bench. The tank would be painted marine green to blend in with the background slope.

2.3.3.8 SECONDARY PIPELINES AND RELATIONSHIP TO THE INJECTION DISTRIBUTION SYSTEM

The ultimate disposal of all the effluent is injection into the southeast Geysers steam field. The Geysers Effluent Pipeline is the primary delivery system to The Geysers. At the receiving end of the pipeline, the effluent would be equally divided between Calpine, Unocal, and NCPA, that is, each would receive 1,800 gpm. Calpine, Unocal, and NCPA would distribute this flow to their separate operating systems, as described in Section 2.3.4. The delivery of effluent to the well

Figure 2.3.3-F
Site and Proposed Layout of
Proposed Y-Pad Injection Fluid Tank

2.0 Description of the Proposed Project

2.3 Geysers Effluent Pipeline Project Component

heads for injection would be in existing and new pipelines for the three Geysers operators (see Figure 2.3.3-D). In total, 15 existing injection wells and 7 future wells (existing production wells converted to injection wells) would receive project effluent.

NCPA Secondary Injection Fluid Distribution Pipelines

The NCPA effluent injection area includes steam fields for Plant Nos. 1 and 2. These are located on lands administered by the BLM and in both Lake and Sonoma Counties. The proposed 1,800 gpm of effluent injection would be distributed through five existing pipelines already used for conveying injection fluids and two new lines proposed to receive injection fluids. NCPA also has identified one existing injection fluid pipeline as an alternate secondary distribution line for receiving the effluent.

The existing injection fluid distribution lines include the pipelines to the following injection wells: A-1, C-11, F-1, J-6, Q-2, Y-4 and Y-5. No significant new facilities would be required as part of the project to supply these wells with effluent for injection. The only new facilities would be interconnection valves at the Geysers Effluent Pipeline to draw off effluent. The existing pipelines are all approximately the same age as their associated power plants.

Two new injection wells would be located at the E-Pad and P-Pad. The project would not require the construction of new wells at these pads, rather, the conversion of existing production wells to injection wells. In some wells, a slotted liner would be installed to convert a production well to an injection well. This is determined on the basis of individual well bore conditions. These pads currently are not served by pipelines carrying injection fluids. As a result, the project would include the construction of two new lines that would connect to the Geysers Effluent Pipeline to draw off effluent and direct it to the injection wells. The pipeline to the P-Pad would be approximately 6,500 feet long and the pipeline to the E-Pad would be approximately 500 feet long. Both pipelines would be similar in construction. Pipeline materials could include fusion butt-welded polyethylene, un-coated carbon steel with internal cement coating, epoxy-coated carbon steel or stainless steel pipe with a 10-inch inside diameter. Pipes constructed with these materials already are in use in The Geysers. The pipelines would be constructed either above ground along the edge of the existing roads to each pad, as is common throughout The Geysers, or would be buried in the road. Neither new pipeline would require an expansion of existing ROW or clearing new ROW.

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2.3 Geysers Effluent Pipeline Project Component

Although no plans are proposed to include injection at the B-Pad, the design of the Geysers Effluent Pipeline would include a tap valve for a possible hook-up to an injection well at that site.

In addition to these lines supplying effluent to the NCPA injection wells, a new pipeline would be constructed from the terminus of the main Geysers Effluent Pipeline (at the existing NCPA C Pad) to the NCPA-Calpine leasehold boundary. This would be a 16-inch diameter polyethylene pipeline buried in the road. This line primarily would serve to convey effluent to Calpine and Unocal, but it could also serve an existing injection well at the C-Pad. The C-Pad well is considered only as an alternate for purposes of this project. Because this secondary pipeline would be located in the road passing through the busy NCPA gate, an alternate route (Alternate Route G) that by-passes the gate also is described in Section 3.

Calpine Secondary Injection Fluid Distribution Pipelines

The injection area includes the steam fields operated by Calpine and supplying PG&E power plants Unit 13 and Unit 16. These are mostly lands administered in part by Lake County and BLM: a small area is in Sonoma County. The amount of effluent injection at each well would vary. The five Calpine wells currently receiving injection fluids are CA956A-1, CA956A-2, Thorne-7, Barrows-1 and CA958-6. Because these wells are already receiving injection fluids, no new facilities would be required as part of the project. Calpine may convert three production wells to injection wells: CA958-5, MLM-1 and McKinley 3. A well may be drilled specifically for injection service instead of converting CA958-5.

To supply the five existing injection wells and the three new injection wells, four new segments of secondary pipelines would be constructed by Calpine as part of the project. A 16-inch polyethylene pipe would continue northerly 400 feet from the NCPA leasehold boundary to the road intersection, where it would turn northeasterly and run along the road to the Barrows-1 well site. From the leasehold boundary to the road intersection, the pipeline would carry a flow of 1,750 - 1,800 gpm. A tap valve at this location will direct all effluent to flow into existing polyethylene lines for delivery to CA956A-2, an existing injection well. Pipeline materials could include fusion butt welded polyethylene pipe, cement-lined carbon steel, epoxy coated carbon steel, or stainless steel. The pipe would continue along the road to the Barrows-1 well site. At Barrows-1, the line would turn northwesterly, following the existing road to the proposed converted injection well CA958-5 or a well drilled near this location. Approximately 700 feet

2.0 Description of the Proposed Project

2.3 Geysers Effluent Pipeline Project Component

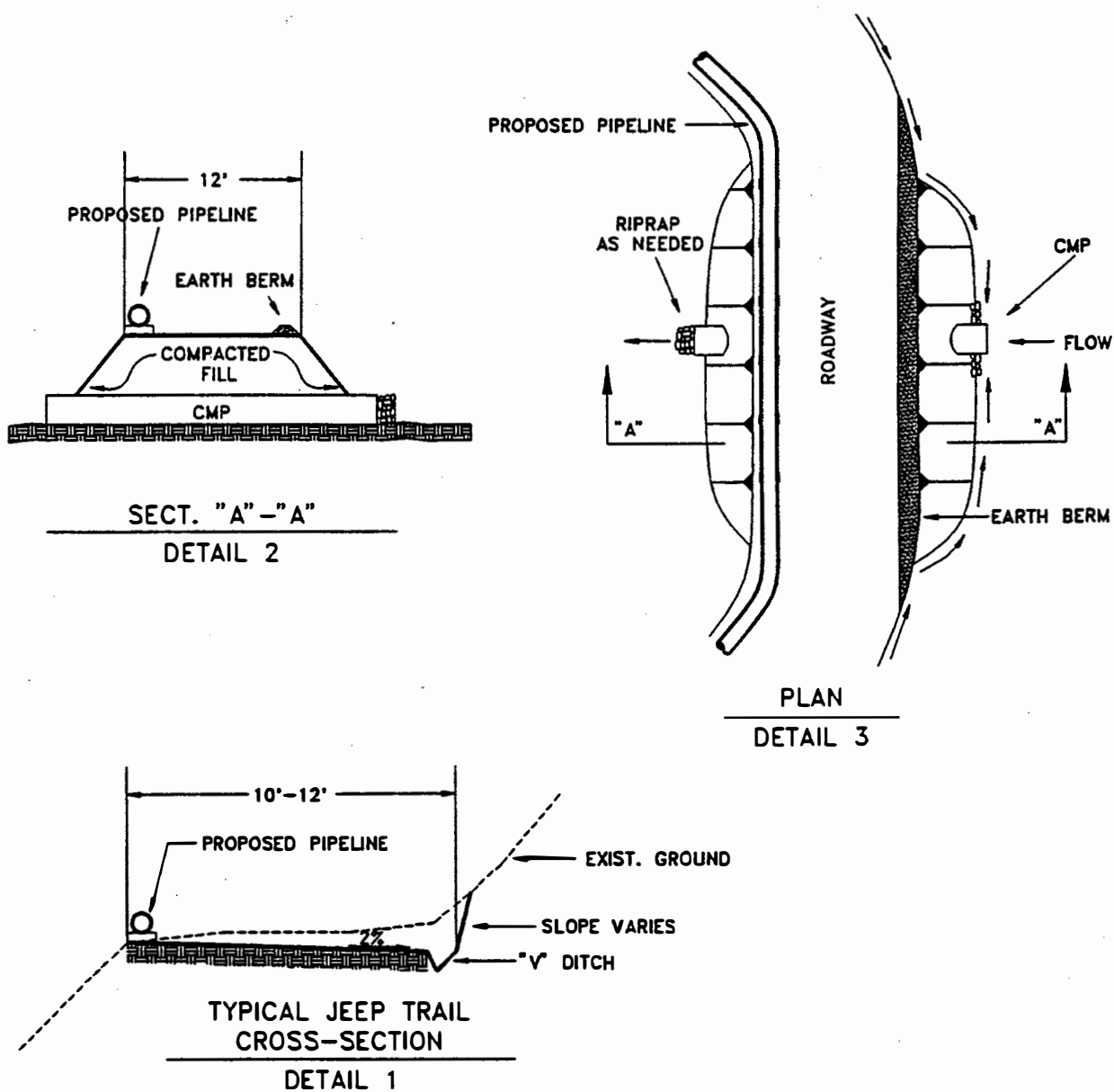
northwesterly of well CA958-5, the line would connect to the McKinley 3 well, which is proposed to be converted to an injection well. Additional tap valves will be provided at this location for possible extension of this pipeline to well MLM-1. All pipelines would be constructed on existing ROW either above ground or buried as is typical throughout the Geysers.

Unocal Secondary Injection Fluid Distribution Pipeline

The Unocal injection area includes the steam fields supplying PG&E power plants Unit 18 and Unit 20. Proposed facilities are located in lands administered by Sonoma County. One secondary distribution pipeline designed, constructed, and operated by Unocal will branch from the Geysers Effluent Pipeline at NCPA's C site. The pipeline will tie into Unocal's existing injection system at D&V 18-1.6 well pad (see Figure 2.3.3-D). The 12-inch nominal diameter pipeline would be constructed of either steel, cement-lined steel, epoxy-coated steel, or HDPE. Pressure rating for the pipeline would be either ANSI class 150 or 300. Materials of construction and the design approach would be similar to other injection lines already in service on Unocal's leasehold. Minor upgrades such as control valves and additional instrumentation may be required in the existing injection system. No new injection facilities are anticipated.

An improved paved road exists between NCPA's C and H pads on lands administered by the BLM. Approximately 4,500 feet of pipeline will be constructed either above ground along the road or buried within the existing right-of-way. From the NCPA H well pad, the pipeline right-of-way will continue northerly, crossing into the Unocal leasehold. It would follow approximately the same grade and alignment as an existing jeep trail for approximately 1/2 mile to Unocal's access road to the D&V 18-1.6 well pad. Regrading of the jeep trail and one creek crossing will be required. The jeep trail would be widened to 10-12 feet to accommodate the pipeline around turns and to allow single vehicle access (see Figure 2.3.3-G). A three-point turnaround would be constructed approximately 550 feet from the NCPA H well pad. A small fill and culvert would be installed at the creek crossing (see Figure 2.3.3-G). A culvert headwall would be constructed with sand/cement sacks or concrete. Riprap would be placed downstream to dissipate energy and prevent erosion, if required to reduce flow velocities.

Construction laydown sites have not been finalized, but probably would involve the use of NCPA sites C and H and Unocal site D&V 18-1.6. No new areas will be disturbed for laydown.



SOURCE: Unocal 76, 1994.

Southeast Geysers Effluent / 920586 ■

Figure 2.3.3-G
 Proposed Unocal Secondary Injection Fluid Distribution
 Pipeline, Access Road Design and Creek Crossing

2.3.3.9 NEW ROAD CONNECTING THE BEAR CANYON ACCESS ROAD AND THE
M-PAD

Purpose

A segment of the Geysers Effluent Pipeline route (approximately Station 120.5 to 124.0) must run cross-country through rugged mountainous terrain. The proposed pipeline route follows the existing Bear Canyon Access Road, which leads to the Calpine Bear Canyon Power Plant but does not go all the way to the power plant. Instead, the alignment cuts off and goes cross-country to connect to the end of the NCPA access road at the M-Pad. At the M-Pad, the pipeline route again follows the existing NCPA road alignment. The project would create a continuous road connection between the Bear Canyon Access Road and the NCPA M-Pad. The proposed connector road would be located on lands administered by the BLM. The connector road would serve four purposes:

- (1) it would provide a bed for the Geysers Effluent Pipeline,
- (2) it would provide a pad for the third Bear Canyon pump station (BC-3),
- (3) it would provide access for monitoring and maintenance of the pipeline and pump station, and
- (4) it would provide another route of controlled access for vehicle traffic from Bear Canyon to the higher-lying portions of the NCPA leasehold.

An important perceived benefit would be improved access to The Geysers for emergency vehicles (fire, ambulance, sheriff, as well as emergency response to a break in the pipeline). Although not stated as a formal objective of the project sponsors, the new road also would provide a potential new route of travel for Calpine, NCPA and PG&E (and other operators) to The Geysers from Middletown. Essentially, the new road would complete a loop connection through the southeast Geysers from the Socrates Mine Road to the Bear Canyon Access Road, both of which dead-end off Highway 175. However, no formal agreements have been made by NCPA and Calpine, allowing each operator's vehicles access to the other's private roads (both roads currently have controlled access and are gated by each operator). At a minimum, this would be a limited access road for purposes of pipeline maintenance, and it need not be accessible to all parties.

Design

The proposed road would be an all-weather hard-surfaced two-lane road, with a minimum width of 15 feet. Similar to the other roads in The Geysers, the road surface would have a Class II base and would be chip sealed. The maximum grade would be 15 percent. The overall length of the road would be approximately 2,300 feet (Figure 2.3.3-H). It would include an outside berm for runoff control, with drainage directed to the inside edge gutter. The gutters would drain into pipes at no less than three locations, which would discharge into energy dissipater rocks and flow onto the adjacent downhill slopes. Rock-lined ditches also would be installed at the edges of a large fill to be placed in an unnamed creek, as described below.

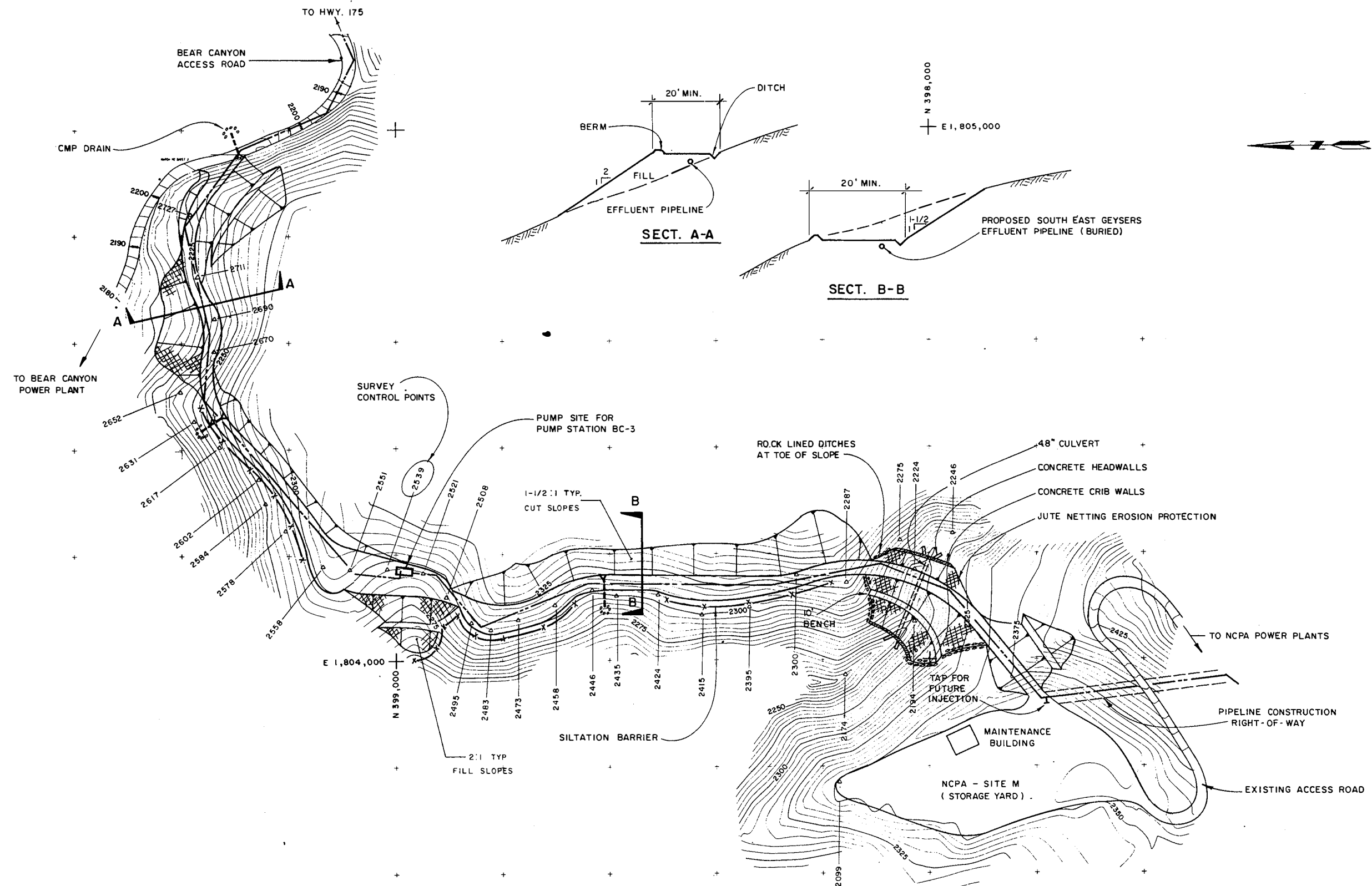
The Geysers Effluent Pipeline would be buried in the road. At about station 123.0, the road bed would be widened to about 60 feet on fill to allow space for parking and a pad for Pump Station BC-3, which would be located on the inside of the road.

The proposed road would intersect with the Bear Canyon Access Road at about station 120.5. Because of the rugged terrain, the road would require either cuts (1.5: 1, horizontal to vertical) on the uphill side or fills (2: 1) on the downhill side for most of its length (Figure 2.3.3-H). Two of the large cuts would be about 70 feet high and would be benched, and two of the fills would be up to 50 feet high and benched.

The road would bend around the nose of ridge above the Bear Canyon Access Road entering BLM-administered land, then follow the contour of the canyon to the crossing of an intermittent creek. The creek is deeply entrenched in a steep-walled canyon. Fill would be placed in the canyon to raise the bed of the road about 60 feet above the creek channel. The lower part of the fill on both the upstream and downstream sides would be retained by concrete crib walls. The upper part of the fill would be benched on the downhill side of the road. The stream channel would be directed into a 48-inch diameter culvert, approximately 170 feet long.

From the stream crossing, the road would rise steeply to the upper end of the NCPA M-Pad. To achieve the proper grade for the road, in addition to the above fill placed in the creek channel, a V-cut would be made into the slopes at the southeastern corner of the M-Pad. The cut would be approximately 60 feet high on the north-facing slope and 25 feet on the south-facing side.

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NO.	REVISIONS	BY	APPR.	DATE
P	ENVIRONMENTAL ASSESSMENT	JAA	HEV	12/3/93
P	PRELIMINARY DESIGN AND ENVIRONMENTAL	JAA	HEV	11/09/93
	ASSESSMENT	SSC	HEV	10/22/93



VEIZADES & ASSOCIATES, INC.
CONSULTING ENGINEERS

90 NEW MONTGOMERY ST., SUITE 707, SAN FRANCISCO, CA 94105
TEL (415) 495-8519 FAX (415) 495-4874

DESIGNED BY	JAA
CHECKED BY	SSC
DRAFTED BY	JCH
APPROVED BY	HEV
DATE	10/22/93
SCALE	1" = 100'

Figure 2.3.3-H
Proposed Road and Geysers Effluent Pipeline Plan
Bear Canyon Access Road - NCPA M-Pad



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2.3.3.10 POWER SUPPLY LINES TO THE PUMP STATIONS

Operation of the pumps for the Geysers Effluent Pipeline would require a dependable source of power at all times. Power to operate the pumps would be required for each pump station including:

- Lake Diversion Pump Station (3 pumps, each with 200 horsepower)
- SERWTP Pump Station (6 pumps, each with 200 horsepower)
- MWTP Pump Station (2 pumps, each with 50 horsepower)
- 5 Bear Canyon Pump Stations (3 pumps at each station, each pump with 250 horsepower)

A variety of power sources would be tapped to operate the pumping system. All the power would be supplied by PG&E with the possible exception of the power for Pump Station BC-5. The lake diversion pump station is located in a developed area of Clearlake and would require a minor hook-up to existing power supplies. The total projected load of the power for the lake diversion pump station is 800 KVA.

The SERWTP pumps would require an increased power supply. The SERWTP already has a 12 kv power line serving the plant. The proposed improvements for the facilities plan (described in Section 2.5) and the proposed pumps for the pipeline would require additional power at the SERWTP. A new power line would be constructed using the existing poles that serve the SERWTP. The project would entail stringing the poles with a new 12 kv distribution line approximately 300 feet.

The total projected load of the distribution line for the SERWTP pump station is 1,800-2,500 KVA.

The MWTP pumps would be powered through a minor connection to the existing power line to the plant. The total projected load of the distribution line for the MWTP pump station is 200 KVA.

Supplying power to the Bear Canyon Pump Stations would require the greatest amount of new construction. A 21 kv power supply line would be needed for the pumps. This would be constructed by and supplied with power by PG&E. A pole-mounted line would be constructed, connecting into an existing line that originates at the switch yard servicing PG&E's Unit 16. The line would run along existing roads to near Bear Canyon Creek. To reach the pump stations, the

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power line would need to run cross-country across Bear Canyon to the Bear Canyon Power Plant. From there, it would run along the Bear Canyon Access Road where the line would split. One part of the power line would run along the Bear Canyon Access Road down to Pump Stations BC-2 and BC-1. The other part would connect into the proposed new Bear Canyon Access Road to Pump Station BC-3, then follow the NCPA Access Road to the pump station at BC-4 and BC-5. There is a possibility that Pump Station BC-5 would receive power from a branch circuit that would tie into NCPA Power Plant No. 2. A total length of 4.5 miles of power lines would be constructed for this purpose. The most difficult part of this power line to construct would be the 2,500 feet crossing from PG&E Unit 16 to the Bear Canyon Power Plant, as there are no roads and the terrain is rugged.

The total projected electrical power required for the Bear Canyon pump stations is 4,500 KVA.

Another source of power demand is that required for operating the Childers Peak Regulating Tank. The power demand is small, as the only power requirement is for the monitoring equipment of water level in the tank and power for communications. As no source of power is located near the site, the power would be supplied using solar-powered photo-voltaics.

2.3.4 SYSTEM OPERATING STRATEGY

The overall strategy for operating the system is presented in Section 2.1.4. This section will provide further details on components of that overall operating strategy.

2.3.4.1 COMPONENT OPERATING CHARACTERISTICS

The proposed operating characteristics for each major component of the project are presented in Table 2.3.4-1. Overall control of the system would be achieved through operation of the pump system.

Operating responsibility for the effluent transport system will be shared between LACOSAN and the steam field operators. The interface point will be the suction side of the first Bear Canyon pump station. The combined capacity of LACOSAN pumping facilities will slightly exceed that of the Bear Canyon Pump Station BC-1, thereby ensuring the latter will have sufficient supply to maintain a constant minimum 5,400 gpm (7.8 mgd) discharge.

TABLE 2.3.4-1: SOUTHEAST GEYSERS EFFLUENT PIPELINE PROJECT COMPONENT DESIGN/OPERATING CONDITIONS

Component	Proposed Design Characteristics	Proposed Operating Characteristics
Lake Intake Pump Station	Three 2,060 gpm 125 Hp turbine pumps (no backup) in building on shoreline with screened intake 300 ft. (±) into Lake at minimum depth of 30 ft. (±).	Constant speed with auto Start/Stop based on water level at SERWTP reservoir.
Lake to SERWTP Pipeline	16,600 ft. of 24 in. PVC pipeline up to 5 feet deep, with manual isolation valves and bottom inlet to SERWTP reservoir.	Continuous with pumping.
SERWTP Pump Station	Up to six 900 gpm 200 Hp turbine pumps (no backup) unenclosed with pressure surge tank on SERWTP site.	Continuous constant speed pumping with all four units; auto Start/Stop of lag pump based on Childer's Peak tank water level.
Childer's Peak Surge Regulating Tank	620,000 gal. (±) steel tank at atmospheric pressure, with level controls.	Water level controls SERWTP pumps and, on high level, shuts down Bear Canyon Pump Station.
Middletown WWTP Pump Station	Two 150 gpm 50 Hp turbine or centrifugal pumps (no backup) unenclosed with pressure surge tank on WWTP site.	Start/Stop constant speed pumping with one or two units depending on WWTP storage water level.
Multiple Bear Canyon Pump Stations	Up to five booster pump stations, each with three 2,000 gpm, 250 Hp pumps in enclosures at intermediate elevations along Bear Canyon Rd. and NCPA roads at Geysers Area; pressure surge tank on suction of station at lowest elevation.	Continuous constant speed pumping of all ten units with auto/manual Start/Stop.
Main Pipeline SERWTP Pump Station to Bear Canyon Pump Station	108,400 ft. of 24 in. steel, DI, HDPE pipeline buried up to 5 ft. deep or aerial in sensitive areas, designed for up to 400 psi conditions, with manual isolation valves at two mile spacing, or less.	Continuous with pumping.
Main Pipeline Bear Canyon Pump Station to Geysers Distribution (Option A) (a)	29,600 ft. of 24 in. steel, DI, or HDPE pipeline buried up to 5 ft. deep, designed for up to 1,100 psi conditions, with manual isolation valves.	Continuous with pumping.
Main Pipeline First Bear Canyon Pump Station to Geysers Distribution (Option B) (a)	29,600 ft. of 24 in. steel, DI, or HDPE pipeline buried up to 5 ft. deep, designed for up to 375 psi conditions, with isolation valves at Option B pump stations.	Continuous with pumping

(Continued)

TABLE 2.3.4-1: SOUTHEAST GEYSERS EFFLUENT PIPELINE PROJECT COMPONENT DESIGN/OPERATING CONDITIONS (Continued)

Middletown WWTP Draindown Storage	Minimum 200,000 gal. emergency storage for main pipeline contents using existing Middletown WWTP storage ponds.	Use in emergencies only; pump back using Middletown WWTP Pump Station.
Geysers Pipeline Access Road	Connect Bear Canyon Rd with NCPA roads in vicinity of M-Pad.	Facilitate access to Bear Canyon Pump Station from Geysers Area.
Electric Power Feed Systems	Extend high voltage power service to major pump station sites.	Continuous
Telemetry System	Central control at NCPA site; direct burial cable signal between Geysers Area and Childer's Peak, dedicated phone line from Geysers Area to SERWTP.	Continuous monitoring of pump and equipment status, tank levels, fluid flow and pipeline pressure conditions.
Injection Well Distribution System	20-inch and smaller steel and HDPE pipelines with automatic flow and/or level control valves extending from main line to injection wells.	Continuous with distribution controlled from Geysers area injection control center.

(a) Selection between Options A and B is proposed to be made during early stages of detailed design work.

SOURCE: EcoLogic Engineers, 1994.

The generalized control strategy for each of the project pump stations is presented as follows:

Lake Diversion Pumps. Pumps would draw suction from Clear Lake at depth, delivering raw (untreated) water to maintain a minimum pool of storage in the SERWTP reservoir. Normally, two of the three diversion pumps would operate continuously. If excess pumping occurs over a period up to three months to avoid diversions during the assumed month-long algae bloom period, all three pumps would run continuously. The rate of filling in the reservoir would be slow enough (a few inches per day normally up to a few feet per day during excess pumping periods) to allow starting and stopping of these pumps to be initiated manually. There does not appear to be a need for continuous level sensing in the reservoir to automatically control these pumps. Telemetered level controls may be added during detailed design, however.

SERWTP Pumps. The SERWTP Pumps would draw suction from the SERWTP reservoir, delivering combined raw lake water and treated wastewater effluent to maintain a designated water level in the Childers Peak Regulating Tank. All six pumps would operate to discharge a nominal flow of 5,320 gpm (7.66 mgd), with six units running continuously, and the seventh serving as an on/off lag pump. Continuous level sensing in the tank would be telemetered to the SERWTP site to start or stop the lag pump. Upon rising tank water level, as would occur with any reduced flow condition from the Bear Canyon pumps, the SERWTP pumps would shut down sequentially. In this way, the SERWTP pumps operate relatively independently from the Bear Canyon pumps. The SERWTP pumps would control pumping to maintain the Low Level of water in the Childers Peak tank. Upon receipt of signaled information that the High High Level had been reached in the tank, the SERWTP pumps would be shut off.

Similarly, upon receipt of a signal that the water level in the tank was at Low Low Level, indicating some kind of operational problem, the pumps would be shut off.

MWTP Pumps. Two pumps would draw suction from the existing treated effluent storage pond and deliver flow into the pressurized main Geysers Effluent Pipeline. Flow rate would be constant against the relatively stable pressure conditions in the pipeline. The pumps would be manually started, with automatic shut down in response to loss of suction pressure or extreme variations in discharge pipeline pressure.

The MWTP pumps would be operative unless a signal were received that the MWTP effluent flow dropped or a problem condition existed in the Geysers Effluent Pipeline. The shut-off of the MWTP pumps would be activated by the NCPA control center.

Bear Canyon Pumps. The five pumps would draw from the Geysers Effluent Pipeline in a sequential operation, elevating flow up to the injection distribution area. Pumps would be started up automatically (or manually, as needed) in a timed sequence controlled from the NCPA control center. Each pump station in the sequence would generate the suction supply for the succeeding pump station. NCPA would monitor the water level in the Childers Peak Regulating Tank to ensure that the suction pressure at pump station BC-1 registers the required pressure. Upon receipt of the signal from the Childers Peak

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2.3 Geysers Effluent Pipeline Project Component

Regulating Tank that the water level is at Low Level, the NCPA control center would activate (or continue to operate) the Bear Canyon Pumps and the flow to the injection wells. The pump controls would be provided with enabling switches that activate the controls at set suction pressures. The total would be set at 5,400 gpm. The controls also would automatically deactivate if a time delay flow switch at each discharge line is not activated within a set time delay. The latter automatic control is intended to prevent starting of the pumps without the required suction pressure or prolonged pump operation (and possible damage) in case the flow becomes restricted. Pumps would automatically shut down in response to extreme variations in suction or discharge pressure. The NCPA control center would deactivate pumping if the signal were received that the Childers Peak Regulating Tank water level was at Low Low Level.

The disposal of the effluent flow into the various injection wells would be independently controlled by the existing Calpine, Unocal and NCPA control systems (see Section 2.4).

2.3.4.2 EFFLUENT PIPELINE FLOW MONITORING AND TELEMETRY SYSTEM

As described in the preceding Section 2.3.4.1, the operation of the system is controlled through the monitoring of water levels in the Childers Peak Regulating Tank. Level monitoring equipment would consist of depth-sensitive pressure sensors and level sensors (floats, ultrasonic, etc.), with transducers generating an electric fiberoptic signal. Water levels in the tank that would signal normal pump operations would be those between Low Level and High Level. If water levels fall to (or below) the Low Low Level, or if the water level reached the High High Level (or above that), the SERWTP pumps would be automatically shut down.

The overall monitoring and control system is operated through a distributed control system (DCS) that links remote terminal units (RTUs) located at either end of the Geysers Effluent Pipeline. Personal computer hardware would be used to monitor flow conditions, signal malfunctions, activate or deactivate pumps, and open or close valves. Instrumentation, status, and alarm conditions would be signaled through fiberoptic cable connecting the Childers Peak tank, the MWTP pump station and the Bear Canyon pump stations, with the NCPA central control terminal in its existing control center for the injection distribution system. This terminal would be interfaced with the existing injection control system computer. A telephone link would be made between the NCPA central control terminal and a control terminal at the SERWTP.

Monitoring of all system instrumentation, status, and alarm conditions would be achievable at both the SERWTP and the NCPA terminals.

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2.3 Geysers Effluent Pipeline Project Component

The various reporting roles during operations would be as follows:

The SERWTP control center would convey information by telephone to the NCPA central control center to alert of the impending delivery of effluent as well as information about malfunctions of the effluent delivery system upstream of Childers Peak.

The NCPA control center would receive the Childers Peak Regulating Tank water level signal over the fiberoptic cable.

The NCPA would receive information about the status of each pump at all pump stations.

The NCPA control center would monitor the flow rate of fluid delivered. NCPA would periodically prepare a print-out record of the total flow received and the total flow delivered to Calpine and to Unocal for each day.

A second backup satellite control station computer would be located at the SERWTP. This would allow either the SERWTP operator or the NCPA control center the capability of monitoring and controlling the system. Under normal operations, the overall system would be controlled by the NCPA central control station.

Both the NCPA and SERWTP terminals would receive alarm signals and information about possible malfunction of a pump motor or valve, exceedance of allowable pressures, and unacceptably high or low water level in the Childers Peak Regulating Tank. For example, earthquakes could cause a failure of the system. The effects of an earthquake would be detected by the monitoring system if it resulted in a drop in pressure, loss of power or pump failure. Both visual display on the computer screen and an audible alarm would signal operational problems.

A detailed description of the proposed telemetry system is presented in the Preliminary Design Report (available at LACOSAN and County Planning Department offices).

2.3.4.3 EFFLUENT PIPELINE SPILL CONTROL PLAN

The system spill prevention plan consists of the following components.

First, the pipeline design incorporates performance criteria to ensure the integrity of the pipeline under higher than normal operating pressures. The main pipeline would be designed in segments to accommodate internal hydrostatic fluid pressures from about 100 psi to 1,000 psi. Pipeline construction in the lower pressure segments (100 to 200 psi) could be ductile iron, cement lined and coated steel, polyethylene with fused joints, or polyvinyl chloride (PVC). In the higher

2.0 Description of the Proposed Project

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pressure segments, the pipeline would be constructed of steel with welded joints. The steel pipeline wall thickness to accommodate these internal pressure conditions would be up to about 0.5-inch thick. This construction is extremely rugged and will resist damage caused by most circumstances. The rigidity of the pipeline structure in above ground segments would resist damage from falling trees and minor rock slides. Major soil movements, such as a landslide or earthquake ground rupture, could exceed the resistance of the pipe although failure at joints is a more likely type of failure. Surge control facilities would be provided at the pump stations to limit internal pressure fluctuations to manageable levels.

The pipeline design also incorporates materials to reduce the risk of leaks from corrosion. Prevention of external weathering corrosion would be provided for buried pipeline segments by wrapping with polyethylene, coating with cement mortar or special epoxy resin paint. In surface-exposed locations, the pipeline would be protected by coating with cement mortar or special paint, or use of Mayari R weathering steel (Type A606). The latter is a special steel alloy that relies on natural oxidation to create a protective surface that retards further oxidation. Additional external protection from electrolytic corrosion may be provided, consisting of sacrificial anodes and/or impressed current systems. A determination would be made regarding which external corrosion protection systems will be employed after completion of a corrosion analysis in the detailed design phase. Severe internal corrosion is not expected because the combined effluent and lake water would have a pH of 7 to 8 and because of the materials for construction selected. Cement lining of steel and ductile iron pipelines also could be provided. No facilities for pigging (cleaning of the line with a mechanical device) are included in the preliminary design. During final design, a determination will be made regarding the need for pigging and, if needed, the locations for pig launchers and receivers.

The pipeline would be pressure tested for leakage after completion of initial construction; operation of the pipeline would not be initiated until a determination is made that leakage is within the minimal tolerances conforming to industry and Department of Health Services standards. During operation, small leaks that may develop in the pipeline will be difficult to detect unless moisture conditions are evident to a visual inspection. A periodic route inspection is proposed on a regular basis.

No electronic or automatic leak sensing equipment is proposed for the project. Such equipment would require extensive regular maintenance, and regular visual inspections would still be required.

2.0 Description of the Proposed Project

2.3 Geysers Effluent Pipeline Project Component

Shutoff valves with access ports are proposed for installation approximately every two miles along the pipeline to enable isolation of segments in the event maintenance is required. With main pumps off, pipeline dewatering to control spills from leaks would be by pumping from one pipeline segment to the next using portable equipment.

Relief storage of at least 250,000 gallons capacity is proposed to be provided in effluent storage ponds at the MWTP site. This capacity would enable dewatering of at least a two-mile pipeline segment.

The primary method of detecting a major failure in the pipeline, and consequent spill, would be through the monitoring system described in Section 2.3.4.2. Alarm signals at both the NCPA central control station and the SERWTP satellite control station would identify a spill through loss of pressure in the pipeline, an unusual drop in the water level at the Childers Peak Regulating Tank, or malfunctioning of the SERWTP and Bear Canyon pumps. The alarm system would trigger the automatic deactivation of the SERWTP, MWTP and Bear Canyon pumps to prevent further water from being pumped into the system. Additionally, an alarm signal would prompt an immediate visual inspection of the pipeline and facilities. The lake diversion pumps would be manually shut off.

The information above would be included in a spill response plan along with contact names and phone numbers. Spills would be handled by LACOSAN staff in accordance with their existing policies and procedures for LACOSAN-operated facilities.

2.3.4.4 RELATIONSHIP TO GEYSERS INJECTION PROGRAM OPERATING CHARACTERISTICS

The proposed program for injecting the effluent into the southeast Geysers steam field is described in Section 2.4. The injection program would be capable of receiving the nominal 5,400 gpm flow in the Geysers Effluent Pipeline guaranteed in the Project Agreement. Calpine, Unocal, and NCPA each would operate their respective injection programs separately. For each operator, the effluent injection program is an extension of current injection operations using condensate and storm water. The project would approximately double the current rate of injection in this area.

The effluent delivered to The Geysers would either be introduced into existing systems for injection, blended with condensate and surface runoff and injected, or injected as a separate

2.0 Description of the Proposed Project

2.3 Geysers Effluent Pipeline Project Component

injection stream. NCPA would initially blend effluent with condensate/rainwater, using the Y-Pad Injection Fluid Tank for storage and blending, and directing it to existing injection wells. The two new injection wells at the P-Pad and the E-Pad may be tapped directly from the Geysers Effluent Pipeline as a direct stream to those injection wells.

In the event that all the effluent cannot be accepted at the injection wells, the delivery would be curtailed by reducing the amount of fluid being delivered through the Geyser's pump stations. A reduction in the rate of delivery would result in a rise in the water level in the Childers Peak Regulating Tank. A rise in the tank level, in turn would signal the manual shut off of the Lake Diversion pumps and/or automatic reduced pumping from the SERWTP pumps. The storage of water in the SERWTP reservoir, combined with storage capacity in the Childers Peak tank and the Y-Pad Injection Fluid Tank, as well as the storage capacity of the Geysers Effluent Pipeline itself, would provide storage of effluent until the injection program could be brought up to regular operation levels.

2.3.4.5 OPERATIONAL LIFE

The proposed project has a contract life of 25 years. The Project Agreement provides for delivery of 5,400 gpm of effluent to the operators in The Geysers until the year 2021. At that time, the Agreement would be extended or terminated. Proposed facilities for the project would have a design life that would extend beyond 25 years. Under the current schedule, operation of the pipeline would begin as early as spring of 1996.

2.3.4.6 ROUTINE INSPECTION AND MAINTENANCE ACTIVITIES

Responsibilities. Inspection and maintenance (I/M) would be included for all project facilities. Responsibility for I/M would be divided among the various project sponsors as follows:

LACOSAN would be responsible for I/M of the Lake Diversion pumps and pipeline, the SERWTP facilities, the MWTP facilities, the Childers Peak Regulating Tank and the Geysers Effluent Pipeline up to the Bear Canyon Pump Station BC-1 and telecommunications cable up to the BC-1 pump station.

Calpine, Unocal, NCPA and PG&E would be responsible for I/M of the Geysers Effluent Pipeline from Pump Station BC-1 to the terminus of the pipeline, the five pump stations, the new road connecting the Bear Canyon Access Road and the M-Pad, and the telecommunications

2.0 Description of the Proposed Project
2.3 Geysers Effluent Pipeline Project Component

cable from the BC-1 pump station to the NCPA central control station. The operators have delegated this responsibility to NCPA personnel.

Calpine, Unocal and NCPA would each have responsibility for I/M of its own secondary distribution lines. NCPA would be responsible for I/M of the Y-Pad Injection Fluid Tank.

PG&E would be responsible for I/M of all power lines, except the power line to the BC-5 pump station if NCPA supplies the power to that station (NCPA's responsibility).

Activities. A specific plan and schedule for I/M of the project facilities have not been developed. This would be prepared during the final design phase. Periodic coordination meetings between LACOSAN and the industry participants would occur to discuss maintenance activities. Currently, personnel of Calpine, Unocal and NCPA inspect their injection fluid distribution lines and wells on a near-daily basis.

2.3.5 PROJECT CONSTRUCTION

This section presents a description of the preliminary construction plan for the project (except for the SERWTP Facilities Plan Component). If the project is approved, upon receiving project permits and clearances, and completion of a final project engineering design, the project engineers would prepare and implement a final construction plan. The preliminary construction plan described here presents a reasonable programmatic-level concept of construction activities. The focus of the preliminary construction plan presented in this document is on activities, equipment, location and areas of disturbance, and schedule considerations that potentially are sources of environmental impact.

Because of the complexity and size of the project, the overall construction will entail multiple types of activities occurring concurrently in different parts of the project area during the approximate 1 to 1.5 years between the date of initiating construction and completion of the facilities for start-up of operations. The details of the sequencing and time relations of the various activities would not be worked out until the final construction plan is developed. For purposes of this EIR/EIS, the construction phase of the project is treated according to the primary elements of each component of the project, that is, construction of pipelines, the new permanent road in The Geysers, etc.

2.0 Description of the Proposed Project
2.3 Geysers Effluent Pipeline Project Component

In total, construction of the project would entail the disturbance of approximately 159.5 acres and 119,500 feet of roadway. Following construction, approximately 10.7 acres permanently would remain as cleared ROW and facility sites. Additionally 2,300 feet of new roadway would remain permanently for the Bear Canyon to M-Pad connector road.

Because of the nature of the topography and related pump station design requirements, the construction plan presented here is divided into two parts: (1) the construction plan for the Geysers Effluent Pipeline from the SERWTP to Pump Station BC-1 and including the Lake Diversion facilities and (2) the construction plan for the Geysers Effluent Pipeline from BC-1 to the terminus and the secondary distribution lines.

2.3.5.1 CONSTRUCTION OF THE GEYSERS EFFLUENT PIPELINE, LAKE DIVERSION PIPELINE, PUMP STATIONS AND RELATED FACILITIES BETWEEN THE SERWTP AND PUMP STATION BC-1

Pipelines

Construction of the pipelines (including the Lake Diversion Pipeline and the main Geysers Effluent Pipeline) would be performed by one, or perhaps several, contractors working concurrently. It is anticipated that plans would be prepared with a number of different schedules. It is estimated that up to eight pipeline schedules or sections would be possible, and that each schedule could have two or three headings each. While this could result in up to 20 headings being constructed simultaneously, a realistic scenario would be six to ten concurrent headings or spreads. Each heading would be composed of the basic construction activities listed and described below in their sequence of occurrence:

- (1) Site and corridor clearing
- (2) Placement of materials
- (3) Excavation
- (4) Bedding
- (5) Placement of pipe
- (6) Initial backfill
- (7) Select backfill
- (8) Trench backfill
- (9) Pipe cleaning and testing
- (10) Top backfill
- (11) Clean up

2.0 Description of the Proposed Project

2.3 Geysers Effluent Pipeline Project Component

Special types of construction include the following:

- Stream crossings
- Boring and jacking
- Aerial construction
- Miscellaneous construction methods

The following sections discuss each of the above activities. Tables 2.3.5-1 through 2.3.5-5 present summary information about the construction activities. Within individual headings (or spreads), the sequence of construction is maintained in the above sequence of order. The construction process may be likened to a train moving along the track. Just as different parts of a train pass a given location, each phase of construction activity would pass a given location along the proposed pipeline route. In areas of easy construction, the periods of greatest activity in the series of construction phases (that is, those involving digging, pipe laying, backfilling) may pass within a few days. These periods of high activity commonly proceed at the rate of about 200 - 500 feet per day in easy to normal construction conditions. Where more difficult conditions are encountered, the process may be slowed substantially. Individual segments of the route may present special circumstances (for example, unstable slopes requiring repair or environmental constraints) which would interrupt the above normal sequence of activities and possibly extend the period of high construction activity.

Site and Corridor Clearing. Clearing activities include the removal of trees, brush, grass, structures and infrastructure in advance of actual excavation. It also includes the development of suitable access roads for the construction machinery used in subsequent phases. The amount of clearing would depend on the location. Where the pipelines would be located within a street or traveled way, no clearing would be required. Where the pipelines would be located outside the street traveled way, or within easements, a strip of land eight to ten feet wide would be made reasonably level. Isolated trees within that strip can remain provided they are not located within two to three feet of the centerline of the proposed pipe. A detailed set of plans would be prepared to show which trees are to be removed and protected, and the construction contractor will be prohibited from removing any other trees without special permission. Protected trees would be flagged.

Machinery and equipment used in this operation includes various sizes of bulldozers, haul trucks, pickups, power saws and other equipment (Table 2.3.5-4).

TABLE 2.3.5-1: SOUTHEAST GEYSERS EFFLUENT PIPELINE PROJECT CONSTRUCTION DISTURBANCE AREA ESTIMATES

Segment	Stationing	Total Disturbed Area (acres)	Permanent Site Area (acres)(a)	Temporary Site Area (acres)	Duration of Disturbance (days)	Disturbance of Existing Roads (lin.ft.)(b)	Duration of Road Disturbance (days)
Lake Diversion Intake	-2+00 to 0+00	0.3	0.1	0.2	30	0	0
Lake Diversion Pump Station	0+00 to 1+40	0.3	0.3	0	0	0	0
Lake to SERWTP Pipeline	1+40 to 130+00 (c)	15	0	15	120	7,000	90
SERWTP Pump Station	-7+00 to 0+00	3.0	0.6	2.0	270	0	0
Main Pipeline SERWTP to Lower Lake	0+00 to 325+00 (c)	40	0	40	180	27,000	180
Main Pipeline Lower Lake to Hwy 29	325+00 to 564+00	30	0.1 (d)	30	150	10,000	120
Main Pipeline Hwy 29 to Big Cyn Rd.	564+00 to 745+00	18	1.4 (e)	17	180	0	0
Childers Peak Tank	660+00	0.5	0.2	0.3	120	0	0
Main Pipeline Big Cyn Rd. to Hwy 175/ Bear Cyn Rd.	745+00 to 1100+00	40	0	40	180	22,000	150
Middletown WWTP Pump Station	1020+00	0.5	0.2	0.3	120	0	0
Bear Canyon Pump Stations (0.9 acres each)	-	4.5	4.5	-	7	-	-
Main Pipeline Bear Cyn Rd. to Terminus	1100+00 to 1390+00	1.4	0.7	0.7	163	29,000	150
Connector Road	1205+00 to 1240+00	6.3	1.1	-	89	-	19

(Continued)

TABLE 2.3.5-1: SOUTHEAST GEYSERS EFFLUENT PIPELINE PROJECT CONSTRUCTION DISTURBANCE AREA ESTIMATES (Continued)

Segment	Stationing	Total Disturbed Area (acres)	Permanent Site Area (acres)(a)	Temporary Site Area (acres)	Duration of Disturbance (days)	Disturbance of Existing Roads (lin.ft.)(b)	Duration of Road Disturbance (days)
Creek Fill and Culvert	1230+00	220 lineal feet	170 lineal feet	50 lineal feet	15	-	-
Y-Pad and Tank	-	0.3	0.3	-	240	-	-
Secondary Pipelines							
NCPA	-	-	-	-	-	8,000	45
Calpine	-	-	-	-	-	12,000	60
Unocal		1.1	1.1 (f)			4,500	45
TOTAL	-	160.6	10.7	144.7	-	119,500	-

- (a) Aboveground facilities.
(b) Public roads and highways.
(c) Lake to SERWTP pipeline station 130+00 to 165+00 included with Main Pipeline SERWTP to Lower Lake.
(d) Exposed pipeline on Lake Street Bridge.
(e) Aerial pipeline segments.
(f) Regrading of existing jeep trail.

SOURCE: EcoLogic Engineering, Veizades & Associates Engineering, and Unocal Corporation 1994.

TABLE 2.3.5-2: CONSTRUCTION MATERIALS FOR THE SOUTHEAST GEYSERS EFFLUENT PIPELINE PROJECT

Segment	Station	Improvements	Imported Backfill (cy)	Aggregate Base (cy)	Asphalt Concrete (cy)	Structural Concrete (cy)	Spoil Material (cy)
Lake Intake	-2+00 to 0+00	24" pipe w/screened intake	100	0	0	0	110
Lake Diversion Pump Station	0+00 to 1+40	Buried pump structure w/24" discharge pipe	100	70	30	80	400
Lake to SERWTP pipeline	1+40 to 130+00 (a)	24" buried pipeline w/appurtenances	4,400	950	400	10(b)	6,400
SERWTP P.S.	-7+00 to 0+00	At grade pumps w/24" inlet and 24" discharge pipelines	800	250	120	110	350
Main Pipeline SERWTP to Lower Lake	0+00 to 325+00	24" buried pipeline w/appurtenances	10,900	1,260	460	60(b)	16,200
278 Main Pipeline Lower Lake to Hwy 53	325+00 to 564+00	24" buried pipeline w/appurtenances	8,100	800	350	50	11,800
Main Pipeline Hwy 53 to Big Cyn Rd.	564+00 to 745+00	24" buried and aerial pipeline w/appurtenances (c)	2,600(d)	0	0	550(e)	3,000
Childers Peak Tank	660+00	400,000 gal. steel tank at grade w/appurtenances	500	100	0	100	600
Main Pipeline Big Cyn Rd. to Hwy 175	745+00 to 1071+00	24" buried pipeline w/appurtenances	8,600(d)	2,400	920	50	13,700
Middletown WWTP Pump Station	1020+00	At grade pumps w/ 8" inlet and 6" discharge piping to 24" main	60	10	5	5	20
TOTAL			36,160	5,840	2,285	1015	52,580

(a) 24" lake diversion pipeline between Stations 130+00 and 165+00 (SERWTP reservoir) included with Main Pipeline to Station 28+50.

(b) Consists of isolation valve boxes at one mile intervals.

(c) Aerial pipeline between Stations 620+00 and 740+00.

(d) Includes 500 cy for rock erosion protection at creek crossings.

(e) Concrete pedestals for aerial pipeline segment at 20 foot centers.

SOURCE: EcoLogic Engineering, 1994

TABLE 2.3.5-3: CONSTRUCTION MATERIALS STAGING AND STOCKPILING SITES AND SPOILS DISPOSAL FOR THE SOUTHEAST GEYSERS EFFLUENT PIPELINE PROJECT

Segment	Station	Staging Area(s)	Material Stockpile Site(s)	Spoil Disposal Site(s)
Lake Intake	-2+00 to 0+00	Lake Diversion P.S. site on Lakeshore Dr.	Lake Diversion P.S. site on Lakeshore Dr.	On-site (lake bed)
Lake Diversion Pump Station	0+00 to 1+40	On-site on Lakeshore Dr.	On-site and/or at SERWTP	SERWTP, Eastlake Sanitary Landfill (Lake Co.)
Lake to SERWTP pipeline	1+40 to 130+00 (a)	SERWTP	SERWTP and/or in temporary rights-of-way along route	SERWTP Eastlake Sanitary Landfill
SERWTP Pump Station	-7+00 to 0+00	SERWTP	SERWTP	SERWTP and/or at Eastlake Sanitary Landfill
Main Pipeline SERWTP to Lower Lake	0+00 to 325+00	SERWTP	SERWTP and/or in temporary rights-of-way along route	SERWTP Eastlake Sanitary Landfill
Main Pipeline Lower Lake to Hwy 29	325+00 to 564+00	Temporary rights-of-way along route	Temporary rights-of-way along route	Within temporary or permanent rights of way along route Eastlake Sanitary Landfill
Main Pipeline Hwy 29 to Big Cyn Rd.	564+00 to 745+00	Temporary rights-of-way along route and/or at Childers Peak Tank site	Temporary rights-of-way along route and/or at Childers Peak Tank site	Within temporary or permanent rights of way along route Eastlake Sanitary Landfill
Childers Peak Tank	660+00	On-site	On-site	On-site
Main Pipeline Big Cyn Rd. to Hwy 175	745+00 to 1071+00	Temporary rights-of-way along route and/or at Middletown WWTP	Temporary rights-of-way along route and/or at Middletown WWTP	Within temporary or permanent rights of way along route at Middletown WWTP
Middletown WWTP Pump Station	1020+00	On-site	On-site	On-site
Unocal Secondary Pipeline	Jeep Trail	Unocal D&V 18-1.6 well pad and NCPA H-Pad	On-site and/or Unocal D&V 18-1.6 well pad	On-site

SOURCE: Eco:Logic Engineering, 1994

TABLE 2.3.5-4: SOUTHEAST GEYSERS EFFLUENT PIPELINE PROJECT CONSTRUCTION ACTIVITY BREAKDOWN, LABOR AND EQUIPMENT

Segment	Pipeline Stationing	Overall Activity Period	Probable Period Of Disturbance (Days)		Onsite Machinery And Equipment (No & Type)	Transport Vehicles (No. & Type)	Transport Trips		Total Crew Size	Worker Commute Trips (a)	
			Total Segment	Local			Each Day	Total		Each Day	Total
Lake Intake	-2+00 to 0+00 (LDP)	8/94-12/94	30	30	1BRG W/ CLAM DRDG 1PU	1FB 1ED, (10cy)	1 1	1 1	4 to 6	8 to 12	200
Lake Diversion Pump Station	0+00 to 1+40 (LDP)	8/94-12/95	180	180	1BH, 1PU	1FB 1ED, (10cy) 1CMT	1 1 1	5 2 2	4 to 6	8 to 12	800
Lake to SERWTP Pipeline (300 ft./day)	1+40 to 130+00 (LDP) (b)	8/94-6/95	120	3 to 5	1BD, 1BH, 1FL, 1L, 1PU, 1SC(d), 2RL(d), 1PV(d) 1PU	1FB 1ED, (10cy)	3 12	130 520	8 to 10	16 to 20	1000
SERWTP Pump Station	-7+00 to 0+00	8/94-12/95	270	270	1BD, 1BH, 1FL, 1L, 1SC(d), 2RL(d), 1PV(d) 1PU	1FB 1ED, (10cy) 1CMT	1 1 1	10 6 3	6 to 8	12 to 16	1700
Main Pipeline SERWTP to Lower Lake (500 ft./day)	0+00 to 325+00	8/94-12/95 (c)	180	3 to 5(c)	1BD, 1BH, 1FL, 1L, 1SC(d), 2RL(d), 1PV(d) 1JM(e), 1PU	2FB 4ED, (10cy)	2 15	220 1630	8 to 10	16 to 20	2000
Main Pipeline Lower Lk. to Copsey Cr. @ Hwy 53 (500 ft./day)	325+00 to 564+00	8/94-12/95 (c)	150	3 to 5	1BD, 1BH, 1FL, 1L, 1SC(d), 2RL(d), 1PV(d) 1JM(e), 1PU	2FB, (18wh) 5ED, (10cy)	4 17	150 820	8 to 10	16 to 20	1000
Main Pipeline Copsey Cr. @ Hwy 53 to Big Canyon Rd. (200 ft./day)	564+00 to 745+00	8/94-10/94 4/95-10/95	180	3 to 5	1BD, 1BH, 1FL, 1L, 1PU	1FB, (18wh) 2ED, (10cy) 1CMT	2 7 2	180 640 50	8 to 12	16 to 24	1800

(Continued)

TABLE 2.3.5-4: SOUTHEAST GEYSERS EFFLUENT PIPELINE PROJECT CONSTRUCTION ACTIVITY BREAKDOWN, LABOR AND EQUIPMENT (Continued)

Segment	Pipeline Stationing	Overall Activity Period	Probable Period Of Disturbance (Days)		Onsite Machinery And Equipment (No & Type)	Transport Vehicles (No. & Type)	Transport Trips		Total Crew Size	Worker Commute Trips (a)	
			Total Segment	Local			Each Day	Total		Each Day	Total
Childers Peak Tank	660+00	4/95-10/95	120	120	1BD,1BH,1FL,1L, 1PU	2FB,(Mat'ls) 2ED, (10cy) 2CMT's	2 8	8 16	4 to 6	8 to 12	300
Main Pipeline Big Cyn Rd. to Hwy 175 (350 ft./day)	745+00 to 1071+00	8/94-12/95(c)	180	3 to 5	1BD,1BH,1FL,1L, 1SC,2RL, 1PV,1PU	2FB,(18wh) 5ED, (10cy)	2 3 15	10 300 1400	8 to 10	16 to 20	1700
Middletown WWTP Pump Station	1020+00	8/94-12/95	180	60	1BH,1FL,1L, 1PU	1FB,(Mat'ls) 1ED, (10cy) 1CMT's	1 1 1	2 1 1	2 to 4	4 to 8	180
2-81 Clearing, M-Pad Road	122 to 125	8/1/-8/19/94		15	2BD, 1L	1ED, (10cy) 1PU, 1WET	2 2	30 30	10	20	300
Clearing, B.C. Pump Sites	123 to 133	8/22/-8/31/94		8	1BD, 1L	1ED	1	8	5	10	80
Earthwork, M-Pad Road	122 to 125	8/10-9/30/94		36	1HE, 3BD, 2SC, 2C	1ED (10cy) 1WET, 2PU	1 3	144	14	28	1008
Earthwork, B.C. Pump Sites	112 to 133	9/1-9/12/94		8	1BD				1	2	16
Creek Culvert, M - Pad Road	124	9/1-9/21/94		15	1HC, 1SC	1FB 1ED (10cy) 1PU	2 1	30 15	11	22	330
Drainage Facilities	122 to 125	9/26-10/14/94		15	1BH	1ED (10cy)	2	30	4	8	120
Base Rock, M-Pad Road	122 to 125	10/12-10/18/94		5	1RG, 1VC	1WET 8ED(10cy) 1PU	3 24	15 120	13	26	130

(Continued)

TABLE 2.3.5-4: SOUTHEAST GEYSERS EFFLUENT PIPELINE PROJECT CONSTRUCTION ACTIVITY BREAKDOWN, LABOR AND EQUIPMENT (Continued)

Segment	Pipeline Stationing	Overall Activity Period	Probable Period Of Disturbance (Days)		Onsite Machinery And Equipment (No & Type)	Transport Vehicles (No. & Type)	Transport Trips		Total Crew Size	Worker Commute Trips (a)	
			Total Segment	Local			Each Day	Total		Each Day	Total
Base Rock, B.C. Pump Sites	112 to 133	10/19 - 10/24/94		4	1RG, 1VC	1WET 1ED(10cy) 1PU	1 1	4 4	6	12	48
Erosion Control Measures	112 to 133	10/24-10/28/94		5	1HS, 1BH	1HSS 1FB 1PU	1 3	5 15	8	16	80
Grading for Y-Site Tank	136	9/5-9/23/94		15	1BD, 1L, 1C	1WET 1PU 1ED(10cy)	2 20	30 300	5	10	150
Y-Site Tank Foundation	136	5/1-5/12/95		10	1HC, 1BH	2PU			4	8	80
Y-Site Tank Installation	136	5/15-6/16/95		25	1HC	2WT 1PU 1FB	1	25	6	12	300
Hwy. 175 to M-Pad trenching	110 to 125	4/19-8/18/95		87	1HE, 1SL,	1ED (10cy) 1PU	8	696	4	8	696
M-Pad to end trenching	125 to 140	4/17-8/19/95		87	1HE, 1SL,	1ED (10cy) 1PU	8	696	4	8	696
Hwy./ 175 to M-Pad installing bedding	110 to 125	4/19-8/22/95		87	1SC	1ED(10cy)	2	174	3	6	522
M-Pad to end installing bedding	125 to 140	4/19-8/22/95		87	1SC	1ED(10cy)	2	174	3	6	522
Hwy./ 175 to M-Pad Installing Pipe	110 to 125	4/20-8/23/95		87	1ST, 1PW	1TT 2WT 1PU	6	522	9	18	1566

(Continued)

TABLE 2.3.5-4: SOUTHEAST GEYSERS EFFLUENT PIPELINE PROJECT CONSTRUCTION ACTIVITY BREAKDOWN, LABOR AND EQUIPMENT (Continued)

Segment	Pipeline Stationing	Overall Activity Period	Probable Period Of Disturbance (Days)		Onsite Machinery And Equipment (No & Type)	Transport Vehicles (No. & Type)	Transport Trips		Total Crew Size	Worker Commute Trips (a)	
			Total Segment	Local			Each Day	Total		Each Day	Total
M-Pad to end Installing Pipe	125 to 140	4/20-8/23/95		87	1ST, 1PW	1TT 2WT 1PU	6	522	9	18	1566
Hwy./ 175 to M-Pad Backfill Trench	110 to 125	4/26-8/30/95		87	1BH, 1SC	1ED (10cy) 1WET	3 2	261 174	4	8	1566
M-Pad to end Backfill Trench	125 to 140	4/26-8/30/95		87	1BH, 1SC	1ED (10cy) 1WET	3 2	261 174	4	8	1566
2-83 Place Rock at Top of Trench (Including finish waork at B.C. Pump)	110 to 140	8/23-9/29/95		26	1RG, 1VC	2ED(10cy) 1PU 1WET	8 2	208 52	6	12	312
Creek Culvert, Unocal Secondary Pipeline	Jeep Trail	6/1-6/15/95		15	1BH 1L 1THL	1PU 1WT	1 1	15 2	4	8	120
Unocal Secondary Pipeline	Jeep Trail	7/1-8/15/95		46	1BH 1THL 1BD	1FB 1PU 1WT	1 1 1	10 46 46	4-6	8-12	184-276
Construct Bear Canyon Pump Stations (B.C.-1 through -5)											
Construct Foundations	112 to 133	4/24-5/26/95		25	1BH	1FB 1PU	2	50	5	10	250
Pump Installations	112 to 133	5/30-6/16/95		14	1HC, 1GP	1PU			4	8	112

(Continued)

TABLE 2.3.5-4: SOUTHEAST GEYSERS EFFLUENT PIPELINE PROJECT CONSTRUCTION ACTIVITY BREAKDOWN, LABOR AND EQUIPMENT (Continued)

Segment	Pipeline Stationing	Overall Activity Period	Probable Period Of Disturbance (Days)		Onsite Machinery And Equipment (No & Type)	Transport Vehicles (No. & Type)	Transport Trips		Total Crew Size	Worker Commute Trips (a)	
			Total Segment	Local			Each Day	Total		Each Day	Total
Building Erection	112 to 133	6/5-7/11/95		25	1HC	1FB 1PU	2	50	5	10	250
Piping	112 to 133	6/12-8/18/95		48	1HC	2WT 1PU			5	10	480
Set Electrical Equipment	112 to 133	6/12-7/18/95		25	1HC	1FB 1PU	1	25	4	8	200
Electrical Wiring	112 to 133	7/17-8/18/95		25	1HC	1PU			2	4	100
Road Surfacing											
Scarify and Recompact Base	110 to 140	10/2-10/20/95		15	1RG, 1VC	1WET	4	60	3	6	90
Place Double Chip Seal	110 to 140	10/9-10/27/95		15	1ED/CS(10cy), 1PC, 1L, 1PB	1OT/S 2ED(10cy) 1PU	2 8	30 120	8	16	240
Construct Power Lines to Bear Canyon Pump Stations											
Clear Right-of-Way	112 to 133	5/1-6/9/95		30	1THL, 1S, 1L	1CT 1PU 1ED(10cy)	2 4	60 120	7	14	420
Set Poles	112 to 133	5/1-6/30/95		44	1APS	2TP 1PU	4	176	6	12	528
String Cable	112 to 133	7/5-8/4/95		20	1H, 1CRT, 1CPT, HC	1FB 2PU	1	20	8	16	320

(Continued)

TABLE 2.3.5-4: SOUTHEAST GEYSERS EFFLUENT PIPELINE PROJECT CONSTRUCTION ACTIVITY BREAKDOWN, LABOR AND EQUIPMENT (Continued)

KEY TO ABBREVIATIONS

FB - Flat Bed Truck

BD - Bulldozer

BH - Backhoe

FL - Forklift

L - Loader

PV - Paver

RL - Roller

SC - Scraper

PU - Pickup

C - Compactor

OT/S - Oil Tank/Sprayer

VC - Vibrating Compactor

SC - Small Compactor

ST - Side Boom Tractor

HC - Hydrocrane

HS - Hydro seed Sprayer

PB - Power Boom

CS - Chip Spreader

CT - Chip Truck

CPT - Cable Puller Truck

APS - Auger/pole Setter

THL - Truck-mounted Hydraulic Lift

TT - Tractor Trailer

TP - Tractor with Pole Trailer

ED - End Dump Truck

CMT - Concrete Mix Truck

cy - Cubic Yard

BRG - Barge with Clamshell Dredge

JM - Jacking Machine

LDP - Lake Diversion Pipeline

WT - Welding Truck

WET - Water Truck

RG - Road Grader

PW - Polyethylene welder

C - Compactor

HE - Hydro excavator

HSS - Hydro seed Support

PC - Pneumatic Compactor

GP - Grout Pump

CRT - Cable Reel Truck

H - Helicopter

S - Shredder

SD - Small Dozer

SOURCE: Eco:Logic Engineering, Veizades & Associates, Inc, 1994

TABLE 2.3.5-5: SOUTHEAST GEYSERS EFFLUENT PIPELINE PROJECT CONSTRUCTION ROAD REQUIREMENTS

Segment	Stationing	New Roads		Road Expansion		Temp Roads		Total
		Miles	Acres	Miles	Acres	Miles	Acres	Acres
Main Pipeline Hwy 29 to Big Cyn Rd.	564+00 to 745+00	0.8	1.5	1.6	3.0	0	0	4.5
Bear Cyn Access Rd. to M-Pad Connector Road	1205±00 to 1240±00	0.4	1.1	0	0	0	0	1.1
Unocal Access Road	-	-	-	0.4	0.6	-	-	-
TOTAL		1.2	2.6	2.0	3.6	0	0	5.6

SOURCE: EcoLogic Engineering; Veizades & Associates Engineering, 1994.

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Placement of Materials. Pipe and backfill material must be placed (strung) along the alignment in advance of construction. The pipe design specifications limit the amount of pipe that can be strung prior to its installation. Its limit would be equal to approximately one week's worth of work and could vary from 50 feet per day to 500 feet per day depending on site conditions.

Imported bedding and initial backfill materials would be stockpiled along the alignment as well (Table 2.3.5-2). This material would be placed in 200 to 300 foot intervals and stored out of the way of the subsequent construction operations until needed. The placement of the pipe would be on one side of the trench. In tight areas (areas with limited space for construction activities), or in some cases along well traveled roads, the pipe material would be stockpiled at a specific site out of the way.

Machinery and equipment used for this operation consist of flatbed trucks that deliver the pipe, forklifts to unload the pipe, and dump trucks to deliver the imported bedding material.

Excavation. Most of the pipeline would be installed with approximately three feet of cover. The Lake Diversion Pipelines and the Geysers Effluent Pipeline's outside diameter would be approximately 28 inches and would require an additional four to six inches of bedding underneath for a total depth of trench of about 6 feet. This depth will be maintained on at least 90 percent of the project. In rare circumstances the cover over the pipe might be reduced to 24 inches; this would occur at some drainage crossings or creek crossings. Extra depth will occasionally be required to avoid existing utilities. This would occur mostly within City or County streets. In addition, extra depth may be required in some instances to avoid a local high spot.

It is advisable to avoid low and high spots along a pipeline whenever possible. This avoids the need for blow off or air release valves that require maintenance. Such valves can be avoided by adding some extra depth in segments that would otherwise result in a high point in the pipeline.

The trenches would be dug primarily with a backhoe. The minimum width of the trench would be about 44 inches (28 inch pipe + 8 inches on either side). A bucket with a width of 42 to 48 inches would be used to dig the trench. Normally the excavated material is placed alongside the trench. In some cases where working room is tight and along some existing roads, the excavated material would have to be placed in a truck and stored away from the working area.

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The amount of rock encountered dictates the progress of the project. Fractured rock and boulders can be excavated with the backhoe. Solid rock would have to be blasted.

California and federal law requires that trenches that are deeper than 5 feet to either be shored or have the side slopes cut to sufficient angles that they will not cave in. The degree of slope varies with the type of soil material. The construction contractor would be required to provide adequate shoring. The provision adopted by the construction contractor will vary between contractors. Whenever possible, the top 6 inches to 1 foot of material would be removed from the trench area prior to the start of excavation. In other circumstances, the trench would be sloped at perhaps a 1:1 (horizontal to vertical) slope for the top 3 feet of the trench. In other circumstances, trench jack shoring may be used. There would be no need for shoring in solid rock.

The excavating equipment used would be either a large backhoe on caterpillar tracks or possibly in some areas a trenching machine. In addition, a rubber tire loader is necessary to help remove the excavated material. Blasting equipment consists of rock drills and blasting mats. The storage of dynamite and blasting caps is regulated by law.

Bedding. Imported bedding material would be placed in the bottom of the trench to a minimum depth of 4 inches. In areas that are very rocky, this depth would be a minimum of 6 inches. The material is used to provide support for the pipe over its entire length to mitigate point loadings. The bedding material would be a 0.75-inch maximum graded crushed rock. A rubber tire loader would place the material. Laborers in the bottom of the trench would spread the bedding material with shovels.

Placement of Pipe. The standard lengths of pipe would be 18 feet for ductile iron pipe, a minimum of 20 feet for PVC pipe and up to 40-foot lengths for the different types of steel pipe or the high density polyethylene pipe. If the pipe has been strung along the trench, a backhoe using slings would pick up the pipe and place it in the trench. If the pipe has been stockpiled, a large loader would transport a pipe section to the trench area, then the backhoe would lower the pipe into the trench.

The actual joining of pipe with rubber gasket joints is accomplished by using a backhoe and come-a-longs in the bottom of a trench. Welded joints require welding equipment.

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Initial Backfill. After the joints are made in the pipe segments, imported material would be placed around the pipe at least up to the spring line, that is, halfway up the sides of the pipe. This material would be placed with a rubber tire loader and spread by workmen in the trench using shovels.

Select Material. Select material would be placed from the spring line of the pipe to an elevation a minimum of 6 inches above the pipe. Select material can either be the imported bedding material, as previously discussed, or it can be excavated material that is free from organic material, rocks greater than one inch or other undesirable material. This material would be placed with the use of a rubber tire loader and compacted using a hand-held compactor.

Trench Backfill. The remainder of the trench would be backfilled using the excavated material to a point below the top backfill. The depth of this section would vary between 12 and 24 inches for the normal trench. It would be deeper where extra depth is required due to previously mentioned conditions. This material would be compacted to a minimum of 90 percent relative compaction and, in some cases, up to 95 percent relative compaction, depending on the location of the trench and the governing agency involved (City of Clearlake, County of Lake or the State Department of Transportation). In some cases, this material would have to be placed in lifts not exceeding 8 inches and then compacted. In all cases, rocks larger than 3 inches would not be allowed in this material.

Machinery and equipment used would include rubber tired loaders and mechanical compaction equipment.

In some cases, compaction can be obtained with the use of jetting. Jetting is accomplished by inserting a 1.5-inch to 2-inch pipe into the backfill to a point 6 inches above the installed pipe. Water from a water truck is then used to compact the material. If jetting is used as a means of compaction, a water truck and a laborer would be needed.

Pipe Cleaning and Testing. During installation of the pipe, care must be taken to keep the interior of the pipe free from excavated and bedding materials. This is best done as each pipe section is placed. Sections of the pipe must be pressure tested after backfilling, but before the top backfill has been completed. These sections of pipe being tested would vary in length, depending on location. Sections tested along traveled ways would be shorter. The maximum

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length of a section tested could be as much as one mile. On hilly terrain the sections tested could be as short as 500 feet.

The line is pressure tested to the pressure specified on the plans. The pipe is filled with water and then raised to the pressure specified. This pressure is then maintained for a period of time and the amount of water that is added to maintain this pressure is then measured to determine whether the pipe has passed the test or leaks are present. The total amount of water required to fill a 24-inch line is 24 gallons per foot or 24,000 gallons per 1,000 feet.

Whenever possible, water for pressure testing would be reused. This can be done where pipe laying is accomplished from higher elevations to lower elevations. In some cases the water used for testing can remain in the pipeline and be used for the final test just before the time when the pipeline is put into operation. If the water has to be removed from the pipe, it would have to be controlled so as not to cause erosion. Blow-offs are installed at low points in the route alignment to facilitate removal of this water.

Top Backfill. The top backfill would vary considerably depending on the trench location. Where the pipeline would cross a field that is used for agriculture, the top backfill would be the return of 10 to 12 inches of the original top soil. In rocky areas, the top backfill would be part of the trench backfill, which would extend to the top of the trench. In traveled roadways, the top backfill would vary depending on the type of road existing prior to project construction. In dirt or gravel roads, the top backfill would consist of a 6 to 8 inch imported aggregate base material. In paved roads, the minimum top structural section would consist 6 inches of aggregate base material and 3 inches of asphaltic concrete. Certain special roads may receive a greater depth of aggregate base and asphaltic concrete material.

Machinery and equipment used would include a rubber tired loader, a scraper and an asphaltic concrete machine. In addition a mechanical roller would be needed for compaction of the aggregate base material and the asphaltic concrete material.

Clean-up. Clean-up would occur both during the course of construction and following completion of topfilling in a segment. Contractors would not be able to wait until their entire section of pipeline is installed before cleaning up. Clean-up would consist of removing excess excavated material and returning the area close to its previous condition.

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Reseeding of the area would follow cleanup, either by hydroseeding or another acceptable method. In some cases, trees and native plants would be planted, as required.

Special Construction Methods

Construction of the pipelines would vary from the above in the following cases: stream crossings, lake water intake, partly roadless area near Childers Peak, highway boring, and aerial construction. These items are discussed below.

Stream Crossings. Most of the stream and creek crossing would be made with the pipeline going underneath the drainage, swale or creek. In some cases the crossing of streams would be above the stream course (that is, a span crossing). Crossings beneath the drainage course would most often occur when there is no flow in the drainage course. This occurs in late summer and in the fall prior to the rainy season. Regular excavation and construction activities would be employed, as previously described.

There are some streams that will have a small amount of water in them all year long. These include Copsey Creek, Big Canyon Creek and Putah Creek. The stream flow would be low for all three of these creeks at the time the construction would occur for those segments of pipeline. It is anticipated that the construction of these crossings would be accomplished in the fall. The contractor would divert the water into a CMP culvert, using clean sand bags and polyethylene material; or he would divert the flow to one side of the channel, constructing the dry side, and then visa versa. Extra heavy wall pipe would be used in such crossing, along with welded joints. Reasonably large boulders would be used to protect the pipe from erosion, along with the use of rocks and boulders on the banks of the stream where the pipe enters and leaves the stream.

Trench backhoe and loaders will be used for this construction.

Construction activities for span crossings of streams would be similar to underground crossings, except when the pipe is to be hung from an existing bridge, as it is at the Clear Lake Outlet Channel crossing at Lake Street. In this particular crossing, casework would probably be done from the bridge, although it is possible the contractor might use a barge floating on the channel beneath the bridge.

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Lake Diversion Water Intake. The lake water intake would extend approximately 200 feet offshore, with the majority constructed using a barge equipped with a boom to lower pipe for placement in sections on the lake bed. Underwater divers would guide positioning of the pipe and concrete anchor weights, and make joint connections. A screened intake manifold provided with an air purge would be installed at the deep end of the intake pipe at an approximate elevation of 1,295, which is about thirty feet below the minimum normal lake surface elevation of 1,326.

Little excavation would be required for placement of the intake pipeline on the lake bottom from the intake structure up to about elevation 1,314, which is believed to be about 50 feet offshore. At this elevation, the intake pipe would be laid horizontally into the pump station wet well, located below ground level on the shoreline.

The trench for the horizontal pipe segment would be excavated underwater using a dragline bucket operated from the floating barge or from the shoreline. Pipe placement and backfilling would be accomplished using the same equipment. Excavated trench material would be stockpiled on the barge or shore property, as appropriate. Select granular bedding and backfill material would be placed in the trench with the pipe and the excavated material returned. Some excess excavated material may be considered surplus spoil and hauled to the County Eastlake landfill. Rock riprap would be placed on the completely backfilled disturbed underwater area to control erosion.

Depending on the results of detailed geotechnical investigations, some localized blasting may be required to excavate the pipe trench and the below-ground pump station. The pump station itself may be constructed either using open cut or caisson excavation procedures.

All construction activity associated with the intake and pipeline to the shore would be scheduled to occur during late summer and early fall, when the lake level is at its minimum. Work on the intake can be completed well within a month, and probably in about a week. Details of design and actual construction must conform with special permits to be obtained from regulatory agencies to minimize impacts on aquatic life and control erosion. Since no long lead time materials or equipment are involved, it is expected that some construction may proceed in the fall of 1994. Most construction would occur from May - October of 1995.

Construction in Partly Roadless Area Near Childers Peak. Between Highway 29 on the north and Big Canyon Road on the south, the pipeline would enter an area of limited access. An existing dirt road in relatively poor condition is located in the Copsey Creek and lower Sweet Springs Valley up to about Station 62. From Station 62 to the Childers Peak Tank site, there is no road (although remnants of an abandoned trail exist in part). From the Childers Peak Regulating Tank site to Big Canyon Road, the area is served by a dirt road in poor condition in many segments. Pipeline construction in the terrain near the Childers Peak Regulating Tank site would require the leveling of ground for an access road and for pipeline grade control. With accurate topographic survey, a bench cut roadway of 10-foot width would be laid out that provides for acceptable pipe grades using special angle fittings. At this time, an aerial pipeline is anticipated in this area to be situated along one side of the graded access road. Progress of construction would proceed from either end. Construction would occur in the autumn when the flows of the creeks on either side of the ridge would be very low or dry.

The roadway bench would have two horizontal to one vertical cut and fill slopes, depending on soil conditions. Excavations in solid or fractured rock may have steeper slopes. The pipeline would be supported above ground on concrete piers spaced approximately 20 feet apart in the rough and/or sensitive terrain segment north and south of Childers Peak between Stations 62.0 and 74.0. This design would minimize the amount of excavation required, since the pier height can be used to provide grade control. Maximum access road grade would be 16%. Construction between Highway 29 and Big Canyon Road (Station 56.3 and Station 74.5, respectively) would be controlled to occur only during the dry period April through September.

Construction in this segment of the pipeline would involve a total of 18 acres of disturbance (Table 2.3.5-1). A total of 1.4 acres would be occupied by the aerial pipeline. New roads, totaling 0.8 mile, would occupy 1.5 acres located in the Sweet Springs Valley. Expansion of 1.6 miles of dirt roads in the same segment would occupy 3.0 acres. No major fills would be required for this construction.

Boring and Jacking. Crossing of important highly traveled roads or state highways would, in some cases, be done by the boring and jacking method. This method entails construction of a bore pit on one side of the road that is roughly 6 feet wide, 20 to 24 feet in length. A jacking machine with an auger would be installed in this pit, and construction would be by means of auguring a hole underneath the road bed. A steel casing would be installed in this hole as it is being bored. The inside diameter of the steel casing would be approximately 8 inches greater in

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diameter than the outside diameter of the carrier pipe to be jacked into the casing. After the casing has been installed, the voids between the outside of the casing and the bored excavation would be filled with grout from the inside of the casing through holes drilled in the casing.

After the casing is secured, the carrier pipe will be jacked in place within the casing and the space between the carrier pipe and the casing would be filled with either dry sand or cement mortar. The agency involved with maintaining the road usually dictates what materials must be used between the carrier pipe and the casing pipe.

Aerial Construction. Aerial construction refers to placement of the pipe a little above the ground surface. At present, it is anticipated that aerial construction of the Geysers Effluent Pipeline would occur in two locations; the Sweet Springs Valley - Childers Peak area, and in The Geysers area. The Lake Diversion Pipeline would be entirely under ground. When the pipe is installed above ground, the pipe material would be made of weathering steel. This means that the steel would not be painted and would turn a rust-colored brown shortly after installation. This type of steel is slightly more expensive than the steel used for the normal buried operation, but it would save in future maintenance cost, as compared to painted or wrapped steel pipes that need to be maintained to prevent corrosion.

Aerial construction would require a path constructed for equipment to proceed adjacent to the pipeline alignment. Concrete piers approximately 20 to 30 feet apart would be constructed to support the pipeline. These piers would be circular, approximately 24 to 30 inches in diameter or rectangular with a cradle. The pier would extend below ground approximately 4 feet, and possibly deeper in some areas, depending on the soil stability of the area. Aerial pipe would have welded joints and provisions for expansion and contraction. In addition, where the pipeline would pass close to large trees, a steel guard rail protection device could be installed to protect the pipe from a falling tree.

Machinery and equipment for installation would require a small concrete truck and a fairly large piece of equipment to bring in and install the pipeline, plus welding equipment for the joints.

Water for Construction Dust Control and Compaction

Dust control would be required throughout the construction period during dry weather. Compaction of fill also may require use of water. Water for dust control during construction

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would be obtained from one or more of the following sources: Clear Lake, effluent from the SERWTP, effluent from the MWTP, or public potable water supplies. All of these sources are controlled in varying degrees. Clear Lake water must be purchased from the Yolo County Flood Control and Water Conservation District. Potable water must be purchased from the involved water purveyor. Treated wastewater effluent must meet specific quality criteria and be applied in a controlled manner conforming with requirements set forth by State and local health departments and other regulatory agencies.

The amount of water required depends in large part on weather and air dispersion conditions. Application rates would be controlled to prevent dust and runoff so there will not be any excess disposal requirements. The water would be hauled to the construction sites in a tank truck.

Construction Equipment and Laydown Sites

A specific plan for construction equipment yard and laydown sites will not be available until the final design phase. It is anticipated that there will not be a need for new construction equipment yards. Pipe materials constitute the bulk of construction materials. Pipe would be taken directly to the construction site. Similarly, construction machinery would be left at the construction site. The remainder of the construction materials, such as select fill, would be delivered directly to the construction site from the supplier.

Construction Traffic Control

A specific plan for construction traffic routing will not be available until the final design phase. As a number of construction spreads would be used, the traffic route selection would be based on the size and relative location of the spreads to the local roadway network. Temporary lane closures would occur on some streets and highways. Temporary road closure would occur on some minor roads. Impacts on traffic are described in Section 5.2.

Spoils Disposal

Most of the soil material removed during excavation of the trench for the pipeline would be replaced in the trench after placement of the pipeline, select material and initial backfill. The excess soils (see Table 2.3.5-2) would be disposed in two ways. Some of the soil would be used along the construction route (between Lower Lake and Station 62 in Sweet Springs Valley and between Big Canyon Creek and the MWTP) for final slope grading, for example fill in cut

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slopes, spread within the right of way and/or placed on the property under an agreement with the landowner. The remainder would be hauled to the East Lake landfill near the City of Clearlake, to the SERWTP or to the MWTP. This material would be used for landfill cover at the East Lake Landfill. Additionally, unspecified private landowners may request to obtain the material under an authorized grading permit. An exception would be spoil from sites with serpentine soil and rock and/or contaminated soil (see Sections 4.12 and 5.2.10, Environmental Contamination Hazards).

2.3.5.2 CONSTRUCTION OF THE GEYSERS EFFLUENT PIPELINE, PUMP STATIONS AND RELATED FACILITIES BETWEEN PUMP STATION BC-1 AND THE GEYSERS, AND SECONDARY DISTRIBUTION PIPELINES

Pipelines

Construction of the Geysers Effluent Pipeline between the first Bear Canyon Pump Station and The Geysers as well as the pump stations and road would occur at the same time as the portion of the project described in Section 2.3.5.1. Construction of the distribution lines and installation of injection well heads also would occur in the same period. Construction would be performed by one, or perhaps several, contractors working concurrently on this portion of the project.

Table 2.3.5-1 indicates construction disturbance. Table 2.3.5.4 summarizes construction locations, schedule, duration, equipment and machinery and vehicle use. Techniques of construction of the pipeline would be similar to those described in Section 2.3.5.1. Most of the construction would occur in existing paved roads. This is equally true for the proposed secondary distribution pipelines for transporting effluent to injection wells. The exception would be for the construction of an improved road on the Unocal leasehold. An existing 2,000-foot four-wheel drive trail (jeep trail) would be re-graded and widened. Overland construction techniques would occur in several sections of the route including areas along the lower part of the Bear Canyon Access Road to by-pass switchbacks, the segment for the proposed new road and a small segment immediately above the NCPA M-Pad to by-pass switchbacks. There would be no aerial construction required, span-type of creek crossings or construction on bridges. No new access roads would be required other than the new road connecting the NCPA development to the Bear Canyon Access Road. On areas where the piping deviates from the roads to shorten the distance, a 20 foot wide construction right-of-way would be constructed. All equipment required to construct the pipeline can be transported on highways as legal loads. The existing

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roads in The Geysers area are constructed to accommodate large and heavy drilling and maintenance equipment.

Construction of the pipeline from Highway 175, along Bear Canyon Road, and up to its terminus on the ridge line in The Geysers (approximate stations 110± to 139±) would be constructed in a manner similar to other buried sections of the pipeline. The pipe itself would be of welded steel construction in the higher pressure areas and of fused polyethylene construction in the low pressure areas. All pipeline work would be accomplished within the traveled way of those roads and within the 20 foot wide right of way in the bypass areas.

Construction of the pipeline in this portion of the route would involve excavation of a trench 42 to 48 inches wide and approximately 6 feet deep; placing bedding in the bottom of the trench; aligning, welding or fusing, and placing the pipe; placing backfill around and over the pipe; and resurfacing the damaged roadway areas with base rock and a chip seal pavement. Testing of the pipeline would probably be done in relatively short segments (500 feet) as the work progresses prior to backfilling the line.

There are three areas along this portion of the project where the pipeline departs from the alignment of the existing or planned roads. These areas are located approximately at Stations 111±, 114±, and 124±. In each case, the departure would be made to avoid following switch backs in the road. The resulting pipeline right-of-ways are short (150 feet, 600 feet, and 350 feet respectively) but steep (up to 67 percent).

Construction of these right-of-ways would involve clearing a strip of land 20 feet wide. After clearing, the surface of the ground would be smoothed to provide equipment access, but no significant grading would be done. During construction of the pipeline, backfill of the trench in these steep areas would require extra effort to get satisfactory compaction. After all construction activity is completed, these right-of-ways would be revegetated and the steeper sections would have jute netting placed on them for erosion control.

Approximately 3,000 cubic yards of imported bedding material and about 5,500 cubic yards of imported select backfill material would be required. Up to 4 staging areas would be used for this portion of the pipeline work. Those areas would be the following: the junction of Bear Canyon Road with Highway 175, one of the two disposal sites along Bear Canyon Road, NCPA's M-Site, and NCPA's E-Site. It is anticipated that this section of the Geysers Effluent Pipeline would be

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constructed on two headings. Construction would commence in April of 1995 and be completed by the end of October of that year.

At NCPA, no new secondary pipelines would be constructed initially. Disposal of effluent would be through existing piping systems. In the future, extension of existing injection piping utilizing buried installation may be required. If so, branch lines would be constructed from the effluent trunk line utilizing taps into the main pipeline.

Secondary distribution pipelines to Sites B, E, and M, would consist of short piping within drill pads and connecting to existing wells. These would be probably 8-inch diameter Sch. 40 cement lined steel pipe with lengths less than 500 feet each. All construction would occur on existing roads and pads. The future 6,500 feet-long distribution line to Site P would require a buried pipeline along the existing road. It would be probably 8-inch diameter Sch. 40 cement lined steel pipe.

All distribution lines in the Calpine area would be through a new piping system. All pipelines would follow existing roads and would either be above ground along the side of the road or buried in the road. Spoils will be disposed locally.

a. Pipeline To Site CA958-5:

Approximately 2,800 feet of 16-inch-diameter x 1.455-inch-thick HDPE pipe and 3,700 feet of 12-inch-diameter 316 stainless steel pipe.

b. Pipeline To Site McK-3/MLM-1:

Approximately 3,000 feet of 8-10 inch diameter 316 stainless steel pipe. All pipeline construction will be above ground where possible.

The Unocal secondary distribution line would be approximately 4,500 feet long. The pipeline would connect to the Geysers Effluent Pipeline at the NCPA C site and be located in the existing NCPA road between the C and H sites. The pipeline would follow the existing road between NCPA's C and H Pads and would either be above ground along the side of the road or buried in it. From the H site, Unocal would re-grade an existing 2,000-foot jeep trail. Unocal intends to balance cut and fill for this construction. A "V"-ditch would be constructed to collect runoff where the road is cut into the hillside. The proposed pipeline would be placed at the edge of the road on the surface.

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The proposed Unocal road would entail one significant stream crossing, a tributary of Big Sulphur Creek. The stream crossing would be formed by an earth berm of compacted fill several feet high. A culvert (CMP) would channel the flow under the road. Rip rap would be placed in the stream channel at the CMP inlet and as an energy dissipater at the outlet. A low berm on the road surface would direct runoff away from the fill slope. The proposed pipeline would be located at the edge of the road on the surface.

At its northern end, Unocal may choose to continue the regrading of the existing road or, alternatively, follow the route a little to the west in a low swale and slightly downslope of the existing trail.

Construction of the Unocal road and pipeline probably would occur in the summer of 1995.

New Road Connecting Bear Canyon Access Road to M-Pad

Construction of the new road (Stations 120.5 to 124.0) would occur in rugged wooded mountains. Construction would involve clearing of approximately 6.3 acres of natural hillside and disturbance of approximately 220 lineal feet of seasonal creek bed. It is anticipated that about 50,000 cubic yards of excavation would be required and that all excavated materials would be utilized in the fills for the roadway. There would be no excess material that would need to be disposed of off site. The intention of the final road design would be to balance the volumes of cut and fill. If excess material is created, it would be disposed at an existing permitted spoil disposal site (BCC site).

Construction of the culvert and fill for the creek crossing would proceed as follows. First, a small, temporary siltation basin would be constructed in the creek immediately downstream of the construction area, utilizing clean gravel and filter fabric. It is not anticipated that there would be any flow in the creek at the time of construction; however, if there is a small flow, a temporary culvert, probably using 8" or 10" diameter flexible pipe, would be established to bypass the construction. Next, a straight, flat-sloped trench would be excavated in which to bed the permanent culvert. After the culvert has been installed, concrete head walls would be constructed at each end and crib walls would be started on either side and on top of both headwalls. Fill material would be placed over the culvert between the crib walls and would be brought up in elevation as the crib walls are constructed. Fill placed above the elevation of the top of the crib

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walls would be placed in the usual manner. Upon completion of this portion of the roadway, the temporary siltation basin would be removed along with any accumulation of silt.

Along the entire roadway, erosion control measures would be utilized to avoid damage to the adjacent hillsides and drainages. A siltation barrier would be constructed along most of the down-hill edge of the roadway where the road is completely in a cut section. This siltation barrier would be put in place after clearing operations are completed in the area, but before any excavation begins. It would consist of posts driven into the ground, with a woven fabric attached to them. The bottom edge of the fabric would be buried in a small trench so that no silt or dirt will be able to go under it. This siltation barrier is intended to stop any silt or small debris from going downslope from the roadway during and after construction. Where fill slopes meet existing ground on steep slopes, the swale formed at the juncture would be lined with rock rip rap to dissipate the energy of water flowing through it and thus prevent erosion. Rock rip rap would also be installed at the outlet of all culverts to dissipate water energy. All significant fill slopes would be covered with jute netting and then hydro-seeded to prevent erosion immediately and to quickly establish a vegetative cover for long-term erosion control.

Approximately 1,500 cubic yards of base rock would be required to surface the new Bear Canyon-M-Pad Road, roughly 2,000 cubic yards would be used at the top of the pipe trench, and up to 2,500 cubic yards of base rock might be needed to repair and resurface the existing roads.

Power Supply Line

The pump stations would be powered by PG&E through a 21 KV electrical distribution line. The line would be pole-mounted and originate at the switch yard servicing PG&E's Unit 16. The total projected load of the distribution line is 5,000 KVA. This power is calculated to accommodate a possible addition of a third pump at each pump station to increase delivery at some future date. The design and installation of the power pole line will be done by PG&E.

It is anticipated that the distribution line would be constructed from the switch yard along existing roads until it reaches Bear Canyon Creek. It would cross the creek on high wooden poles and then follow the Bear Canyon access road. A split would be made at the intersection of Bear Canyon Road with the new road to the M-Site. One branch would follow the existing Bear Canyon Road to supply pump stations BC-1 and BC-2. The other branch would follow the new access road and existing NCPA roads to supply pump stations BC-3, BC-4 and BC-5.

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2.3 Geysers Effluent Pipeline Project Component

Construction along the existing roadways would involve minor excavation of holes for the power lines. Construction of the span crossing of Bear Canyon Creek would require construction of the high poles, anchoring them with guy wires or other means of support. These construction methods would entail minor disturbance of the sites. Stringing of the poles across Bear Canyon would be achieved using a helicopter.

Bear Canyon Pump Stations

Earthwork construction for the four Bear Canyon pump sites, BC-1,-2,-4, and -5 (BC-3 is included with the construction of the Bear Canyon-M-Pad Road) would require a small amount of pad construction. The four sites were selected in areas where the terrain is fairly level. Up to a maximum of about one-tenth of an acre would be cleared at each site. Grading for each pump station would require moving no more than 100 cubic yards of dirt. The volumes of cut and fill materials would be balanced on each site so that there would be no excess material to remove from the sites.

Y-Pad Injection Fluid Tank

The first step in construction of this tank would be clearing of approximately one quarter acre and then performing additional excavation in the existing cut slope on the south end of the Y-Pad. The excavation is needed in order to develop a bench approximately 45 feet wide with an access ramp up to it. This would involve excavation of about 6,000 cubic yards of material, half of which would be disposed in a spoils area at the north end of the pad, and the other 3,000± cubic yards would be disposed in an existing excess spoil disposal site near NCPA's Power Plant No. 2. After the bench is established, a concrete foundation for the tank would be constructed and then the tank would be erected. Both the bench and access ramp would be surfaced with base rock.

Construction of the tank can take place in two stages, with earthwork being done in September of 1994 and tank foundations and erection being done in late spring or summer of 1995.

Water Usage

Water would be needed for construction of the new Bear Canyon to M-Pad Road and for placement of the spoils from the Y-Pad tank excavation. Water is usually required to adjust the moisture content of the soil as it is being placed as fill in order to properly compact it. Assuming

2.0 Description of the Proposed Project
2.3 Geysers Effluent Pipeline Project Component

that the moisture content of the approximately 56,000 cubic yards of material involved in these two activities would be increased on average about 2 percent, the water required would be approximately 400,000 gallons.

Planned dust control along the roads during pipeline construction would use about two truckloads of water per day. Assuming construction takes 90 working days, this would require approximately 600,000 gallons of water.

Moisture conditioning the trench backfill and the base rock for resurfacing the roadways also require significant amounts of water. Assuming that the moisture content of 7,000 cubic yards of backfill is increased by 2% and that of 9,000 cubic yards of base rock is increased by 5%, approximately 275,000 gallons of water would be required for these activities.

Assuming that no reuse of test water is made, the total quantity of water for testing of the pipeline would be 750,000 gallons. This would require approximately 190 trips of 4,000 gallon water trucks. It is possible (although unlikely), to reuse the water by following a specified construction sequence starting at the top of the line and working towards the bottom.

The most likely source of water for all of these construction activities is a privately owned pond located just off of Socrates Mine Road near Highway 175. Water for hydrostatic testing of the line would be obtained from commercial sources. Alternatively, utilizing a small surface run pipe, water for testing can be obtained from Calpine's water system.

Disposal of test water would be through discharge into existing water ways since the water would not be contaminated. A small amount of sediment may be present in the water.

Spoils Disposal

Spoils would be generated by the excavation for the Y-Pad tank and by that portion of the trenching excavation that is replaced by bedding, pipe, select backfill, and base rock. There would be approximately 6,000 cubic yards of spoils from the Y-Pad tank excavation and about 15,000 cubic yards from pipeline trenching. No spoils are anticipated from the construction of the new Bear Canyon to M-Pad Road because the excavated soil would be used for the fill at the creek crossing.

2.0 Description of the Proposed Project
2.3 Geysers Effluent Pipeline Project Component

Disposal of the spoils from Y-Pad tank excavation would be in an existing fill site at the north end of Y-Pad and in an existing disposal site near NCPA's Power Plant No. 2. If spoils would result from the pipeline excavation, the soil would be taken to the existing permitted disposal sites located along Bear Canyon Road near the proposed location for Pump Station BC-2.

Road and Lane Closures

All roads involved in the construction of this portion of the effluent pipeline are private roads that are controlled and used solely by the geothermal operators. The only current use of these roads is for operation and maintenance of the geothermal facilities within the area.

It is anticipated that lane closures and occasional road closures would occur throughout the pipeline construction period. However, as long as these closures are scheduled with the geothermal operators and properly authorized, Calpine will be able to use the new Bear Canyon-to-M-Pad Connector Road to access the Bear Canyon Power Plant throughout the construction period.

Conversion of Production Wells to Injection Wells

Production wells can be converted to injection wells by removing the steam piping and installing the injection piping. At some wells, a slotted liner must be installed in order to convert a production well to an injector. The need for the liner is determined on a case by case basis, depending on the rock formation within the well bore. Installing a liner entails "killing" the production well (quenching the well), installing a slotted steel liner, and reinstalling the well head valves. This procedure requires the occupation of the well by a drilling rig. No site disturbance is associated with this activity.

2.3.5.3 CONSTRUCTION SCHEDULE

The schedule for construction of the various facilities would depend on the dates on which permits and clearances for the project would be obtained, as well as funding. As currently envisioned, this would occur as early as fall of 1994. Final, detailed project design plans would be developed immediately thereafter and a construction plan would be prepared. At that time, the project sponsors would issue contracts for materials and construction. Some parts of the construction could be initiated in autumn of 1994 prior to the onset of the rainy season in October.

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2.3 Geysers Effluent Pipeline Project Component

Most construction activity would be initiated in spring of 1995 at the end of the rainy season. This most likely would occur in April. Pipe laying and backfilling would be completed in most sections by September 1995. Much of the major project construction would be completed by the autumn of 1995. In some areas, construction would extend into autumn. Under the current plan, construction of all facilities of the various project components would be completed in November. Pre-operational testing of the system would be made at that time. Start-up of the project would begin in early 1996.

2.4 SOUTHEAST GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT

This section provides a description of the proposed plan for disposal of the effluent delivered to the southeast Geysers through the Geysers Effluent Pipeline. Facilities for this delivery system were described in Section 2.3. This section presents the plan for injection of the effluent into the steam field.

2.4.1 BACKGROUND AND GENERAL OBJECTIVES

The Geysers has been a geothermal power production area since 1960. Installed capacity currently is 1,865 net Mega-Watts (MW). The present generating capacity is approximately 1,216 net MW, employing the use of 455 production wells. As steam fields developed and power production increased, the annual production of steam increased substantially, reaching a peak of almost 250 billion pounds in 1987 (CDOG, 1992). Since 1987, the annual production has declined dramatically, dropping to approximately 190 billion pounds in 1992. The data indicate that the production of steam has resulted in dropping pressure in the steam reservoir that is reflected in the decreased production. The source of the decline appears to be related to production in an area with highly variable or little or no natural recharge. A decline in the ultimate source of the geothermal energy, i.e., geothermal heat, does not appear to be as significant a contributing factor in this decline. (See also Sections 4.14 and 6.2.)

Recognizing the need to maintain pressure in the reservoir, operators in The Geysers have conducted programs to inject water into the deep geothermal reservoir beginning in 1968. There have been 25 years of augmented injection in The Geysers, and there are currently 27 injection wells in operation. The injection fluid has consisted of condensate collected at the power plant cooling towers as well as surface runoff collected during storm events. The injection of geothermal condensate is mandatory because other methods of disposal are not available. Calpine, NCPA, and Unocal currently carry on programs of injection in their leaseholds. This is because there are well-identified pressure sinks which occur in portions of all three leaseholds. Data indicate a pressure decline to 200 psi in this area. Further details on the geothermal reservoir are presented in Section 4.14.

A primary objective of the project is to use effluent brought to The Geysers in the Geysers Effluent Pipeline as a major source of fluid for injection in the Calpine, NCPA and Unocal leaseholds. The objective is to inject the effluent in order to replenish the mass produced as

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2.4 Southeast Geysers Effluent Injection Program Plan Component

steam and mine additional heat from the reservoir rock. In so doing, the intent is to extend the operating life of the steam field and steam production for producing power at the NCPA, Calpine, and PG&E power plants. Without the addition of the effluent, continued substantial decline in steam production is anticipated (see Section 6.2).

2.4.2 PROJECT-RELATED STEAM FIELD POWER GENERATION PROJECTIONS

The injection of effluent into the geothermal steam field is proposed to raise the power generation at the Calpine/PG&E plants, Unocal/PG&E plants and the NCPA plants to a level closer to the installed capacity. Calpine's present generation (as of February 4, 1993) was 294 MW, which is 80.2 percent of the installed capacity of 367 MW. Similarly, NCPA's present generation is 150 MW, which is 62.8 percent of the installed capacity of 239 MW. Unocal's present generation rate is 640 MW in the entire steam field, which is 62.7 percent of the installed capacity level. However, the project would not increase production to installed capacity levels for NCPA, Calpine, or Unocal.

The injection of effluent mixed with condensate, rainwater and currently permitted Sonoma County stream diversions would generate increased steam, thereby increasing steam pressure in the reservoir and leading to increased steam collection used for power generation. An exact determination cannot be made of the ratio of effluent injectate to the amount of steam that would be created and returned for power production at the Calpine, PG&E and NCPA power plants. This is because of the complexities and uncertainties involved in analyzing the behavior of injection fluids in the geothermal reservoir and the varying amount of water recovery as condensate at the power plants. Past experience with injection in The Geysers, and in the Southeast Geysers specifically, provides a general empirical basis for establishing the expectation of return as power production from injection of condensate and rainwater.

Assuming 100 percent recovery, an effluent flow of 5,400 gpm to The Geysers could generate up to 2,700,000 pounds per hour (lb/hr) of equivalent mass in steam. It takes approximately 16,000 to 19,000 lb/hr of steam to generate one MW of electrical energy. Therefore, the anticipated unadjusted power generation from the project at the design flow rate of effluent would be approximately 150 MW. Empirical evidence in The Geysers, however, indicates that this theoretical return would be possible but is not necessarily guaranteed.

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2.4 Southeast Geysers Effluent Injection Program Plan Component

Data collected on recovery of steam from injection by operators in The Geysers as a whole indicate return values of zero to 60 percent within the first year of injection in a low pressure area. This recovery stabilizes to perhaps 30 percent by the fourth year of continued injection and thereafter. The Geysers field-wide average has been approximately a 15 - 20 percent recovery (Thomas Box, Calpine, personal communication 4/1/93). If a 15 percent recovery is assumed in the first year, the adjusted expected power production from the project would be approximately 22.5 MW. Assuming 30 percent recovery for the fourth year of injection and thereafter, the annual adjusted production from the project would be 45 MW. It is important to note that higher or lower returns than these are possible.

Data specific to the Southeast Geysers indicate a more optimistic likely return than the recovery rate for The Geysers as a whole. Beall (1993) reported that geochemically measured mass flow rates of injection recovery for PG&E Units 13 and 16 indicate a strong response of the geothermal reservoir to injection. Data analyzed by Beall and by Eneidy *et al.* (1993) indicate that injection derived steam (IDS) is being recovered at rates greater than 60 percent. However, such conditions would not persist in the long term. Beall attributes the success in recovery in the Southeast Geysers to three conditions of the geothermal reservoir in the Southeast Geysers: (1) high permeability, (2) high superheat of the reservoir rock, and (3) the low reservoir pressure. Beall notes, however, that the IDS response from individual injection wells is variable.

While the overall beneficial response to injection seems assured, the localized IDS recovery rates may be variable. The data indicate that IDS recovery rates may be strongly influenced by the location and timing of injection fluid delivery. Additionally, natural reservoir phenomena account for a significant, but unknown, effect on IDS recovery. Calpine, NCPA and Unocal have all reported that the use of certain wells for injection produced marked increased in IDS recovery. In contrast, the use of wells, or the suspension of injection in some wells, had no observable effect on IDS mass flow rates.

In summary, The Geysers field-wide averages support power generation figures from injection programs of 30 MW. This expectation may be regarded as conservative. The optimistic expectation based on 100 percent recovery, as may be possible in the Southeast Geysers, would be 150 MW or greater.

As the effluent stream would be equally divided between Calpine/PG&E, NCPA and Unocal, it is assumed that the resultant power generation would be equally divided. Using the above

2.0 Description of the Proposed Project
2.4 Southeast Geysers Effluent Injection Program Plan Component

Geysers-wide average and the 100 percent possibility for recovery of injected fluid, each operator would have an expected increased power generation of between 15 and 50 MW.

2.4.3 OPERATIONAL STRATEGY

Under the proposed project, the 5,400 gpm flow of effluent in the Geysers Effluent Pipeline would be divided equally by Calpine, NCPA and Unocal. Each operator would integrate their 1,800 gpm of effluent into ongoing injection programs. Each operator would inject the effluent into the wells at rates and locations which are related to anticipated optimal return based on the specific characteristics of the steam field in their respective leaseholds and desired modes of operation. Each operator would monitor the output of producing wells and adjust its own injection program accordingly. The following information presents the proposed injection program based on each operator's anticipated initial plan for injection at specific wells.

2.4.3.1 CALPINE INJECTION STRATEGY

Calpine would receive 1,800 gpm (at 50 psi) through the Geysers Effluent Pipeline. Calpine would take possession of the effluent on its leasehold near the NCPA C-Pad. That water would not generally be mixed with steam condensate because of the position and operation of existing injection wells and planned future pipeline locations. In the future, such mixing may be undertaken to increase operational flexibility, particularly during the winter months. There are three injection wells in the area of PG&E's Unit 13 and 16 that would receive effluent for injection through new distribution lines proposed as part of the project. These wells, their elevation, average injection rate and injection interval are identified in Table 2.4-1.

All the wells in Table 2.4-1 currently are production wells that would be converted to injection wells as part of the project. Additional wells on the leasehold that are not planned as initial effluent injection wells but which could later become replacement injection wells include McKinley 1, MLM-5, MLM-2 and MLM-1. It is assumed that any of these replacement wells also would receive the effluent at an injection rate of 600 gpm.

Calpine has four existing injection wells (CA956A-1, CA956-2, Barrows-1 and CA958-6) that are used for injection of plant condensate. Current plans include use of the CA956-2 well for injection of effluent. There are no plans at present to use the project effluent for injection to supply steam for the Bear Canyon Power Plant.

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2.4 Southeast Geysers Effluent Injection Program Plan Component

TABLE 2.4-1: CALPINE PROPOSED INJECTION PROGRAM RECEIVING WELLS,
AVERAGE INJECTION RATE, WELL HEAD ELEVATION AND INJECTION
INTERVAL

Well	Average Injection Rate (in gpm)	Elevation (feet, msl)	Injection Interval (feet)
CA956A-2	600	3,163	3,005 - 6,150
CA958-5	600	2,553	3,563 - 6,612
McKinley 3	600	2,478	2,489 - 8,049

SOURCE: Calpine Corporation, 1993, Calpine Injection Strategy for Lake County Wastewater

2.4.3.2 NCPA INJECTION STRATEGY

NCPA would receive 1,800 gpm (at 50 psi) through the Geysers Effluent Pipeline. NCPA would take possession of the effluent on its leasehold near the NCPA M-Pad. The effluent would be directed into NCPA's existing condensate distribution and injection program. The rates of injection of the effluent combined with condensate are presented in Table 2.4-2.

The proposed Y-Pad Injection Fluid Tank on the NCPA leasehold would receive the effluent from the Geysers Effluent Pipeline. Mixing of the effluent would occur with the condensate and rainwater in the tank and the water would be directed through the existing injectate lines to the well heads. In a later phase, direct tapping of the Geysers Effluent Pipeline could occur for flows to proposed injection wells at the E-Pad and P-Pad. These would entail direct removal of the effluent without mixing it with condensate and rain water in the Y-Pad Tank.

2.4.3.3 UNOCAL INJECTION STRATEGY

Unocal would receive 1,800 gpm (at 50 psi) through the Geysers Effluent Pipeline. Unocal would direct effluent into its existing injection system where it may be mixed with condensate and diverted stream flow prior to injection. The main goal of injection is to extend resource longevity, maximize steam production, and enhance reservoir pressures.

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2.4 Southeast Geysers Effluent Injection Program Plan Component

TABLE 2.4-2: NCPA INJECTION PROGRAM RECEIVING WELLS, AVERAGE INJECTION RATE, WELL HEAD ELEVATION AND INJECTION INTERVAL

Well	Average Injection Rate (in gpm) ^a	Elevation (feet, msl)	Injection Interval (feet)
<u>Existing</u>			
A-1	200 - 2,000	3,026	3,850 - 8,066
C-11	200 - 1,000	3,050	3,566 - 8,710
F-1	200 - 1,000	3,043	3,099 - 5,627
J-6	200 - 1,000	3,200	5,225 - 10,086
Q-2	200 - 500	2,908	4,129 - 7,340
Y-4	200 - 2,000	3,333	4,795 - 9,296
Y-5	200 - 2,000	3,333	4,743 - 7,986
<u>Proposed</u>			
E-Site	200 - 2,000	3,195	approx. 4,500 - 7,000
P- Site	200 - 2,000	2,514	approx. 3,400 - 7,000

^a Flow of combined effluent and condensate/rainwater. Effluent could be up to 1,800 gpm of this flow.

SOURCE: NCPA, 1993: NCPA Reservoir Operating Strategy

There are currently four injection wells located within PG&E Unit 18 and Unit 20 areas. These wells, their elevation, average injection rate, and injection intervals are shown in Table 2.4-3. Any combination of these wells may be used to inject effluent.

2.4.4 MONITORING

2.4.4.1 INJECTION AND PRODUCTION MONITORING

An integral part of the effluent injection program includes monitoring of both the rates of injection and production. Calpine, NCPA and Unocal all have ongoing programs for monitoring both parameters on a continuous basis. No change in the nature of the monitoring programs is proposed, however, the number of monitored injection wells would be increased for each operator. As no additional production wells are proposed as part of this project, no change in

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2.4 Southeast Geysers Effluent Injection Program Plan Component

TABLE 2.4-3: UNOCAL INJECTION PROGRAM RECEIVING WELLS, AVERAGE INJECTION RATE, WELL HEAD ELEVATION AND INJECTION INTERVAL

Well	Average Injection Rate (in gpm) ^a	Elevation (feet, msl)	Injection Interval (feet)
BEF 42B-33	200 - 4,000	2,521	2,856 - 9,113
DV 11	200 - 1,000	2,820	2,923 - 5,932
DV 73-33	200 - 2,000	2,704	4,107 - 6,140
GDC 21	200 - 1,000	2,426	5,273 - 9,915

^a Flow of combined effluent and condensate/rainwater. Effluent could be up to 1,800 gpm of this flow.

SOURCE: Unocal, 1994

monitoring of production would occur. Typical monitoring would occur for the following parameters:

- flow rate;
- wellhead temperature;
- wellhead pressure; and
- enthalpy.

The monitored data would be used to determine the relationships between injection and production. These data would be used to identify adjustments in the injection program. Such adjustments could include alteration of the rate of effluent injection into any given well, termination of a given well as an injection well and selection of replacement wells, and/or alteration of the program for injection into existing injection wells using project effluent. The objective of the monitoring and injection program adjustments would be to obtain optimum increases in reservoir pressures and resultant steam production. It is anticipated that the locations and rates of injection would vary over time in response to reservoir pressure conditions and steam production.

It is anticipated that all the effluent received at the Geysers would be injected as there are sufficient injection wells to accept the 5,400 gpm flows at all times. Routine maintenance

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2.4 Southeast Geysers Effluent Injection Program Plan Component

activities would require various wells and distribution lines to be periodically shut down. Under normal operations, the effluent would be redirected to other wells.

The operators have stated that it would be highly unlikely to face a situation in which the full flow of effluent could not be accepted. In situations where one of the operators might not be able to accept the full allotment of effluent, the portion not accepted could be directed to the other operators for injection. If all three operators could not accept the full 5,400 gpm in the Geysers Effluent Pipeline, then the NCPA control center would curtail the pumping of Clear Lake diversion water into the SERWTP reservoir.

2.4.4.2 GROUNDWATER MONITORING

Calpine, NCPA, and Unocal intend to monitor groundwater quality in two ways. First, in response to concerns expressed during EIR/EIS scoping about possible effects of the project on potable water sources, periodic water quality sampling of significant springs would be conducted. While impacts to groundwater are not anticipated (see Section 5.3.3), monitoring of spring water quality is proposed as a precautionary measure in the unlikely event that problems were to occur. If baseline data on spring water quality are unavailable for the significant sources of potable groundwater, baseline data would be collected prior to the start of effluent injection.

Second, in response to mandatory requirements of the California Division of Oil and Gas and Geothermal Resources (CDOG&GR) and the BLM to monitor injection wells, Calpine, Unocal, and NCPA each performs a fluid level survey, and cement bond log or a caliper log. This type of monitoring is conducted to ensure that injection well casings do not leak and allow contamination of groundwater.

2.4.4.3 SEISMIC EVENT MONITORING

While significant impact on earthquake hazards is not anticipated (see Section 5.3.2), the project sponsors will participate in seismic event monitoring and information dissemination that may be administered by other agencies. The project sponsors intend to cooperate with programs that disseminate information about seismic events to residents in the vicinity and county as a whole. While details of the program have yet to be identified, the importance of keeping nearby residents informed about earthquakes in reduced and easily understandable forms, earthquake hazards and preparedness is recognized. While this may not allay citizen concerns, it would

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2.4 Southeast Geysers Effluent Injection Program Plan Component

provide some better information to better understand what is happening in the region, thereby allowing them to better prepare for any real or perceived effects of induced and natural earthquakes.

2.4.5 GEYSERS INJECTATE SPILL CONTROL PLAN

The proposed effluent injection program is an extension of the ongoing injection programs of Calpine, Unocal and NCPA. Calpine, Unocal and NCPA have existing spill control plans related to their injection programs. The overall nature of those plans would not change because of the project. These are summarized in Section 5.3.3.

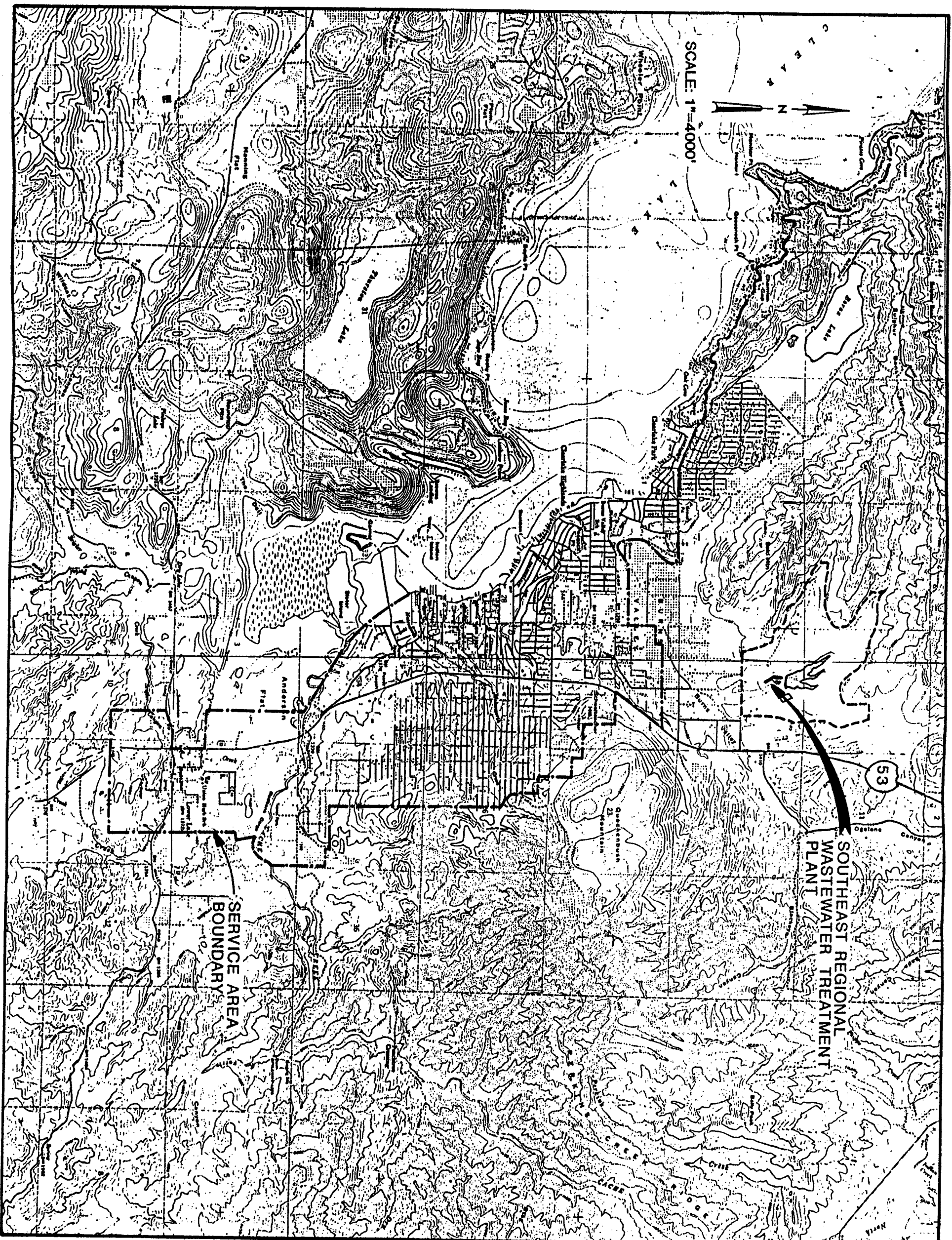
2.5 SOUTHEAST REGIONAL WASTEWATER TREATMENT FACILITIES PLAN COMPONENT

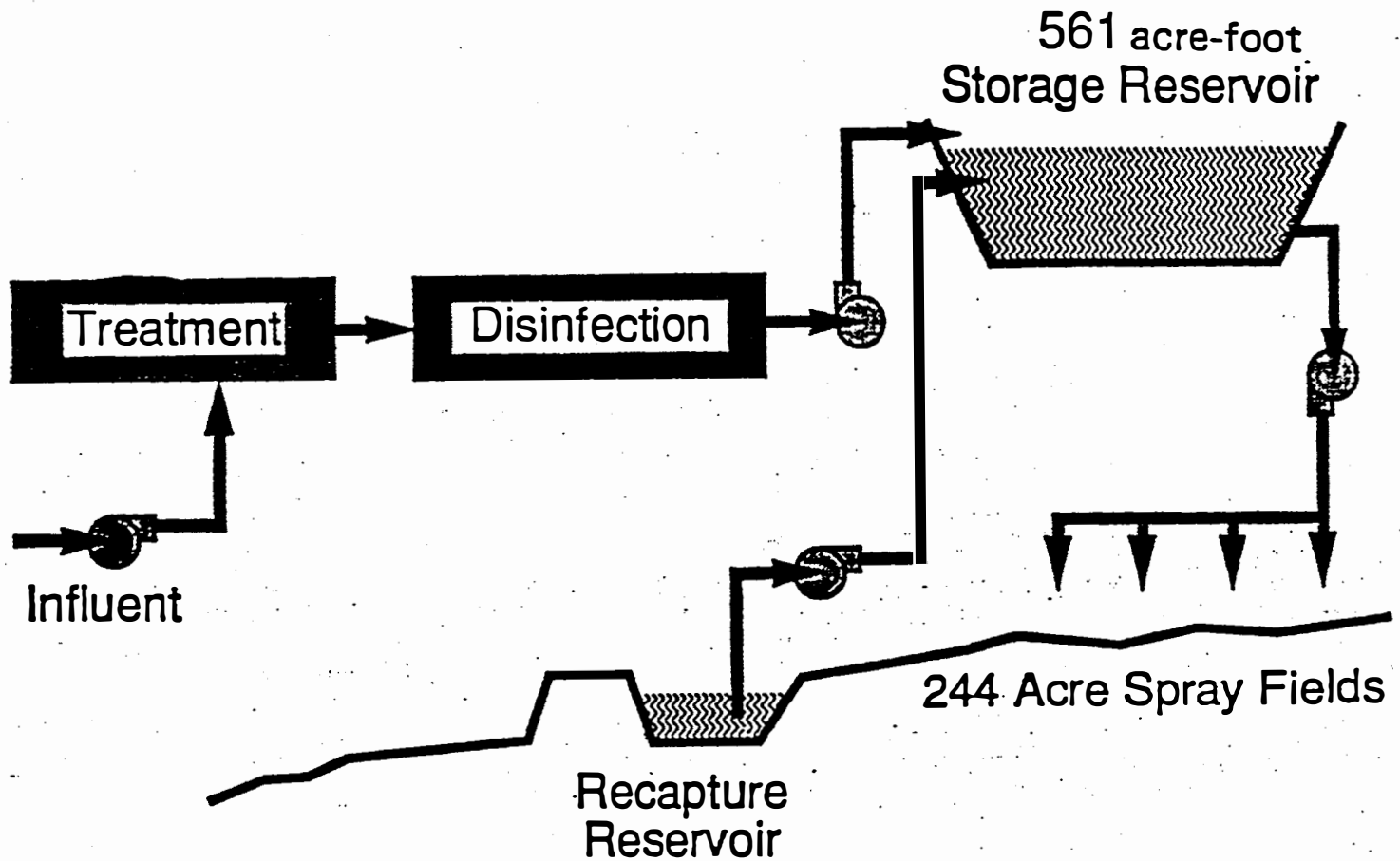
2.5.1 SERWTP EXISTING FACILITIES AND WASTEWATER TREATMENT

The proposed project is located at the east end of Clear Lake, in Lake County, approximately 100 air-miles north of San Francisco. The Southeast Regional Wastewater System (SERWS) corresponds to LACOSAN Improvement District No. 1 which includes most of the City of Clearlake, and most of the community of Lower Lake and LACOSAN Improvement District 1-6. The service area, shown in Figure 2.5.1-A, extends 1.3 miles northwest of Monitor Point (the City of Clearlake boundary) about one mile, then is a narrow strip following the lake shore to Oak Cove. The SERWS consists of the raw sewage collection and pumping facilities within the service area, and the existing treatment and disposal facilities (the SERWTP) which are on a 485 acre site in Burns Valley north of the City of Clearlake, approximately half a mile west of Highway 53 and two miles south of Highway 20 (Figures 2.5.1-A, B, C, and D), in the northwest quarter of Section 15, Township 13 North, Range 7 West, Mount Diablo Base and Meridian.

The SERWTP has a nominal design capacity of 1.49 million gallons per day (mgd) and can handle peak flows up to 2.75 mgd. The treatment plant uses an oxidation ditch biological treatment system that discharges to a land disposal system consisting of a 561 acre-foot storage reservoir and a 244 acre spray irrigation field, as shown schematically in Figure 2.5.1-B. Treatment processes include grit removal, comminution, oxidation of organics via activated sludge in an oxidation ditch process, clarification of ditch effluent and return of activated sludge to the ditch via secondary clarifiers, and chlorine disinfection of effluent. A layout of the SERWTP site is shown in Figure 2.5.1-C and a flow schematic in Figure 2.5.1-D.

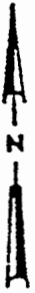
The facilities are operated under a Regional Board waste discharge permit which mandates that effluent be confined to the existing land disposal areas. Storage of effluent is necessary when irrigation cannot be practiced for disposal (generally November through April). The irrigated area is leased as pasture for non-milking cattle. Management of the irrigation is discussed in detail in the Facilities Plan. The irrigation system is not adequate to dispose of 100 percent of the volume requiring disposal (plant effluent plus precipitation less evaporation and percolation), when average annual flows exceed the rated disposal capacity of 0.84 mgd average annual flow by very much.





The recapture reservoir has a minimum capacity of 3.2 acre-feet, which may be increased to a maximum of 12.2 acre-feet by addition of removable bars when required.

Figure 2-5.1-B
Treatment Process Schematic



SCALE: 1"=1000'

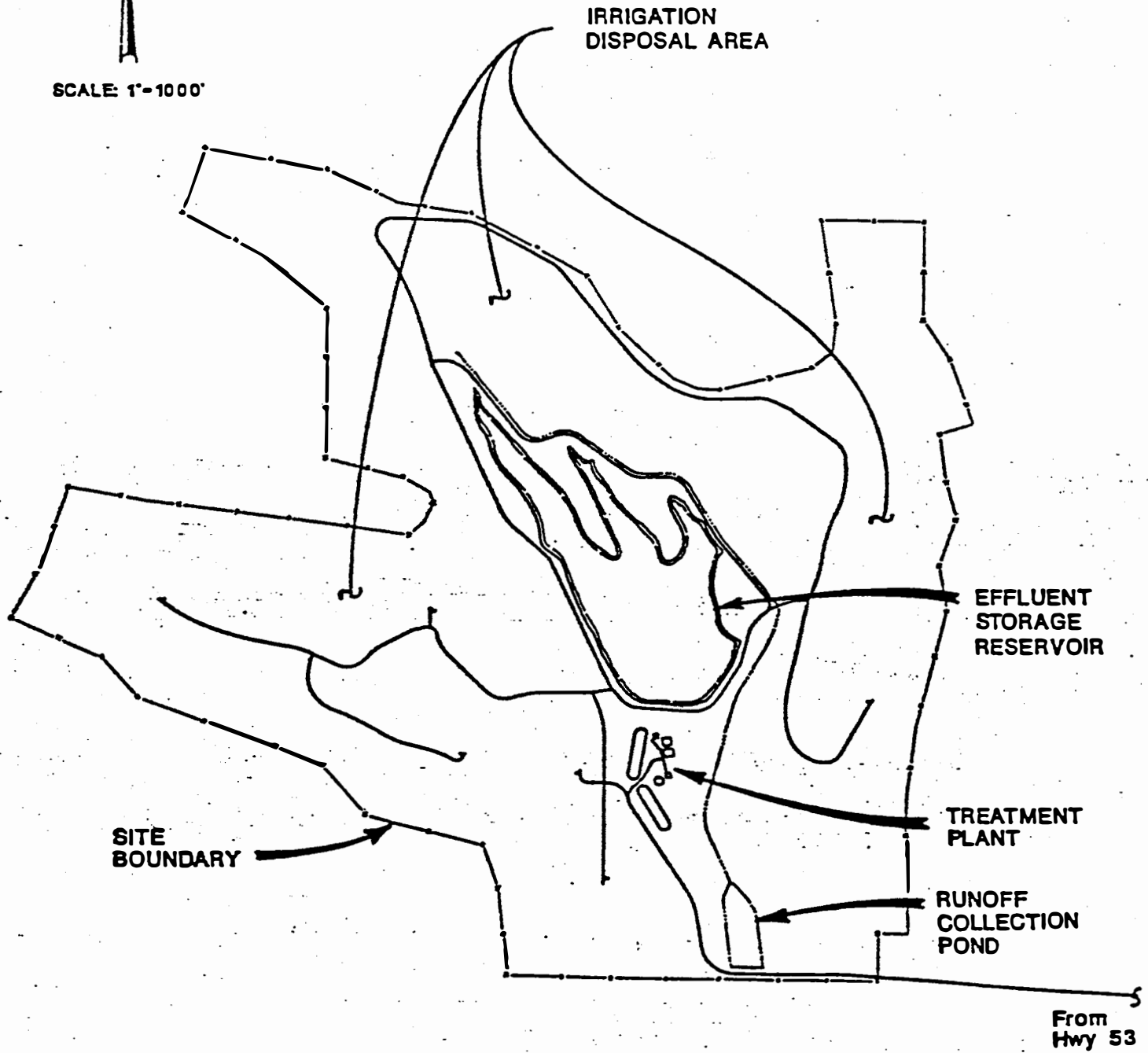


Figure 2-5.1-C
Existing SER WTP Layout

SOURCE: Dewante & Stowell Engineers (1991). Graphic as reproduced by Goddard & Goddard Engineering.

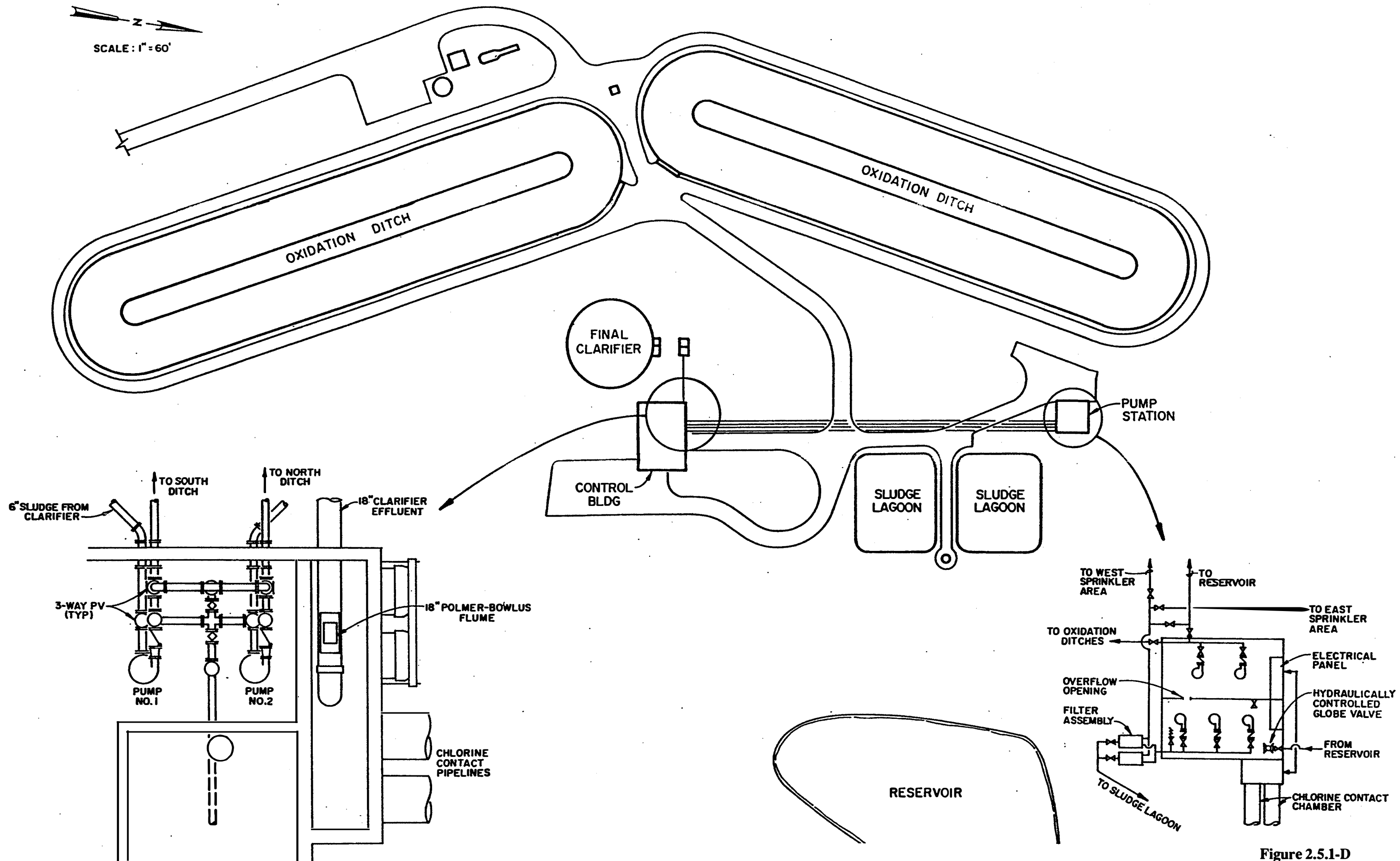


Figure 2.5.1-D
Existing SER WTP Facilities

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2.5 Southeast Regional Wastewater Treatment Facilities Plan Component

Construction of the facilities began in 1972 and they were operational in 1975. A major expansion was undertaken in 1980 when the reservoir dam was raised 8 feet and the irrigation area was increased by approximately 100 acres. Facilities consist of the following individual process components:

Raw Sewage Pumping (from
remote Pump Station No. 1)
Grit Removal
Screening and Comminution
Oxidation Ditch Aeration
Secondary Clarification
Return/Waste Sludge Pumping

Chlorine Disinfection
Process Pipework and Flow Control
Effluent Pumping
Reservoir Storage of Effluent
Pasture Irrigation Disposal
Waste Sludge Lagoons
Sludge Disposal on-site at SERWTP.

Process design data for the SERWTP are summarized in Table 2.5.1-1.

Wastewater solids (sludge) separated from the treatment process flow are pumped to two lined lagoons located east of the northerly oxidation ditch, which have sloped concrete walls and paved bottoms. Each has a design sludge depth of 4 feet and a volume of 96,000 gallons. An unlined emergency sludge lagoon was constructed by the District in 1984 just east of the concrete lagoons to eliminate a critical storage deficiency. The sludge thickens to about 4 percent solids, then it is sprayed onto plant area soils at about 2 to 3 tons/acre/year using a mobile transport vehicle.

Grease pits are used for storage of grease from the SERWS pipeline cleanings and from commercial grease trap pumps, for whom the SERWTP is the only disposal site in the Clear Lake area. Grease is handled separately from influent raw sewage because it has a tendency to foul oxidation ditch rotors, settle out in ditch basins or clog return motors. Grease pits are excavated with a backhoe and filled in and covered after the liquid fraction of the stored wastewater evaporates, percolates or is decanted to a low level. Until the planned improvements are implemented, the CRWQCB has mandated that the grease pit contents be sampled once a year and tested for metals and organic compounds. If the extractable concentrations approach designated levels, the contents will have to be removed and other facilities found for grease handling. Standing water must be kept to two feet or less and freeboard to one foot or more. Excess free liquid must be removed and introduced to the headworks of the plant. Characterization of the grease is discussed in Section 4.4.4.6.

TABLE 2.5.1-1

DESIGN CRITERIA FOR THE EXISTING SERWTP

WASTEWATER	Design Flow		1.49 mgd
	Peak Flow, Maximum Month		2.75 mgd
	Biochemical Oxygen Demand (BOD)		3,100 lbs/day
	Suspended Solids		3,650 lbs/day
GRIT REMOVAL	Basin Volume		1,100 cu.ft.
	Rated Capacity		2.9 mgd
COMMINUTOR	Channel Width		24 inches
	Capacity		2.75 mgd
OXIDATION DITCHES	Number		2
	Organic Loading		7.5 lbs BOD/1,000 cu.ft.
	Detention Time		24 hours
	Nominal Depth		5 feet
	Volume		1.55 m. gal. each
	Velocity		1.0 ft/sec. min.
	MLSS	Design	6,000 mg/l
		Operating Range	3,000 to 6,000 mg/l
	Rotors	Length	4 @ 20 feet
		Diameter	42 inches
		Submergence	4 to 11 3/4 in.
CLARIFIERS	Number		1
	Diameter		60 feet
	Depth		10 feet
	Solids Loading		35 lb/sf/day (a)
	Overflow rate, peak		970 gal/sf/day
RETURN/WASTE SLUDGE PUMP SYSTEM	Number of Pumps		2
	Pump Capacity, each		0.85 mgd
	Recycle Ratio	at average flow	0.6
		at peak flow	0.3
	Pipe Size		6 inch
FLOW MEASUREMENT	Influent		None
	Effluent	Type	Palmer Bowlus Flume
		Size	18 inches
DISINFECTION SYSTEM	Chlorination System	Chlorine Storage	Ton Containers
		Number of Chlorinators	2
		Maximum Feed	400 lbs Cl ² /day
	Contact Basin	Pipeline Size	Twin 42 inch
		Pipeline Length	255 feet
		Volume	4,900 cu.ft.
		Detention Time (Peak Flow)	19 minutes

TABLE 2.5.1-1 (cont.)

DESIGN CRITERIA FOR THE EXISTING SERVTP			
EFFLUENT PUMPS	Low Head-Reservoir	Number	2
		Capacity, each	1.15 mgd
		Motor Size	100 HP
STORAGE RESERVOIR	Volume		470 ac. ft.
IRRIGATION FIELD	Irrigation Area		244 acres
	Buffer Zone		200 feet
	Transmission Pipelines	10 inch (PVC, ACP)	13,000 feet
		12 inch (ACP)	6,200 feet
	Lateral Lines (PVC)		2 inch to 8 inch
			181
	Sprinkler Heads	9/16" - 66.5 gpm	118
		7/32" - 17.5 gpm	197
		5/32" - 4.5 gpm	884 ac.ft./yr
	Application	Annual	4,100 gpm
		Rate	

Note: MLSS = Mixed Liquor Suspended Solids

SOURCE: Dewante & Stowell (1991) as reproduced by Goddard & Goddard Engineering

2.0 Description of the Proposed Project

2.5 Southeast Regional Wastewater Treatment Facilities Plan Component

The SERWTP is operated by the Lake County Sanitation District (LACOSAN). On-site staff include a chief operator and three operators, and four maintenance personnel. Additional LACOSAN staff, having similar training, and working at two other LACOSAN facilities in Lake County, are available to perform tasks at the plant on scheduled and emergency bases. Testing is performed by operations personnel or commercial laboratories.

Costs for wastewater treatment and disposal alone exclusive of administration in fiscal year 1992/93 were approximately \$980 per million gallons based on an annual average flow of 1.3 mgd. Based on 6,880 residential connections, total system costs in 1992/93 averaged about \$165 per unit.

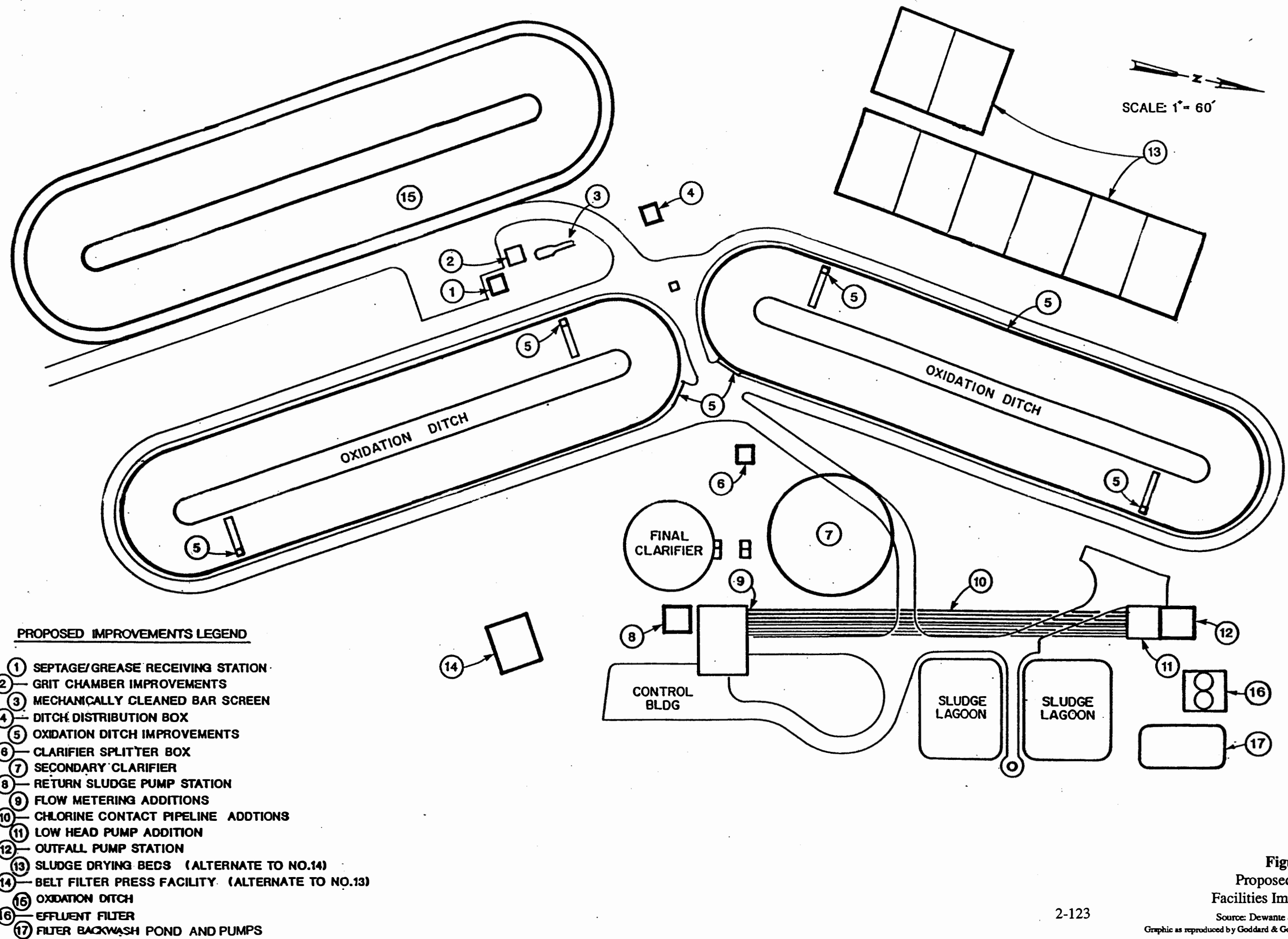
Wastewater system revenues are derived from connection fees, monthly service charges, interest on a capital expansion improvement fund, and lease payments for the cattle grazing operation. Generally, major capital improvements and facilities expansions are financed from the improvement fund, which receives revenue from connection fees. The treatment capacity improvements may have additional financing from assessment bonds and/or State Revolving Fund loan proceeds which would be paid back by LACOSAN from improvement funds, monthly service charges and connection fees.

2.5.2 PROPOSED FACILITIES PLAN AND WASTEWATER TREATMENT

The proposed project consists of capacity improvements to the SERWTP treatment facilities. Proposed treatment plant improvements are shown in Figure 2.5.2-A and listed in Table 2.5.2-1. Improvements are needed to eliminate current capacity and operational deficiencies and to create additional capacity to provide dependable secondary effluent.

Excavations will be as deep as 12 to 15 feet for the construction of the treatment facilities.

Upon completion, the proposed project facilities will provide for effective compliance with regulatory requirements in a dependable and reliable manner. Under normal conditions, the oxidation ditch process would be operated on a continuous year-round basis to produce a high quality secondary effluent with BOD and suspended solids concentrations expected in the 10 to 20 mg/l range. Average annual effluent flow is expected to increase from a current level of about 1.3 to 1.4 mgd up to about 2.5 mgd in 2021. Average wet weather season (December through



2.0 Description of the Proposed Project

2.5 Southeast Regional Wastewater Treatment Facilities Plan Component

April) flows under 1 in 100 year return conditions are expected to increase from the current 2.5 mgd up to about 3.4 mgd in 2021.

Under conditions that could adversely impact The Geysers, all plant effluent would be directed to the storage reservoir for retention. At such time as normal satisfactory operating and performance conditions are assured, disposal in The Geysers would be resumed. Management of reservoir water level by LACOSAN operating personnel would ensure the availability of adequate storage for such circumstances.

2.6 PROJECT ABANDONMENT AND REUSE

The project is expected to have a minimum 25-year life based on the length of the project operating agreement negotiated by LACOSAN and steam suppliers. At the conclusion of 25 years, one of three actions may occur: 1) the operating agreement is extended and the project continues to function unchanged for several additional years; 2) project operations are terminated and certain facilities are abandoned; or 3) the project is adapted and reused for another purpose, e.g. piping of wastewater effluent to a new type of end-use.

In the event of project termination, the SERWTP would convert to an alternative method of effluent disposal, and some or all of the main pipeline and its ancillary pump stations and tanks would be abandoned. Any abandoned pipeline segment would consist of the pipeline being abandoned in place, with plugging and/or sealing of access points in accordance with applicable regulations. Abandoned pump stations and tanks would have major pieces of equipment removed for salvage purposes, demolition of structures, and restoration of property in accordance with County land-use regulations and the desires of private landowners.

In the event of project reuse, such proposed adaptation of project facilities for a new use would be subject to another full environmental review under CEQA and/or NEPA.

2.7 PROJECT ECONOMICS AND FINANCING

Total cost estimates for construction of the Project are approximately \$39 million (Eco:Logic and Veizades & Associates, 1994). Of these, approximately \$8 million would be for the SERWTP facilities improvements. The remainder would be costs for construction of the Geysers Effluent Pipeline, Lake Diversion Pipeline, Pump Stations and other related facilities. The figures do not include costs for construction of the secondary injection fluid distribution lines which would be paid for by Calpine, Unocal and NCPA.

Funding for construction of the project would be obtained from the following sources:

Committed funds would be made available by the U.S. Department of Energy, the California Energy Commission, the U.S. Department of the Interior/BLM and U.S. Minerals Management Service (through royalty rate reduction), and by the project sponsors including LACOSAN, NCPA, Calpine, Unocal and PG&E. Additional funding sources (as yet not committed) may include the U.S. Environmental Protection Agency, the U.S. Department of Agriculture Rural Development Administration, the Department of Commerce Economic Development Administration, the California Water Resources Control Board (SRF funds), and others as made available.

Main pipeline operation and maintenance expenses will be about \$3 million annually. Under a draft flexible operating agreement, about 90 percent of these expenses will be shared by the Geysers operators and 10 percent by LACOSAN. The additional cost of the treatment and disposal facilities for LACOSAN will be about \$450,000 annually, with all costs paid by LACOSAN through collection of effluent purchase charges, sewer connection fees and monthly service charges.

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3.0 DESCRIPTION OF ALTERNATIVES TO THE PROPOSED PROJECT

3.1 ALTERNATIVES TO THE PROPOSED PROJECT

LACOSAN and the BLM can take one of three basic actions with regard to the application for the proposed project. (1) The proposed project can be approved with conditions, some of which would be mitigation measures presented in this EIR/EIS. (2) The application for the proposed project can be denied without further recommendation or postponed indefinitely. That decision, in effect, would establish the No Action/No Project Alternative as the selected course of action with respect to the objectives of the project. (3) The application for the proposed project can be amended to include approved design alternatives to those proposed as part of the project. This section of the EIR/EIS (3.1) describes the No Action and the Design Alternatives which are evaluated in this EIR/EIS. Other alternatives which were considered are described (Section 3.2) and compared with the proposed action in Table 3.2-7.

3.1.1 NO ACTION/NO PROJECT ALTERNATIVE

The No Action/No Project Alternative is the condition which would apply if the project or the design alternative were not constructed. The Alternative does not include any new facilities, operations or activities that are related to the objectives of the proposed project. Instead, the No Action/No Project Alternative presents a scenario of conditions which would exist if the project or the design alternatives were not constructed.

Under the No Action Alternative, there would be no new facilities constructed at the SERWTP or MWTP. No pipeline would be constructed to carry effluent to the Geysers. No pipeline would be constructed to divert water from Clear Lake to the SERWTP. None of the proposed facilities supporting the pipelines (as described in Section 2) would be constructed including all pump stations, the Childers Peak and Terminus Tanks, the new road connecting the Bear Canyon Access Road and the M-Pad, new injection fluid distribution lines and well-heads in the Geysers, power lines, and telecommunications facilities. No construction activities related to any of the preceding facilities would occur. No injection of effluent into the Geysers steam field would occur and there would be no related power generation. There would be no environmental impacts related to facilities construction, operation or abandonment.

3.0 Description of Alternatives to the Proposed Project

3.1 Alternatives to the Proposed Project

None of the project objectives presented in Section 2.2 would be realized under the No Action Alternative. Under the No Action Alternative, the conditions which led to proposing the project at this time would continue to exist. These are described below.

The requirements of the regulatory agencies to correct wastewater problems at the SERWTP would not be met. The existing Cease and Desist Order from the California Regional Water Quality Control Board (CRWQCB) would be violated, as deficiencies in the existing SERWTP would not be corrected. Continued repeated violations of CRWQCB Waste Discharge Requirements would occur in relation both to treatment performance and overflows related to deficiencies in storage capacity and discharge. Raw wastewater could overflow manholes in local streets because of surcharging of the sewer pipes during wet weather. During maximum flow conditions, some sewers could back up temporarily, causing stopped or slow flow of toilets and drains. Wet weather conditions would result in untreated wastewater overflows to Burns Valley Creek and eventually into Clear Lake and Cache Creek.

The implications of non-compliance include financial penalties to LACOSAN (with fines possibly as high as \$10,000 per day) and possible prosecution for criminal negligence. Assuming the fees to cover the cost of fines alone, the rates charged to existing users would be increased by as much as \$0.53 per day per person for violations which were fined the maximum allowable amount. Assuming 60 days of violation per year in 1994, this could total up to \$40 per month per household (Goddard and Goddard, 1991).

The No Action/No Project Alternative also would result in a continuation of a moratorium on new connections to the sewer system. Under the No Action/No Project Alternative, further growth would be prohibited in LACOSAN's SERWTP service area, including the City of Clearlake, the Lower Lake area and all other areas in the district.

Under the Alternative, continued declines in steam pressure in the southeast Geysers would be anticipated (see Section 6.2.12 for details). This, in turn, would result in continued decline in power production at The Geysers.

3.1.2 PROJECT DESIGN ALTERNATIVES

The Project Design Alternatives include an assortment of engineering design and pipeline local route variations from those included in the proposed project. As these are all sub-components of

3.0 Description of Alternatives to the Proposed Project

3.1 Alternatives to the Proposed Project

the overall Geysers Effluent Pipeline, they do not individually or collectively represent a complete alternative to the proposed project. If approved, individually or collectively, the Project Design Alternatives would be an amendment to the proposed project design.

The Project Design Alternatives include two types: alternative facilities designs and alternative routes for some pipeline segments. Each is described below.

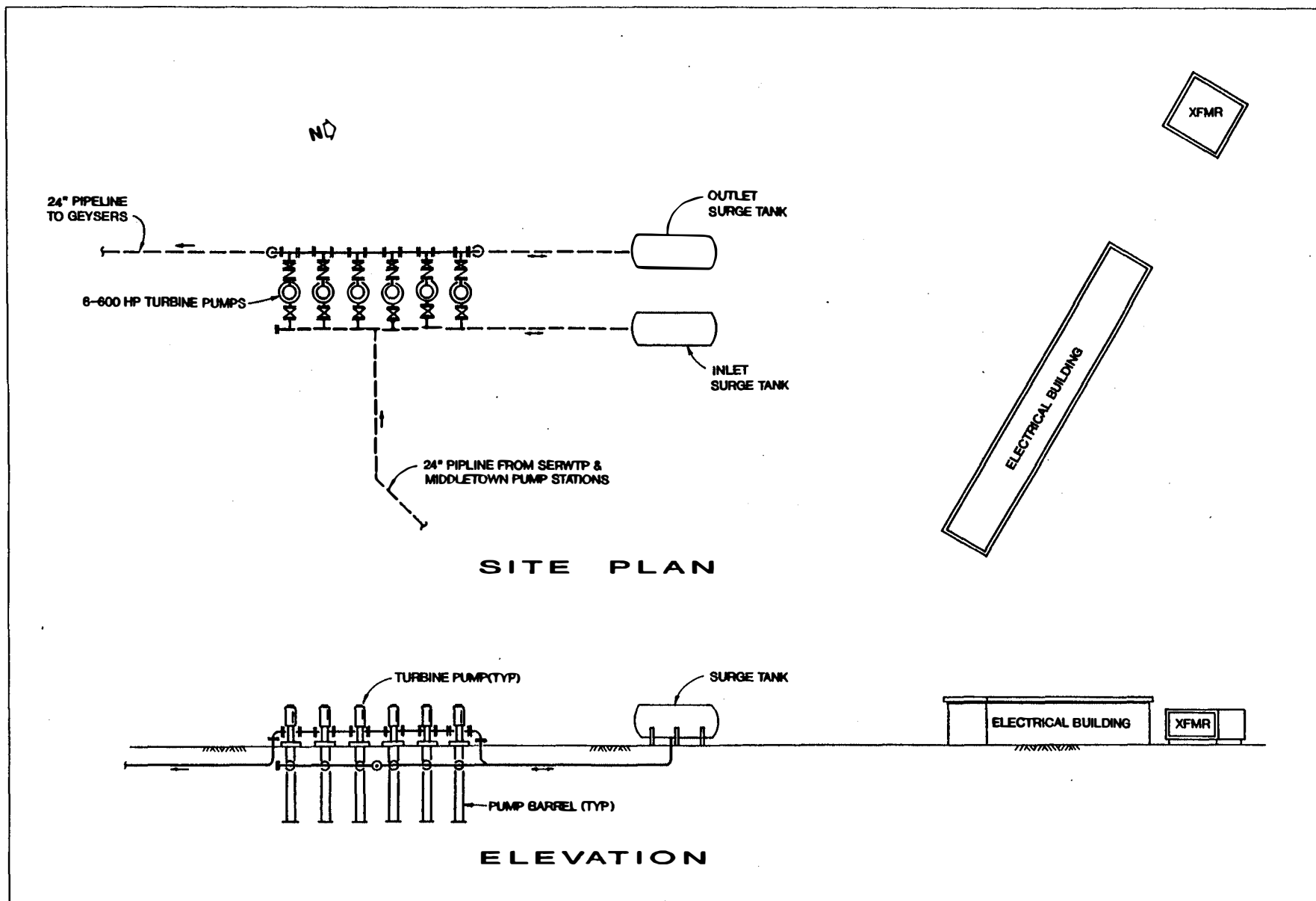
3.1.2.1 ALTERNATIVE FACILITY DESIGNS

Lake Diversion Pumps and Pipeline on Pier

Under this alternative facility design, the pumps and pipeline to the lake shore would be located on a pier constructed approximately 300 feet horizontally into Clear Lake. The location would be the same as that for the proposed project (for which the pipeline would be under water and the pumps located in a building on the shore - see Section 2.3.2.2). Three vertical turbine pumps, similar to those of the proposed project, would be located at the end of the pier directly over the intake, which would be located at a depth of approximately 30 feet at elevation 1,295 msl (the same as the proposed project). The pumps, motor control center, air compressor, and air receiver would be housed in a small, sound-proof garage-like structure on the pier. The surge arrestor would be situated on the shoreline as in the proposed plan. Water pumped from depth in the lake would be directed into a 24-inch pipeline that would be located on the pier to the lake shore, at which point it would pass underground as with the proposed design.

Bear Canyon Single Pump Station

A single pump station is an alternative design concept to the proposed use of five separated pump stations to lift the effluent up to The Geysers after leaving the MWTP (see Section 2.3.3.5). The single pump station would be located at the Bear Canyon Access Road/Highway 175 intersection in an area currently used for vehicle parking and open space. The site is located south of the highway within the gated area at the base of the Bear Canyon Access Road. A total dynamic head of about 1,800 feet is needed to convey the effluent to The Geysers. Up to six vertical turbine pumps, each with an output capacity of 900 gpm and with 600 horsepower motors would operate 24-hours per day (Figure 3.1.2-A). A seventh pump possibly could be installed to serve as a back-up pump to the operating pumps. Ancillary facilities at the pump station would include electrical facilities housed in a single building, an electric power feed transformer, a nominal



SOURCE: Dewante and Stowell Engineers

Southeast Geysers Effluent / 920586 ■

Figure 3.1.2-A
 Bear Canyon Pump Station Alternative
 Design Plan and Elevation

3.0 Description of Alternatives to the Proposed Project

3.1 Alternatives to the Proposed Project

1,6500 cubic foot hydropneumatic air chamber on the suction side of the pump station, a nominal 600-cubic foot hydropneumatic air chamber on the discharge side of the pump station (Figure 3.1.2-B). The pumps would be located outdoors. The electrical facilities would be housed in industrial type buildings. The entire site would occupy approximately 0.4 acres and would be entirely fenced (chain link-type). The site is flat and would require minimal grading.

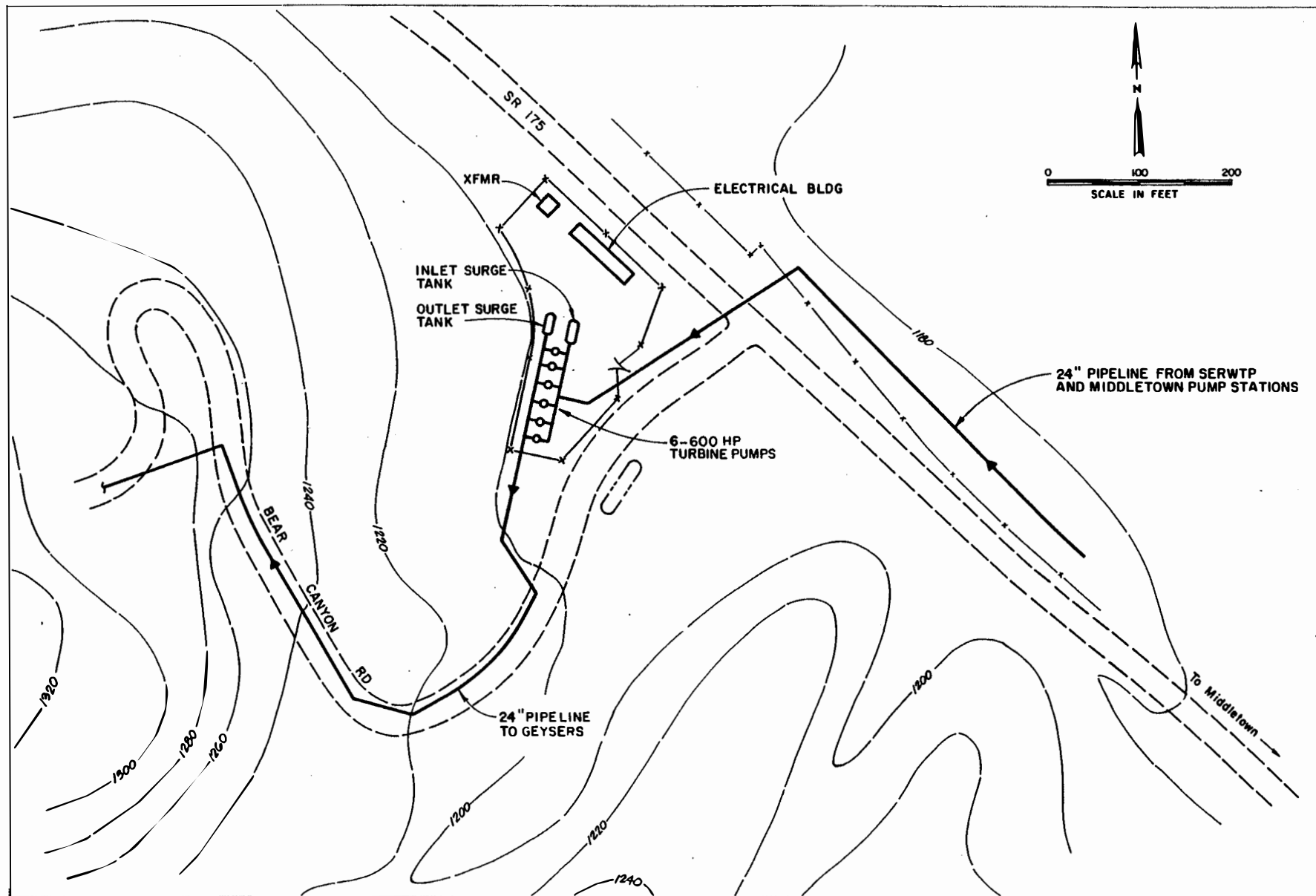
One-Way Surge Tank in The Geysers

Associated with the single Bear Canyon Pump Station described above is the need for a surge tank on the Geysers Effluent Pipeline at the high point of the pipeline in The Geysers. This would be a one-way surge tank to prevent the potential for destructive down-surge conditions caused by an instantaneous pump shutoff. The volume of the tank would be determined during detail design; at this time, it is estimated to be no greater than 50,000 gallons. The steel tank would be exposed to the atmosphere at the top (Figure 3.1.2-C). A float valve would monitor fluid height to ensure a constantly full tank. Upon excessive down-surge in the Geysers Effluent Pipeline, the tank contents would drain through a check valve to fill the line and prevent a separation of the water column that could be highly destructive to the pumps. The tank would be located on an existing pad occupied partly by a fire control water storage tank near the NCPA Plant 2 (see Figure 2.1.3-D). The proposed tank would be constructed immediately adjacent to that fire control tank. It would be constructed entirely above-ground. The tank would be up to 20 feet high and 25 feet in diameter.

Under the proposed project design, the one-way surge tank would not be needed.

Lake Diversion By-Pass Pipeline at the SERWTP

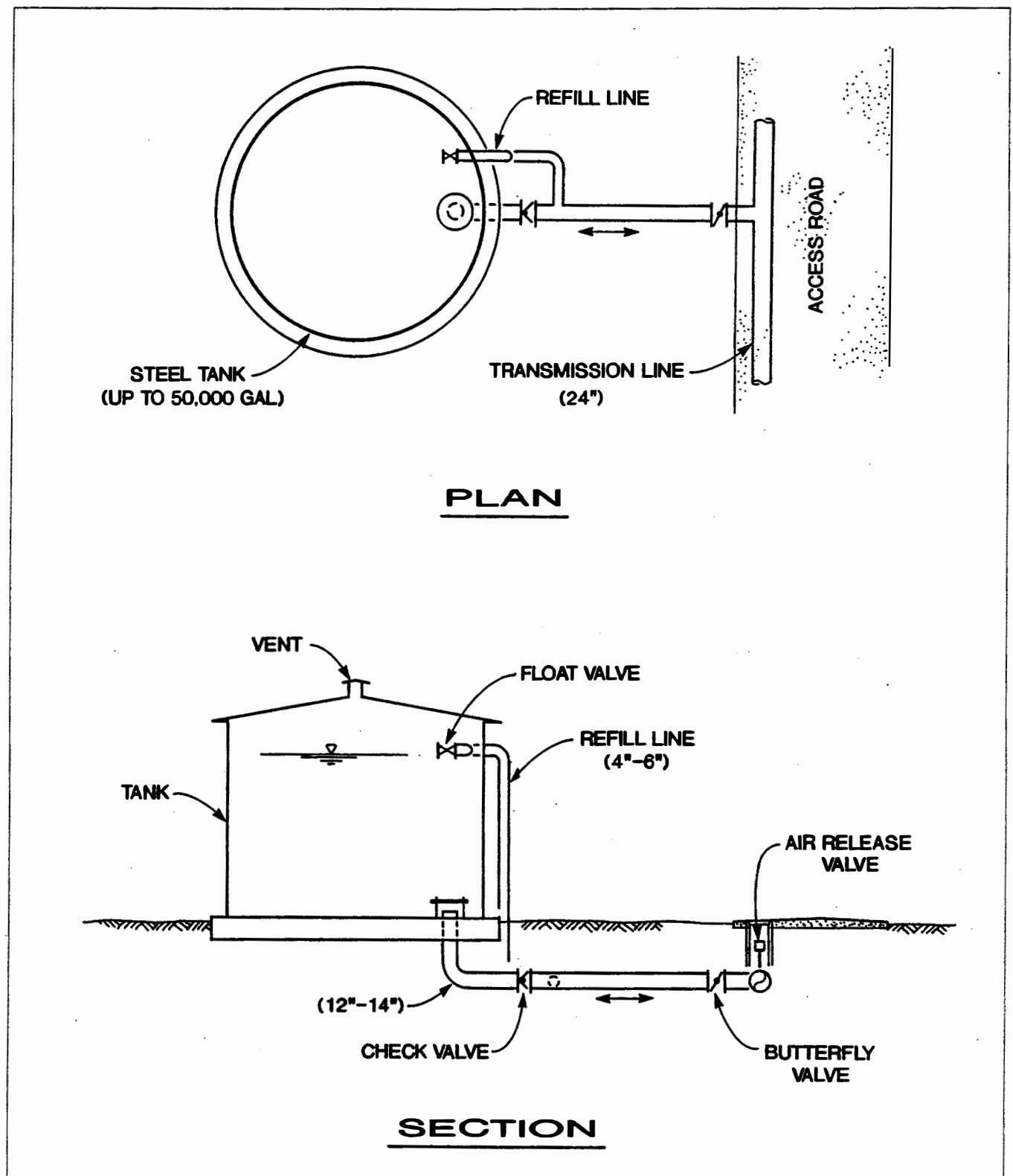
As an alternative to discharging diverted lake water into the SERWTP reservoir, a pipeline would be constructed between the point where the lake diversion pipeline enters the SERWTP and the pumps for the Geysers Effluent Pipeline. This would be a 24-inch pipeline constructed entirely within the SERWTP (Figure 3.1.2-D). This alternative would directly convey the diverted lake water to the Geysers Effluent Pipeline instead of conveying it to the reservoir. Mixing of the lake water and the SERWTP effluent would occur at a junction point at the suction side of the pumps at the SERWTP instead of mixing in the reservoir. Under this alternative, the existing 18-inch reservoir outlet pipe drawing water from the reservoir would not need to be modified or supplemented with an additional pipe to the SERWTP pumps.



SOURCE: Dewante and Stowell Engineers

Southeast Geysers Effluent / 920586 ■

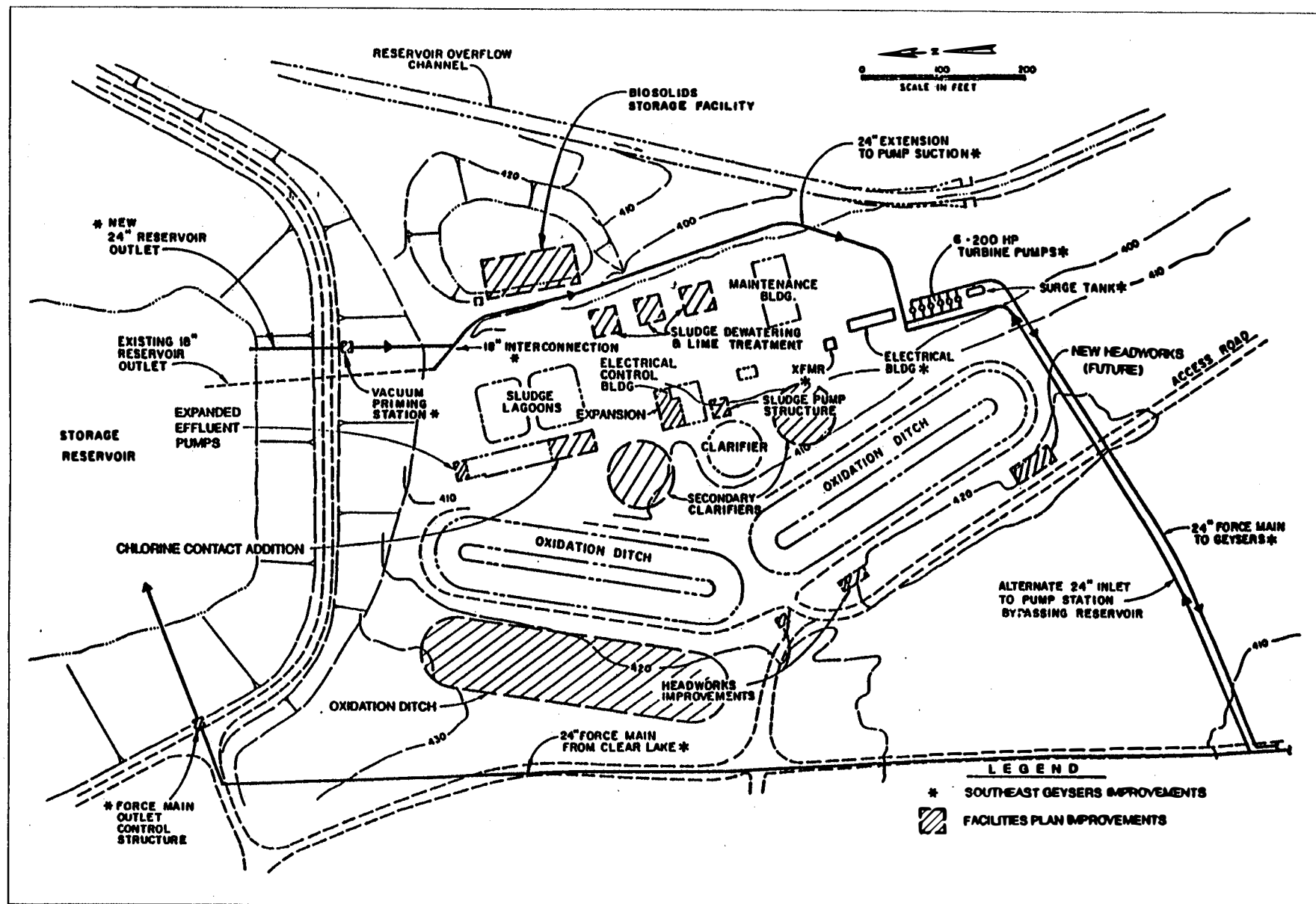
Figure 3.1.2-B
Bear Canyon Pump Station Alternative Site Plan



SOURCE: Dewante and Stowell Engineers

Southeast Geysers Effluent / 920586 ■

Figure 3.1.2-C
Proposed One Way Surge Tank
for Alternative Plan



SOURCE: Dewante & Stowell Engineers

Southeast Geysers Effluent 1920586 ■

Figure 3.1.2-D
 Proposed Optional Configuration With Bypass
 Lake Diversion to the SERWTP Pump Station

3.0 Description of Alternatives to the Proposed Project

3.1 Alternatives to the Proposed Project

3.1.2.2 ALTERNATIVE ROUTES FOR PIPELINE SEGMENTS

This section describes alternative routes that were evaluated in this EIR/EIS for specific segments of the Geysers Effluent Pipeline and the Childers Peak Regulating Tank. These alternatives were proposed because of engineering design considerations and flexibility in final site selection. Each route segment is identified below including the station post (referenced to the proposed route).

These alternatives do not include overall route alternatives for the Geysers Effluent Pipeline which were evaluated early in the planning process and rejected (see Section 3.2).

Alternate Route A-1 (station 23.3 - 24.5)

Where the pipeline route is located a little downhill of the end of Boyles Drive in Clearlake, the proposed route encounters the rear fence of an existing residence (see Figure 2.1.3-B). This alternative is proposed in order to avoid placement of the pipeline in an existing private driveway. Under this alternative, the pipeline route would make a left turn and run approximately 75 feet to the east, then turn right heading straight down hill. The route is a brush-covered hill slope with scattered trees. The route would run down to Dam Road, where it would make a right turn, running in the road westward to rejoin the proposed route just east of the bridge. This alternative would be about 1,000 feet long. It would add about 400 feet to the proposed route.

Alternate Route A-2 (station 23.3 - 24.5)

This alternate route is a variation similar to Alternate A-1. At the rear fence of the residence identified above, the pipeline route would make a left turn and run approximately 100 feet to the east, then turn right heading straight down hill (see Figure 2.1.3-B). This alternative is proposed in order to avoid placement of the pipeline in a private driveway. The route follows a cleared path through the brush-covered hill slope with scattered trees. The route would run down to Dam Road, where it would make a right turn, running in the road westward to rejoin the proposed route just east of the bridge. This alternative would be about 1,050 feet long. It would add about 450 feet to the proposed route.

3.0 Description of Alternatives to the Proposed Project
3.1 Alternatives to the Proposed Project

Alternate Route B. Crossing of Clayton Creek (station 38.8 - 39.1)

As an alternative to crossing Clayton Creek on the bridge, just upstream of the bridge the route would turn left (eastward), spanning the deeply incised channel and crossing the large meander loop of Clayton Creek located above the bridge. The pipeline would enter onto the opposite bank in a flat open field just north of the bridge. The route would re-enter the proposed route just east of the bridge. This alternative route is proposed because of the possible limitations of construction on the bridge (that is, future bridge widening would be limited by the pipeline). This alternative would be about 250 feet long. It would reduce the proposed route by approximately 100 feet.

Alternate Route C. Crossing of Highway 29 (station 53.0 - 53.3)

At this location, the proposed pipeline route would head south on the west side of the highway. Instead of making the Highway 29 crossing at the site of an existing fruit/vegetable stand, the route would continue on the west side of the highway about another 150 feet to the south. This route would be taken to avoid damage to some large trees on the east side of the highway. The pipeline would make a sharp left turn, directly crossing Highway 29 in an easterly direction and joining the proposed route on the east side of Highway 29 at the fence line. From that location, the route rejoins the proposed pipeline route. The alternate is neither shorter or longer than the proposed route.

Alternate Route D (station 74.5 - 75.5)

In this portion of the pipeline route, the proposed alignment would be in an existing dirt road leading down from Childers Peak saddle. From 74.5 to 75.5 the route would leave the road and continue straight ahead on a southerly course along an old trail. The trail is steep with deep gullies. Farther downhill, the route would rejoin the proposed route located in the dirt road. This alternative is proposed in order to reduce the length of the pipeline. This alternative would be about 500 feet long and would reduce the length of the pipeline by about 250 feet by avoiding the longer turn that the existing road takes.

Alternate Route E (station 97.0 - 98.5)

At 97.0, the proposed route would leave the west side of Big Canyon Road and go westerly across the northern edge of a pasture, continuing westerly until it intersects the Harbin Springs

3.0 Description of Alternatives to the Proposed Project

3.1 Alternatives to the Proposed Project

Road. As an alternate to this route, the pipeline would continue southerly in the Big Canyon Road to its intersection with Harbin Springs Road. At that intersection, the pipeline would sharply bend back northwesterly in Harbin Springs Road. The road would continue in that road to the point where it intersects the proposed alignment, turning left (westerly) into the adjacent field. This route is proposed in order to reduce the need for easement acquisition. This alternative would be about 2,000 feet long. It would about 900 feet longer than the proposed route, but would be entirely located within or in the shoulder of public roads.

Alternate Route F (station 121.0 - 124.0)

At 121.0 the proposed route leaves the Bear Canyon Access Road to follow in a new road connecting to the NCPA M-Pad. Under this alternative, the pipeline would continue in the Bear Canyon Access Road to the Bear Canyon Power Plant pad. At the pad, the pipeline would cross the unnamed creek in the fill above the culvert, then trend uphill along the eastern edge of the large cut behind the power plant. Upon reaching the top of the cut, the route would bend southerly and trend uphill to the M-Pad. In that segment the route would be located overland in a predominantly brush-covered slope with scattered trees. The pipeline would be buried under shallow soil, but there would be no adjacent access road. Upon reaching the nose of the M-Pad, the pipeline would continue southerly to the upper end of the pad. A tap valve would be constructed in the pipeline at the M-Pad. At 124.0, the pipeline would continue in the same alignment as the proposed route to The Geysers. The overall length of this alternative route would be approximately 5,000 feet; of this about 2,000 feet would be the overland segment. This alternative would be about 2,700 feet longer than the proposed route, but it would require substantially less grading. Under this alternative, a pump station would be constructed on the M-Pad (instead of Pump Station BC-3). This route was the alignment originally proposed by the project engineers. It was believed to be less costly to construct and less disruptive of the environment than the proposed alignment.

Alternate Distribution Pipeline Route G (station 138.5 - 139.5)

At about 138.5, approximately 400 feet south of the NCPA gate, the 16-inch diameter pipeline would leave the road, instead following the more westerly direction taken by a steam collection line. This line is in a cleared area, going over a low hill and along the existing cleared NCPA C-Pad. The pipeline would follow along the southern edge of the pad to its western side, then head northerly in a cleared area used for access that ends in the main road on the Calpine leasehold. It would cross the road approximately directly south of the cleared pit area. At that point, the line

3.0 Description of Alternatives to the Proposed Project

3.1 Alternatives to the Proposed Project

would connect into the proposed 600 gpm pipeline to well CA 956-2. At that point also, the line would convey the flow easterly in the proposed 1,200 gpm pipeline to the CA 958-5 and McKinley 4 proposed injection wells. This alternate route was proposed in order to avoid construction disturbance in the road at the busy NCPA gate.

Alternate Site for Childers Peak Regulating Tank

The Childers Peak Regulating Tank would be located at the high point of the Geysers Effluent Pipeline between the SERWTP and the MWTP. The proposed tank site would be located in an open area along the west side of the saddle in the Big Canyon Creek watershed. The alternate site would place the tank more to the east of the saddle. The same design of the tank would be used. To accommodate the tank at the alternate site, a cut would be made into the hillside. This likely would be a fairly substantial cut with 1.5 to 1 (horizontal to vertical) slope and up to 10 feet high. The engineering advantage of this location would be its more direct tie-in to the pipeline where it ascends Sweet Springs Canyon.

3.2 ALTERNATIVES CONSIDERED IN THE SERWTP FACILITIES PLAN

As part of the planning studies conducted in 1991, a number of alternative improvement plans were analyzed for the disposal of treated wastewater from the SERWTP under the Facilities Plan. These alternatives are summarized in Table 3.2-1 and shown in Figure 3.2-A. In this section, each of the project alternatives is discussed in detail. They were then ranked according to each of the environmental issues. Alternative G, disposal in The Geysers, was given to preliminary evaluation in 1991, but was not selected as the preferred method of effluent disposal. The chosen method of disposal was a discharge into Cache Creek (Alternative B2), and that method was included in the part of the proposed project in the 1991 Draft EIR on the SERWS Improvement Facilities Plan. Following a high level of concern expressed by Yolo County, the Cache Creek disposal option was replaced by The Geysers disposal plan as the proposed project evaluated in the current EIR/EIS. The following section, with minor revisions and updated information is taken from the 1991 Draft EIR on the SERWS Improvement Facilities Plan (Goddard & Goddard, 1991).

3.2.1 ALTERNATIVE A: NEW STORAGE RESERVOIR AND EXPANDED LAND DISPOSAL

Alternative plan "A" identified in the Facilities Plan involves expansion of the existing treatment facilities, addition of a new storage reservoir, and discharge of treated effluent to an expanded land (irrigation) disposal system, including a new 700-800 acre disposal area on both sides of State Route 53 between the existing site and Ogelene Canyon.

The SERWTP currently provides for 100 percent containment of all waste flows on land during dry years. The effluent storage capacity of the existing on-site earthen reservoir is 561 acre-feet (about 176 million gallons) and the existing land disposal area used for seasonal spray irrigation is 244 acres.

Analysis of the flow-based capacity of the existing storage and disposal facilities and determination of required sizing of additional storage reservoir(s) and disposal areas was undertaken as part of the Facilities Plan. A water balance was calculated using a month-by-month accounting of all inflows and outflows from the wastewater treatment and disposal system for an entire year. Inflows into the system include wastewater flows through the treatment facility plus precipitation collected in the storage reservoir. Outflows include

TABLE 3.2-1

PROJECT ALTERNATIVES IDENTIFIED IN THE FACILITIES PLAN

- A** Expand existing treatment; add new storage reservoir; discharge treated effluent to expanded land (irrigation) disposal system, including new 700-800 acre disposal area on both sides of State Route 53 between existing site and Ogelene Canyon.
- B1** Expand existing treatment facilities and add effluent filtration; store and dispose of as much unfiltered effluent as deemed possible via existing on-site irrigation system; dispose of remaining effluent after filtration to an unnamed tributary of Cache Creek. When flows in Cache Creek would provide less than 20:1 dilution of the effluent, the effluent would receive advanced secondary treatment. ⁽¹⁾
- B2** Expand existing treatment facilities and add effluent filtration; store and dispose of as much unfiltered effluent as deemed possible via existing on-site irrigation system; dispose of remaining effluent after filtration to Cache Creek near Peachtree Crossing. When flows in Cache Creek would provide less than 20:1 dilution of the effluent, the effluent would receive advanced secondary treatment. ⁽¹⁾
- C** Expand existing treatment; add full Title 22 tertiary treatment; discharge to the North Fork of Cache Creek year-round, managed to maintain capacity in reservoir/irrigation disposal system sufficient for maximum expected flows.
- D** Expand existing treatment; add full Title 22 tertiary treatment; discharge to Clear Lake year-round, managed to maintain capacity in reservoir/irrigation disposal system sufficient for maximum expected flows.
- E** Expand existing treatment; discharge to Borax Lake year-round, managed to maintain capacity in reservoir/irrigation disposal system sufficient for maximum expected flows.
- F1** Expand existing treatment; discharge to the retrofitted existing Audrey A-No.1 geothermal well year-round, managed to maintain capacity in reservoir/irrigation disposal system sufficient for maximum expected flows.
- F2** Expand existing treatment; discharge to the retrofitted existing Borax Lake geothermal well year-round, managed to maintain capacity in reservoir/irrigation disposal system sufficient for maximum expected flows.
- F3** Expand existing treatment; discharge secondary effluent year-round to a new deep injection well on the SERWTP site, managed to maintain capacity in reservoir/irrigation disposal system sufficient for maximum expected flows.
- G** Expand existing treatment facilities; discharge 2.9 mgd effluent year-round through a pipeline to The Geysers geothermal area near Middletown for deep subsurface geothermal resource replenishment.

Note:

- (1)** Advanced secondary treatment would, as a minimum, consist of coagulation-aided filtration, followed by disinfection and dechlorination.

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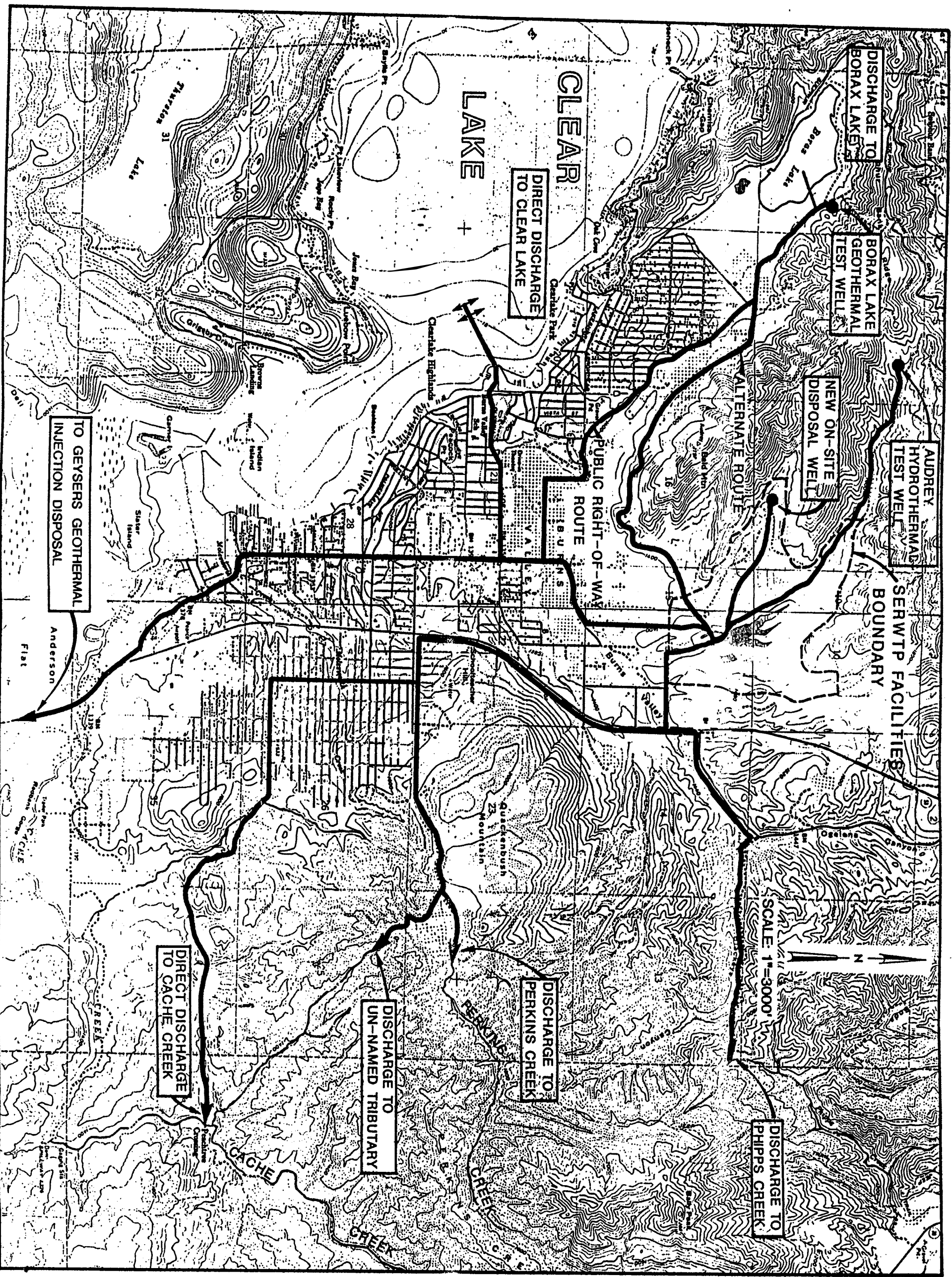


Figure 3.2-A
Project Alternatives

SOURCE: Dewane & Stowell Engineers
(1991). Graphic as reproduced by
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3.0 Description of Alternatives to the Proposed Project

3.2 SERWTP Facilities Plan Alternatives

evaporation from the water surface of the storage reservoir, percolation out of the bottom of the reservoir, evapotranspiration (irrigation) in the disposal area, and discharge flows if any.

The relative magnitude of the various inflow and outflow components varies from month to month throughout the year, and from year to year depending upon weather conditions. The most critical conditions for the wastewater management system occur in years when rainfall totals are greatly in excess of average. In recognition of this concern, it is considered reasonable that the wastewater management systems should be designed to operate without overflow or direct discharge of wastewater outside the dedicated disposal area when wet weather conditions, as measured by annual rainfall, are at levels that are equaled or exceeded only once every 100 years. This criterion is a requirement of the project imposed by the CRWQCB.

Wastewater inflow quantities developed for preliminary design estimates are summarized in Table 3.2-2.

All precipitation that falls within the watershed area of the existing storage reservoir is assumed to be accumulated and must be disposed of as wastewater inflow into the treatment system. Precipitation data were collected at the SERWTP from 1981 to 1989 and used to estimate inputs on a month-by-month basis in wet years. Each of the monthly normals is multiplied by a factor of 1.44 for 1 in 10 year occurrence and 1.85 for a 1 in 100 year occurrence. This factor is the ratio of total annual precipitation for the Southeast Clear Lake area in a 1-in-10 year occurrence to normal annual precipitation. It was assumed that any future storage reservoir would have surface area versus volume characteristics similar to the existing reservoir and would have a percolation rate of 0.4 inches per day. Using these parameters, the computed storage volume and disposal area requirements for an expanded reservoir and land disposal system were calculated to be as shown in Table 3.2-3.

Storage Reservoir Analysis

Potential treated wastewater storage sites were analyzed, including a geotechnical analysis conducted by Kleinfelder & Associates in 1986. Sites were evaluated for their suitability on the basis of storage capacity, embankment stability, soil suitability, availability of access roads and fill material and seismic stability. The presence of fault traces was identified by photographic techniques and previous field work. Further investigation of the faults would be required for any sites under serious consideration. The sites and fault traces are shown in Figure 3.2-B.

TABLE 3.2-2

WASTEWATER INFLOW QUANTITIES

		Average Wastewater Influent Flow (mgd) Under the Given Precipitation Conditions		
<u>Design Horizon</u>		<u>Normal</u>	<u>1 in 10 yr</u>	<u>1 in 100 yr</u>
1994				
	May-October	1.33	1.33	1.33
	November-April	2.00	2.90	3.80
2000				
	May-October	1.73	1.73	1.73
	November-April	2.60	3.70	3.90

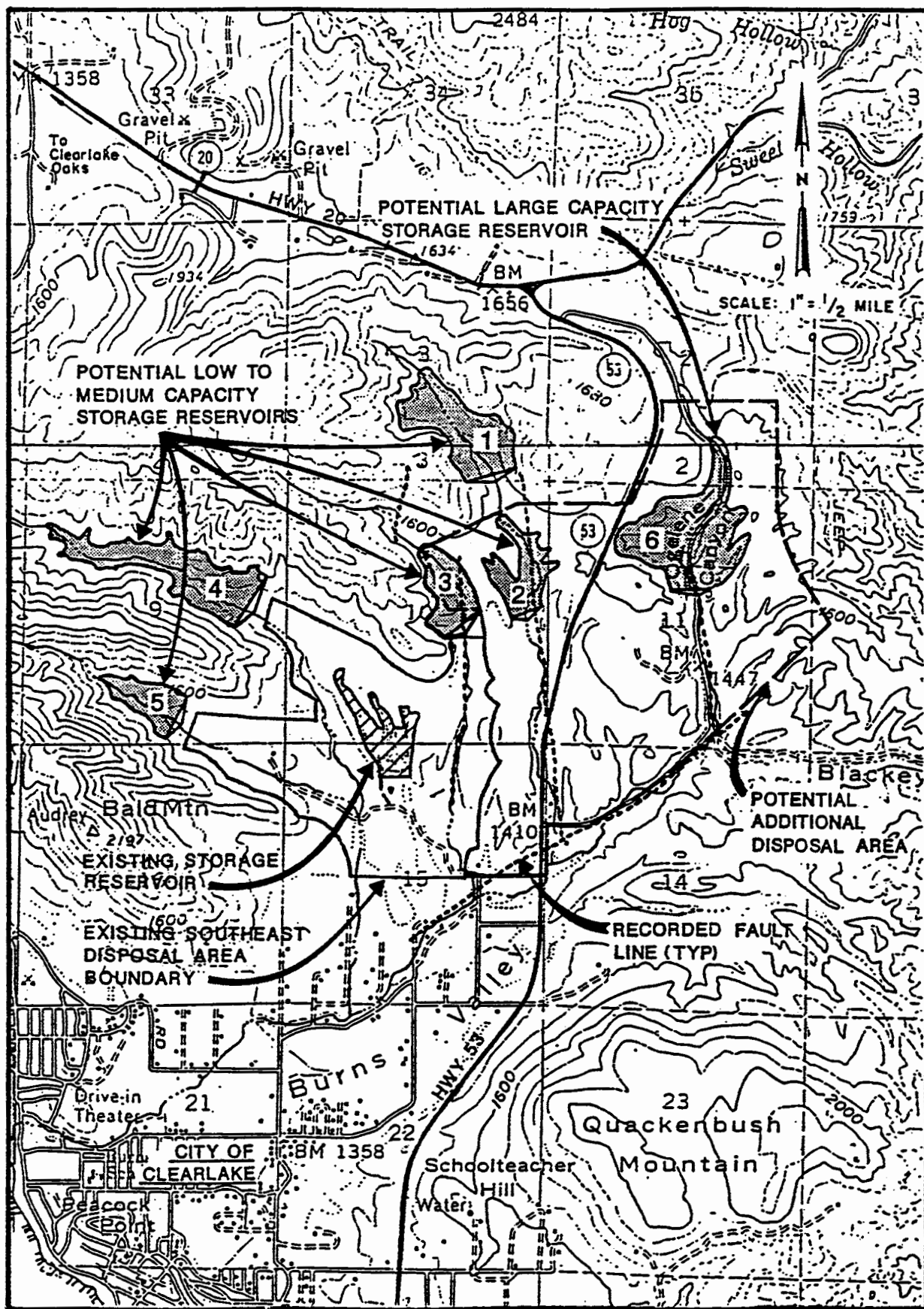
SOURCE: As reproduced by Goddard & Goddard Engineering

TABLE 3.2-3

ESTIMATED STORAGE AND DISPOSAL AREA REQUIREMENTS

<u>Design Horizon</u>	<u>1994</u>	<u>2000</u>
Storage Requirement (ac.ft.)		
1 in 10 year	1390	1780
1 in 100 year	1990	2160
Disposal Area Requirement (acre)		
1 in 10 year	605	775
1 in 100 year	805	915

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SOURCE: Graphic as reproduced from Goddard & Goddard Engineering

Figure 3.2-B
Potential Storage Reservoir
and Land Disposal Sites

3.0 Description of Alternatives to the Proposed Project

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Sites 2, 3, and 5 had insufficient storage capacity for 1994 design flows. Site 4 had good capacity potential but showed evidence of serious embankment instability, which renders it relatively unfeasible. Site 1 had a relatively large capacity and future expansion potential. Some embankment instability and fault traces would require further investigation to determine real feasibility. Site 6, in Ogelene Canyon, appeared to have relatively large storage capacity and good embankment stability. Disadvantages of the site were distance from the treatment facilities and a fault trace through the site. In conclusion, only Sites 1 and 6 showed potential as sites for construction of a storage reservoir. Both sites showed fault traces and would require more thorough seismic and soils investigation.

Reservoir site geology is discussed in more detail below based on Kleinfelder (1986).

Reservoir Site No. 1

Basalt rock was observed on the upper portions of the east abutment which may prove suitable for use as riprap material for erosion protection of reservoir slopes. Some landslides are present on the westerly abutment and at the northerly end of the valley. Several springs exist on the valley side slopes (in winter). The moderate cover of trees and brush would have to be removed prior to reservoir filling. Three test pits excavated in the impoundment area yielded material consisting of slightly clayey, very fine sandy silts (derived from weathering of an in-place volcanic ash flow) to a depth of at least 13 feet and silty sands and clayey sandy silts containing variable weathered gravels. A fault trace appears across the upper portion of the eastern abutment. Detailed studies of this fault would be required by the California State Division of Safety of Dams prior to construction. Generally the site appears feasible for a relatively high embankment dam with the possibility for future expansion and there are good access roads to the site.

Reservoir Site No. 2

This site has fairly gentle side slopes, with some indication of small ancient landslides. Sidewalls show soil profiles consisting of sandy clayey silts with some intermixed gravels on the order of 6 feet thickness. Three test pits showed alternating layers of alluvial clayey silts and slightly clayey very silty sands and gravels. Maximum embankment height feasible for this site appears to be 40 feet to 45 feet which may not provide for adequate storage capacity. Vegetation consists of scattered oak trees and moderate dry grasses and there were no rock outcrops.

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3.2 SERWTP Facilities Plan Alternatives

Foundation excavation on the order of 20 feet deep would probably be required for the main dam. The same fault trace that occurred at Site No. 1, also passes through this site. Detailed geologic studies would be required for fault evaluation.

Reservoir Site No. 3

This site has gentle side slopes with a shallow soil cover with some small peripheral landslides. The steep valley floor would not provide much reservoir capacity. Numerous larger landslides were observed up the valley to the northwest of the reservoir storage boundaries and a fault trace appears near the probable embankment location. The fault would require detailed studies to determine the potential for future movements.

Reservoir Site No. 4

The site has high abutments that could yield a relatively large impoundment area. However, the site has numerous landslides, especially on the northerly side slopes. There were no such indications of slope instability observed on the southern side. Construction would require stabilization of the landslides and a significant amount of earthwork. Filling of the reservoir may trigger the existing landslides by saturation of the soil mass. Entrance of these slides into the reservoir would reduce storage capacity and pose the threat of overtopping of the embankment by the displaced water. Thus, allowances for additional embankment free board would be needed. Three test pits excavated within the reservoir area yielded typically clayey, fine to coarse grained sandy silts with intermixed weathered gravels, and interbedded clayey, very silty sands. One pit yielded weathered sandstone in the bottom of the valley drainage at approximately seven feet below grade. Rock outcrops were also observed in numerous locations in the stream bed, thus relatively shallow foundation excavation would be required on the southern half of the embankment. However, deeper excavating would be necessary on the northern half. The moderate cover of trees and brush on the southern side of the valley would have to be removed prior to reservoir filling. On the north side of the valley, several developed springs exist and are being used for livestock watering. No faults have been mapped within this site or the immediate area.

Reservoir Site No. 5

There were numerous landslides along the northerly side of the site, especially near the probable abutment area while soil cover on the south side appears to be relatively shallow. This site

3.0 Description of Alternatives to the Proposed Project
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would require landslide stabilization work. There is a moderate oak and brush cover that would require clearing prior to reservoir filling. No faults have been identified in or adjacent to the reservoir area. Impoundment area may not be adequate at this location.

Reservoir Site No. 6

This site, in Ogelene Canyon, is located on the eastern side of State Highway 53. The east abutment area has evidence of a small ancient landslide, while there are no indications of landslides on the west abutment. The abutment area has steep side slopes, so a relatively large storage area could be built. Soil cover shows gravely sandy clayey silts ranging from three feet to more than 15 feet. The northwest area of the site appears to have a shallow soil cover as indicated by the basalt outcrops. This basalt may prove suitable for use as riprap material. The site has good access. The vegetation cover of brush and oak trees is moderate on most portions of the site. A fault trace has been mapped beneath the proposed embankment which indicates additional studies would be needed. As proposed, the reservoir could cause inundation of the lower portion of the fill for Highway 53, thus an analysis to determine stability under saturated conditions would be needed.

Based on the above analysis, Kleinfelder & Associates concluded that:

- It appears that reservoir locations 3 and 5 would not have adequate storage capacity.
- Site 6 may not be feasible due to the distance from the treatment facilities and irrigation areas.
- Geotechnical suitability is highest for Site No. 1 followed in order of preference by Site 2 and Site 4.
- Site No. 4 appears to have significant slope stability problems.
- The mapped faults at Sites 1 and 2 need to be evaluated to determine the potential for future activity. The California Division of Safety of Dams would require detailed studies to determine if the fault traces actually pass beneath the embankments. Potential movements along these faults would be relatively small, based upon the mapped fault lengths.

A dam constructed across the canyon mouths at Sites 1 or 6 would be about 125 feet high and 900 feet long to yield 1,900 acre-feet of storage for Site 1 and 4,000-5,000 acre-feet of storage at Site 6. Construction would require excavating and moving an estimated 420,000 cubic yards of earth. This material would be obtained locally from within the confines of the proposed

3.0 Description of Alternatives to the Proposed Project

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reservoir. No imported soil would be required based on preliminary evaluations of the suitability of local materials (Kleinfelder & Associates, 1986). Materials which would have to be imported are concrete and rip-rap rock for stabilizing the dam face to prevent erosion. An estimated 1,250 tons of rock may be needed.

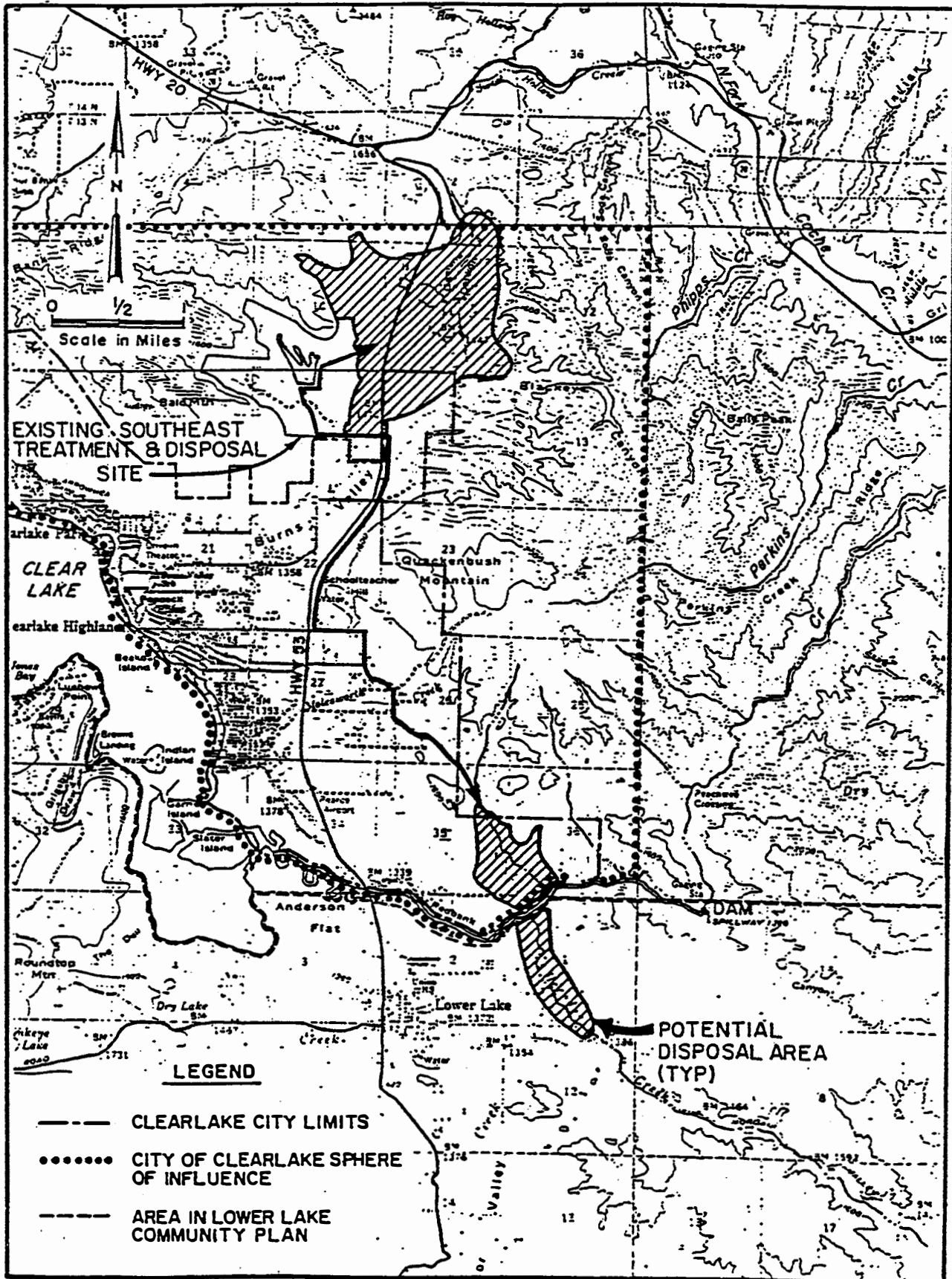
Either site, developed in conjunction with the existing 469 acre-foot reservoir, would satisfy the design year 2000 storage requirements for 1 in 100 year conditions of 2,160 acre-feet. Site 1 is considered more suitable than Site 6 in Ogelene Canyon because it would not occupy land that could be utilized for disposal area.

Land Area Analysis

The total disposal area requirements are 915 acres, of which 244 acres is existing, 25 acres is available on-site, 100 acres may be available in the existing buffer zone if flood irrigation is used, and 546 acres new off-site sprinkler area is needed, plus buffers.

A potential additional disposal area in Ogelene Canyon is shown in Figure 3.2-B. An alternative land disposal area is shown in Figure 3.2-C. These were evaluated for potential suitability for use in an expanded irrigation disposal project. Land suitability was evaluated on the basis of information from soil and topographic maps, previous soil studies, and percolation test records available from the County Environmental Health Department. Sites selected for potential disposal application would need to be investigated in more detail, including field permeability testing, to confirm suitability.

The Ogelene Canyon site is approximately 2 square miles or 1,280 acres. About half of this area (660 acres) is unsuitable for irrigation disposal due to steep slopes exceeding 30% grades and/or insufficient soil depth. Another 330 acres can be developed for disposal but are marginally suitable because of high slopes (15-30%) and/or shallow soil characteristics. The remaining 310 acres appear to have suitable soil types for disposal but this area is broken by marginal or unsuitable areas or highways. The largest area of suitable land is about 280 acres, allowing a corridor for Highway 53 and connecting suitable areas with marginal areas. In order to achieve about 550 usable disposal acres in this terrain and allowing for an adequate buffer zone, at least 900 acres of land would be needed.



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Figure 3.2-C
Alternative Off-Site Land Disposal Area

3.0 Description of Alternatives to the Proposed Project

3.2 SERWTP Facilities Plan Alternatives

The alternative area that spans Redbank Gorge, east of the town of Lower Lake, has land with soils that are suitable for irrigation disposal. Much of this land is already developed as rural residential land. The remaining areas are discontinuous and do not amount to enough area to be cost effectively developed for irrigation disposal.

Other factors to be considered are land ownership and price. However it is apparent that adequate disposal area capability does not exist within a reasonable distance of the SERWTP.

Storage Reservoir and Land Disposal Facilities

An 18 inch transmission pipeline, approximately 8,000 feet long, to Site 1 would be constructed to interconnect the existing plant facilities and a new transfer pump station with the new reservoir inlet and outlet structures. Maximum design water surface in the reservoir would be about elevation 1,680 feet, such that the static head lift from the plant would be nearly 300 feet.

The reservoir would be formed by an earthen dam, protected by rock rip-rap and an overflow spillway. Construction cost is estimated at \$4,190,000. Further geotechnical studies including fault investigation would be needed to confirm this site's suitability.

3.2.2 ALTERNATIVE B1: DISCHARGE TO UNNAMED TRIBUTARY OF CACHE CREEK

Alternative plan "B1" identified in the Facilities Plan involves expansion of the existing treatment facilities, addition of effluent filtration; storage and disposal of as much unfiltered effluent via existing on-site irrigation system as possible; and disposal of remaining effluent after filtration to an unnamed tributary of Cache Creek.

All treatment improvements including effluent filtration under this alternative would be similar to those of the proposed project. The tentative effluent pipeline route would be similar to that considered for the Perkins Creek disposal option. The route and the disposal outfall location are shown in Figure 3.2-A.

Pipeline length would be about 20,000 feet with an approximate peak elevation of 1,900 feet. Total dynamic pumping head would be about 630 feet.

3.0 Description of Alternatives to the Proposed Project
3.2 SERWTP Facilities Plan Alternatives

Effluent discharge would be to an intermittent ephemeral stream which is assumed to carry natural runoff flow only during winter and spring wet weather periods. Flows during much of the year in this unnamed tributary therefore could be 100 percent wastewater effluent.

3.2.3 ALTERNATIVE B2: DISCHARGE TO CACHE CREEK

Alternative plan "B2" identified in the Facilities Plan involves expansion of the existing treatment facilities, addition of effluent filtration; and storage and disposal of as much unfiltered treated effluent as possible via the existing on-site irrigation system while disposing of the remaining effluent after filtration to Cache Creek near Peachtree Crossing. Alternative B2 was the proposed project evaluated in the 1991 Draft EIR on the SERWS Improvement Facilities Plan. As noted, this alternative has been replaced as the preferred project by the plan to dispose of effluent in the Southeast Geysers.

3.2.4 ALTERNATIVE C: DISCHARGE TO TRIBUTARIES TO NORTH FORK OF CACHE CREEK

Alternative plan "C" identified in the Facilities Plan involves expansion of the existing treatment facilities, addition of full Title 22 tertiary treatment; and discharge to the North Fork of Cache Creek year-round, managed to maintain capacity in the reservoir/irrigation disposal system sufficient for maximum expected flows.

Disposal routes to Phipps or Perkins Creeks, both tributaries to the North Fork of Cache Creek, are shown in Figure 3.2-A. Pipeline length to Phipps Creek would be 16,400 feet and to Perkins Creek 20,000 feet. Total dynamic pumping head requirements would be 330 TDH to Phipps Creek and 630 TDH to Perkins Creek. The greater length and significantly higher pumping head requirement of the Perkins Creek option makes it less desirable from an engineering and cost perspective.

Minimum persisting low flows, as occurred in 1976-77 and 1988-90 are higher in the North Fork of Cache Creek than in Cache Creek itself, presumably due to required discharges from the Indian Valley reservoir by the YCFCWCD. However flow in the North Fork of Cache Creek has been as low as 1.85 cfs (1.2 mgd) during the discharge season (December to April). Flows in Phipps and Perkins Creek are variable and intermittent.

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The assimilative capacity and environmental impact of discharging treated wastewater to the North Fork of Cache Creek was analyzed in detail by the CLOCWD in 1987. However, the permit to discharge to the North Fork was denied by the CRWQCB.

The minimum 20 to 1 dilution applies to total treated effluent in the creek, and so any discharge by the SERWTP would be limited not only by creek flow, which is governed by releases from Indian Valley Reservoir, but also by the CLOCWD discharge, if it is implemented as a discharge option in the future. CLOCWD waste discharge requirements are shown in Table 3.2-4.

In order to enable a discharge exceeding the 20 to 1 dilution limit or extending over a greater portion of the year, a higher level of treatment would be required. This advanced secondary treatment could range from filtration plus disinfection to full Title 22 treatment facilities.

Recognizing that a 20 to 1 dilution cannot be guaranteed for discharge to the North Fork of Cache Creek, advanced secondary treatment of the wastewater would be required when discharges exceed 5% of stream flow. Advanced secondary treatment would be set up so that it is only used when discharges exceeded the 20 to 1 dilution limit.

Determining whether discharge to the North Fork of Cache Creek would be a better alternative than discharge to Cache Creek itself requires evaluation of environmental, economic and operational factors and constraints of the alternatives. The most critical consideration associated with a North Fork discharge is that the CLOCWD already has denied a permit to discharge by the CVRWQCB. A request for a permit to discharge the larger flows from the SERWTP probably would meet a similar fate.

3.2.5 ALTERNATIVE D: DISCHARGE TO CLEAR LAKE

Alternative plan "D" identified in the Facilities Plan involves expansion of the existing treatment facilities, addition of full Title 22 tertiary treatment, and discharge to Clear Lake year-round, managed to maintain capacity in the reservoir/irrigation disposal system sufficient for maximum expected flows.

Current CRWQCB Basin Plan policy prohibits discharge of treated wastewaters to Clear Lake. Lake County Ordinance 1801 prohibits direct or indirect discharge of treated or untreated sewage into Clear Lake. It is also inconsistent with the Lake County General Plan Policy 2.2

TABLE 3.2-4

**CLOCWD WASTE DISCHARGE REQUIREMENTS
SEASONAL FLOW LIMITED (20 TO 1) DISCHARGE TO
NORTH FORK CACHE CREEK (a)**

Parameter	Requirement or Limit	
	30-Day Average	Daily Maximum
Flow Limit (Minimum Dilution) (b)	---	5% of Creek Flow
BOD (mg/l)	30	60
Suspended Solids (mg/l)	30	60
Chlorine Residual (mg/l)	---	0.1
Total Coliform Organisms (MPN/100 ml)23(c)		500

Notes: (a) Excerpted from Central Valley Regional Water Quality Control Board Order No. 88-068, issued to the Clearlake Oaks County Water District.
(b) Seasonal only discharge allowed between December 1 and April 30.
(c) 30-day median value.

SOURCE: As reproduced by Goddard & Goddard Engineering

3.0 Description of Alternatives to the Proposed Project

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(page V-60) "The discharge of potential water pollution from ... wastewater disposal facilities ... into Clear Lake should be avoided". The principal reason for these prohibitions is that Clear Lake is a source of domestic water supply for much of the lakefront community and its quality is already significantly impacted by agricultural discharges and other natural conditions which contribute pollutants such as mercury to the lake. Clear Lake is also a significant recreational and tourist resource, and is designated as an important Natural Area in the Lake County General Plan. Portions of the shoreline are designated as wetlands and Environmentally Sensitive Areas (Working Paper #3, Figures 3 and 4). Clear Lake as a source of public water supply is discussed in Section 4.4.

In the unlikely event that discharge to Clear Lake were permitted, full Title 22 treatment facilities would be required. Components and costs of the treatment and conveyance system would be as presented for the Creek discharge alternatives. Pipeline length to Clear Lake would be 14,400 feet and there would be no dynamic pumping head (0 TDH).

3.2.6 ALTERNATIVE E: DISCHARGE TO BORAX LAKE

Alternative plan "E" identified in the Facilities Plan involves expansion of the existing treatment facilities, and discharge to Borax Lake year-round, managed to maintain capacity in the reservoir/irrigation disposal system sufficient for maximum expected flows. This alternative was considered by the project engineers in considerable detail. It would require a 24,000 foot 18 inch pipeline west from the SERWTP with a total dynamic pumping head of 130 TDH, as shown in Figure 3.2-A. Access to Borax Lake is provided by Sulfur Bank Drive which loops off of Lakeshore Drive near the Clearlake Post Office. Access to the area is from Highway 53 via either Olympic Drive, Lakeshore Drive or Old Highway 53.

Secondary treated wastewater would be discharged to Borax Lake, adding to inflow from precipitation. Some of the water would be removed by evaporation, but Borax Lake could potentially overflow. To prevent this, a pump station discharging to Clear Lake could be used. However, current CRWQCB Basin Plan policy and Lake County Ordinance both prohibit discharge of treated wastewater to Clear Lake. It would therefore be necessary to construct an embankment around the lake with a lined ditch in order to divert precipitation runoff from reaching Borax Lake and pump that runoff to Clear Lake. Based on anticipated rainfall conditions, Borax Lake water level would vary about ten feet, and the embankment at the east end would have to be raised to accommodate this. Land around the lake would have to be

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condemned to accommodate these facilities. The engineers concluded that the project was not feasible based on the extensive construction involved, the prohibitive cost and incompatibility with the land owner's planned uses for the area.

3.2.7 ALTERNATIVES F1, F2, F3 AND G: DISCHARGE TO A DEEP INJECTION WELL

A number of options were analyzed involving injection of treated wastewater deep in the earth to depths of 4,000-11,000 feet and resulted in project alternatives F1, F2, and F3. All three alternatives involve expansion of the existing treatment facilities, disposal of treated wastewater through an injection well, and management to maintain capacity in the reservoir/irrigation disposal system sufficient for maximum expected flows.

Alternative F1 involves disposal to the retrofitted existing Audrey A-No.1 geothermal well, F2 to the retrofitted existing Borax 7-1 geothermal well, and F3 to a new injection well onsite at the SERWTP. General aspects of discharging treated wastewater to a deep injection well are discussed below, followed by discussion of each alternative separately.

In the 1991 Alternatives evaluation, a fourth deep injection well alternative, identified as G, was evaluated. That alternative included deep injection in The Geysers, which is the proposed project evaluated in this EIR/EIS. It differs from the proposed project only in the proposed route of the pipeline to the Southeast Geysers.

Introduction

Deep injection disposal has the possibility of using known deep high temperatures in the area of the SERWTP (and/or at The Geysers) to sterilize wastewater, while at the same time developing a working fluid that could be used for geothermal electrical production. The process involves injecting the secondary treated wastewater through an enclosed well deep into the earth at between 4,000 to 11,000 feet, at sufficient depth to prevent mingling of wastewater with usable groundwater.

A study by Goddard & Goddard Engineering (1991) considered the environmental, technical and institutional opportunities and constraints related to disposal of secondary-treated municipal wastewater from the Lake County SERWTP by deep injection underground. The following sections on regulations and deep well injection technology are summarized from that report.

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Regulations

Underground injection of wastes is regulated by the Environmental Protection Agency (EPA) and by State Government through the State Water Resources Control Board (SWRCB) and RWQCBs, the Department of Health Services (DOHS), and the Department of Conservation. There are federal and state statutes governing underground injection control. The federal statute is the Safe Drinking Water Act. State statutes are Health and Safety Code (SS4458, 25159.10), Public Resources Code (SS3200 et seq., 3250 et seq., 3700 et seq.), and the Water Code (SS13260 et seq., 13304, 13540, 13541).

Federal

Under the 1974 Federal Safe Drinking Water Act, the EPA implements the Underground Injection Control (UIC) program for protection of the nation's drinking water. On meeting requirements, states are eligible for primacy (primary enforcement responsibility). Under the UIC program, injection wells were divided into five classes. Class I wells inject hazardous wastes or dispose of industrial and municipal fluids below the deepest underground source of drinking water (USDW). Class II wells are oil and gas production and storage related wells. Class III wells inject fluids for the extraction of minerals, such as salt solution mining wells. Class IV wells inject hazardous wastes into or above a USDW (these are banned). Class V wells are all other wells not included in Classes I through IV and include geothermal injection wells and aquifer recharge wells (40 CFR 144.6, Classification of Wells). California has primacy for Class II injection wells (oil and gas waste) through the Department of Conservation, and has a Memorandum of Agreement for geothermal wells [40 CFR 147.250 (a)(2)(b)]. The EPA administers the UIC program for Class I, III, IV and V wells [40 CFR 147.251 (a)].

State

The California Department of Conservation, Division of Oil and Gas and Geothermal Resources (CDOG&GR), has jurisdiction over the drilling, operation, maintenance and abandonment of wells for disposal of non-hazardous, oil, gas and geothermal field wastes under authority in the Public Resources Code and the delegated federal program. An operator must notify the CDOG&GR prior to drilling a geothermal production or injection well, or re-opening an existing well, and file a monthly injection report for any private, state or federal well injecting or capable of injecting fluids. Injection wells must also be surveyed in the presence of CDOG&GR during

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the first 30 days and every two years thereafter to prove that the fluids are being injected into the intended zone and to show casing integrity.

The CRWQCB regulates underground injection facilities by issuing Waste Discharge Requirements (WDRs) under the Porter-Cologne Water Quality Control Act (1957) (CRWQCB, 1987). Injected effluent must be sampled annually, and volumes reported. Any lost circulation at depths less than 300 feet must be reported. Separate WDRs may be issued for surface facilities. Projects are subject to the California Environmental Quality Act (CEQA). CDOG&GR is lead agency for geothermal wells.

County

Lake County Code Ch. 9 Health and Sanitation Sections 9-16 through 9-27 govern the disposal of sanitary waste, enforceable through the Department of Public Health and Division of Environmental Health. Sewage disposal, other than by the property owner, requires state licensing (Section 9-25.1) in addition to a Permit to Operate from the Lake County Health Department (Section 11-23). Sewage treatment and disposal in Lake County is undertaken by the Lake County Sanitation District (LACOSAN) and several independent districts.

The Lake County Geothermal Resource and Transmission Element of the General Plan (May 16, 1989) details policies and objectives related to geothermal resources, and their conservation and management. The Lake County General Plan (November, 1981), Chapter V, details policies and objectives related to water resources. As water supplies become increasingly limited, municipal wastewater is becoming recognized as a valuable water resource rather than a "waste". The Lake County Zoning Ordinance (November 1986) requires a use permit for geothermal related projects, and for projects proposed by public or private utilities. However, if it is a county project, the Board of Supervisors issues a mitigation monitoring plan which is equivalent to a use permit (Hinds, 1988).

Permits and Approvals

Deep injection disposal of wastewater through an existing geothermal well and/or into a geothermal resource would, therefore, be subject to review by regulatory agencies and the public, and would require obtaining several permits and approvals, including:

3.0 Description of Alternatives to the Proposed Project

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- LACOSAN approved project with incorporated mitigation measures;
- Finding of Consistency with the Lake County General Plan or Sonoma County General Plan;
- Landowner and Well owner approvals;
- Contract to operate between land/well owner and County of Lake or Sonoma County;
- Agreements on pipeline rights-of-way and easements acquisition; and
- Permit from the BLM for construction occurring on federal lands.

All agencies contacted responded favorably to the concept of wastewater deep injection and the possible useful generation of geothermal electrical power in the injection area. CDOG&GR District 3 (Santa Rosa office) has indicated it would have jurisdiction over injection wells used for disposal of municipal wastewater involving use of geothermal wells and/or injection into a geothermal resource. BLM would issue permits for facilities on federal land in The Geysers.

Deep Well Injection Technology

The history of deep well injection of fluids was reviewed. Deep well injection of liquids began about 50 years ago in the petroleum industry. In the 1930s it became common practice to dispose of saltwater (brines) which usually accompany oil and gas production by injection into underground formations. Deep well disposal of other wastes at greater depths began in the 1950s. Deep injection of geothermal waste fluids is an established practice both in Lake County and throughout the United States. Deep injection is also used extensively in the State of Florida for disposal of treated municipal wastewater (Dehan, 1990; DER, 1989).

Deep well injection technology is summarized below. A well is constructed in stages as follows. A hole is drilled to a level below all drinking water. A steel surface casing or pipe is installed the full length of the bore hole and concrete is placed outside of the casing from the bottom to the top to seal the casing into the hole. This provides a barrier of steel and concrete to protect drinking water zones. Drilling then continues below the surface casing into the injection zone. Samples and instrument measurements are routinely taken to evaluate the type and thickness of the rock formations. Another protective casing string is installed from the surface to the injection zone and again cemented the entire depth to seal the space outside the casing. The casing can be constructed from steel or corrosion resistant materials like fiberglass or titanium. This provides two concrete and two casing barriers to protect the drinking water zone.

A smaller pipe, called injection tubing, is installed inside of this protective casing. Waste is injected through this inside tubing. It is secured and sealed at the top with a wellhead and sealed at the bottom with a packer. The space between the tubing and the casing, called the annulus, is

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A smaller pipe, called injection tubing, is installed inside of this protective casing. Waste is injected through this inside tubing. It is secured and sealed at the top with a wellhead and sealed at the bottom with a packer. The space between the tubing and the casing, called the annulus, is filled with a noncorrosive fluid under pressure. The fluid in the annulus is maintained at a different pressure than the waste within the injection tubing. The annulus and injection tubing pressures are continuously monitored and recorded. Any leak which may occur in either the injection tubing or protective casing will result in a change in the annulus pressure and the well is shut down and repaired. (UIPC Research Foundation, no date.)

CDOG&GR requires operators to make periodic surveys of injection well integrity. The surveys are run as diagnostic tools to ascertain whether or not the injection fluid is confined to the intended injection zone and if the casing integrity remains intact.

Alternatives F1 (Audrey A-No.1) and F2 (Borax Lake 7-1)

Alternative plan "F1" identified in the Facilities Plan involves expansion of the existing treatment facilities, and discharge to the retrofitted Audrey A-No.1 geothermal well year-round managed to maintain capacity in the reservoir/irrigation disposal system sufficient for maximum expected flows.

Alternative plan "F2" identified in the Facilities Plan involves expansion of the existing treatment facilities, and discharge to the retrofitted Borax Lake 7-1 geothermal well year-round, managed to maintain capacity in the reservoir/irrigation disposal system sufficient for maximum expected flows.

There are four exploration test wells 2,089 to 10,042 ft deep in the Sulphur Bank Mine/Borax Lake area 3 miles west of the SERWTP. The name of each well along with the driller and total depth is listed below:

1. Bradley Mining No. 1 (BM-1) well, drilled by Earth Energy, Inc. (June 1964), 2,089 ft;
2. Bradley Mining No. 2 (BM-2) well, drilled by Earth Energy, Inc., 3,982 ft;
3. Borax Lake 7-1 well, drilled by Phillips Petroleum Company (1978), 6,050 ft; and
4. Audrey A-No. 1 well, drilled by Phillips Petroleum Company (1981), 10,042 ft.

Three of the exploratory geothermal wells encountered temperatures over 400 degrees F. Bradley Mining No. 1 well, at Sulfur Bank, produced large quantities of hot water and steam during flow testing, while the other three were dry or encountered small amounts of geothermal fluids. All

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four were plugged and abandoned (Beall, 1985). A fifth well, the Jorgensen-1 well was drilled by Union Oil Company 3 1/2 miles south of Borax Lake.

As shown in Figure 3.2-A, Audrey A-No.1 well is located 1 mile northwest of the SERWTP at an elevation of 1,630 feet. The Borax 7-1 well is located 2.5 miles west of the SERWTP, adjacent to Borax Lake, at 1,350 feet above sea level, which is the same elevation as the SERWTP.

The Audrey and Borax Lake wells were drilled as geothermal exploration tests, attempting to delineate the extensions of the area's geothermal system which was encountered beneath the Sulphur Bank Mine. Both wells encountered temperatures above 460 degrees F but failed to penetrate sufficiently permeable formations for commercial geothermal production.

Of the two wells, Borax Lake 7-1 well appeared more suitable because its elevation was similar to the SERWTP, being 300 feet lower than Audrey, and testing of the Audrey well indicated the formation was "tight". The Borax Lake 7-1 well penetrated a permeable water zone which would not produce.

The permeable zone believed to be at about 4,800 feet in the Borax Lake well flowed when the well was being unloaded (blown down) with drilling rig air compressors. During drilling through this zone, drilling breaks (sudden increases in penetration rate) and very high gas levels in the drilling mud indicated permeability. Calculations of the formation temperature of the produced water determined from the water chemistry (process known as geothermometry) indicated 273 degrees F. An equilibrated temperature log of the well indicates 277 degrees F at 4,800 feet. This appears to confirm the location of the water entry at about 4,800 feet. This zone of possible permeability was, however, subsequently cement squeezed to prevent continued formation sloughing. The squeezed interval was from 3,714 - 6,050 feet.

To make use of the Borax Lake 7-1 well for wastewater injection, the well must be reentered and the abandonment concrete plugs drilled out. Next, a slotted liner must be hung in the anticipated injection zone. The well must then be "pressured up" to break the concrete squeeze zone so that the formation will re-establish communication of the borehole with the presumed zone of permeability at 4,800 feet (G&GE, 1991). No guarantee exists that these procedures will be successful and, if unsuccessful, new abandonment expense will be incurred.

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The estimated costs to drill out the well are \$264,000 with the injection test costing another \$19,000 bringing the total costs of assessing the feasibility to about \$283,000. Should the well not prove suitable, additional cost estimated at a minimum of \$30,000 would be involved in abandonment of the well. If the Borax Lake 7-1 well option is initiated, it is recommended that a qualified geothermal firm which specializes in drilling and well testing activities be retained to manage the drilling and testing aspects of the program.

A three phase plan for testing feasibility and implementation was developed. The well site at Borax Lake is situated in the middle of a large barren earthen pad encompassing an area of about 5 acres. If for some reason the injection well proved to be infeasible or unusable at any time, the alternative for direct discharge to Borax Lake could be implemented.

Phase 1. Initial well injection feasibility test (1-2 months):

1. Obtain necessary well test permits.
2. Rehabilitate existing Borax 7-1 well.
3. Test rehabilitated well using trucked potable supply.
4. Assess feasibility of proceeding to Phase 2 well development.
5. Initiate assessment proceedings, grant or loan procedures, or other financing processes.
6. Initiate detailed design of treatment plant improvements to be constructed in subsequent phases.

Phase 2. Test disposal potential of the rehabilitated well using SERWTP effluent. (1 year)

1. Install temporary effluent pump station and 23,000 foot pipeline to Borax Lake geothermal test well site (3.9 mgd, 30' TDH).
2. Prepare SERWTP Facilities to allow diversion of wastewater necessary for testing of well.
3. In minimum 12 month study, monitor operation and environmental effects of effluent injection disposal into well.
4. Research and test the feasibility and environmental acceptability of using Borax Lake as backup for receiving effluent should the deep injection need to be stopped.
5. Prepare summary report of findings, conclusions and recommendations regarding feasibility and environmental impacts of permanent injection disposal operation.
6. Complete design and begin construction of treatment plant improvements.

Phase 3. Complete permanent improvements and commence operation.

Assumes confirmation of the feasibility of deep injection through Phases 1 and 2. If not, project modifications would be required, possibly including development of the Borax Lake disposal option.

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1. Complete construction of treatment plant improvements.
2. Install permanent effluent pump station and effluent pipeline; in the event Borax Lake proves to be suitable as a backup disposal option for the deep injection well, install tee, valves and pipeline to outfall diffuser in Borax Lake.
3. Install permanent well head injection facilities per recommendations of demonstration project.
4. Construct mitigation measures (if any) found to be necessary during Phase 2.

Alternative F3: On-site at SERWTP

Alternative plan "F3" identified in the Facilities Plan involves expansion of the existing treatment facilities, and discharge of secondary treated effluent year-round to a new deep injection well on the SERWTP site, managed to maintain capacity in the reservoir/irrigation disposal system sufficient for maximum expected flows.

The feasibility of drilling a new injection well on site at the SERWTP was considered. The concept was acceptable to LACOSAN because of existing ownership of the site, elimination of pipeline costs, and reduced maintenance. However preliminary review of the geology of the area indicated that this is an area of greenstone which does not accept much water (Beall, 1990). This alternative therefore was found to have a low probability of success due to lack of a receptive reservoir rock. Also, there would be no reuse of the water as a valuable resource (beneficial use).

Alternative G: Effluent Injection in The Geysers

Alternative plan "G" identified in the Facilities Plan involves expansion of the existing treatment facilities, and discharge of secondary treated effluent year-round through a pipeline to The Geysers geothermal area near Anderson Springs for deep subsurface reservoir replenishment injection. This alternative is discussed as the proposed project in this EIR/EIS. Alternative G differs from the proposed project only in the pipeline route to the Southeast Geysers.

In November 1990 LACOSAN requested that G&GE investigate the administrative and technical feasibility of wastewater deep injection at a number of locations in Lake County (G&GE, 1991). In spring of 1991 the County of Lake's Energy and Resource Manager proceeded with discussions with industry representatives. On May 28, 1991 Calpine Corporation presented the results of their preliminary assessment of disposal of Lake County effluent at The Geysers to the Board of Supervisors. A June 1991 report by GeothermEx, Inc. evaluated the potential for

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injecting SERWTP treated wastewater at The Geysers. In July of 1991 the LACOSAN project engineers, Dewante & Stowell, reviewed alternative pipeline routes and costs. Results of these studies are included in the following brief discussion.

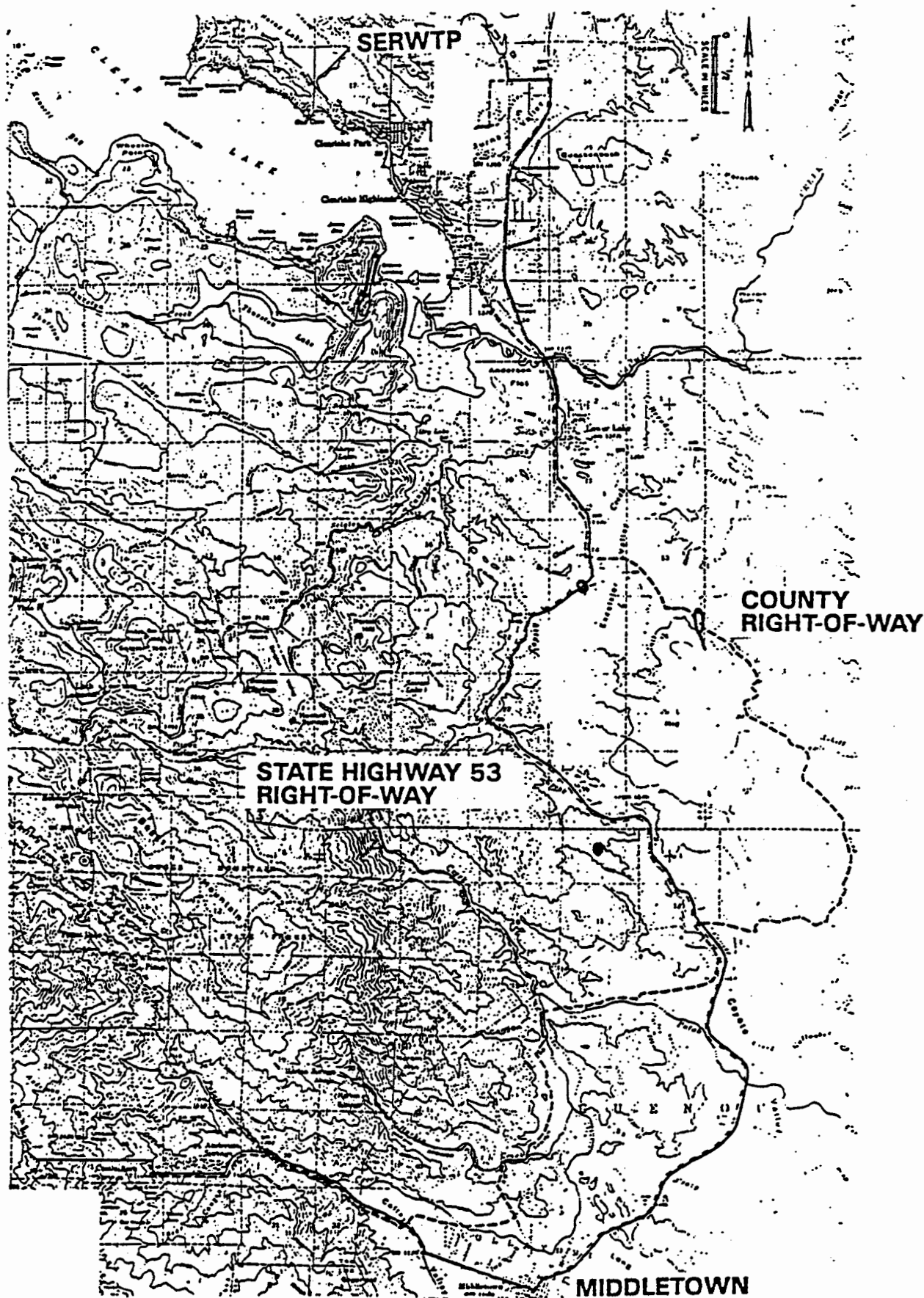
Possible Routes to the Geysers

G&GE (January 1991) noted that a feasible route would be along Highway 53 through Lower Lake, past Hidden Valley then continuing on SR 29 through Middletown to possible pipeline routes up Bear Canyon and/or through Anderson Springs. Calpine (May 1991) presented a preliminary pipeline route which passes through Lower Lake, Middletown and Anderson Springs. Dewante & Stowell (August 1991) reviewed the Calpine preliminary route, made a route inspection and developed the two alternative routes shown in Figure 3.2-D. One route follows the Caltrans SR 53 and SR 29 right-of-way, while the other follows County rights-of-way. Neither route was subsequently selected. The proposed route evaluated in this EIR/EIS does follow portions of the two alternates identified in Figure 3.2-D.

The two pipeline routes in the alignment survey in 1992 were evaluated because it was believed the Hidden Valley Lakes Community Services District (HVLSCD) would participate in the project. However, they subsequently declined to become part of the current project. The two alignments and reasons for eliminating them from consideration are discussed below.

1. Highway 29 Right of Way. Caltrans originally indicated it could not support a longitudinal encroachment into this R.O.W. However, they may have been willing to allow access in the R.O.W. but only outside of their controlled access area. This means the pipeline would have to be placed at the top of several large cuts, which represented significant issues related to pipeline pressure surging during operation, geologic stability problems, erosion and sedimentation issues; in addition to a cost increase of \$3 million to \$7 million as a result of longer distance compared to the currently proposed route. Also, there would have been an increase in spoil generation and increases in traffic disruption.

2. Spruce Grove Road. This was also evaluated in earlier studies when HVLCS D participation was considered. This alignment was even longer than SR 29 and represented similar impacts. This is a County right of way and is prescriptive. All the potential impacts identified for the SR 29 alternative above would be the same except for traffic disruption which would be less.



SOURCE: Graphic as reproduced from Goddard & Goddard Engineering

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However, traffic impacts would still be significant. Additional cost would be up to \$7 million. Increase in spoil generation over SR 29 alternative would be 15 percent to 30 percent more.

Costs

Preliminary estimates of pipeline costs for the two 1991 alternate routes to The Geysers ran from 10 to 24 million dollars. G&GE (January 1991) estimated, based on low pressure pipelines, \$400,000 per mile for the 28 miles of the line to the base of the Mayacmas Mountains and \$900,000 per mile for the remaining 4 miles or a total of roughly \$14,800,000 which includes the pumping stations.

Calpine (May 1991) estimated capital costs for 20-inch coated steel pipeline, pump stations, rights-of-way, and permits at \$20,790,000 for Clearlake to Anderson Springs and \$6,170,000 from Anderson Springs to Unit 13. Annual pipeline operating costs (in 1991) were estimated at \$700,000 and \$1,500,000 based on 3,500 gpm (5.0 mgd) flow. GeothermEx, Inc. (June 1991) estimated an annualized cost of about \$5.5 million, and \$5,000 per acre-foot (based on 1 mgd flow) or \$980 per acre-foot for 5 mgd flow.

Linkage with Other Wastewater Sources

The CLOCWD wastewater treatment facility could potentially be connected as well as community systems along the pipeline route including Middletown, Hidden Valley, and Anderson Springs.

A possible synergistic alternative would include participation in the Sulfur Bank Hazardous Waste Site SuperFund remediation program. This addition to The Geysers pipeline would include drilling geothermal production wells into the existing Sulfur Bank hydrothermal spring system, developing an estimated 2.8 megawatt (MWe) of electrical power and sending the estimated 4.9 mgd of spent Sulfur Bank brine along with the wastewater for injection at The Geysers. The Sulfur Bank Mine production wells would allow draining of the existing Herman Pit and filling the pit with mining tailing. The electrical production from Sulfur Bank could then be used to power the wastewater pumps necessary for The Geysers pipeline to lift the fluids to the Mayacmas Mountain ridge height of 3,400 ft. Development of Sulfur Bank geothermal production well(s), a suitable injection alternative line/wells and a 3 MWe power plant is estimated at \$5,000,000.

3.2.8 REDUCTION OF FLOW OPTIONS

Correction of Inflow and Infiltration

Some of the District's wastewater collection system piping is in low lying areas immediately adjacent to Clear Lake. When lake levels rise above normal levels as a consequence of above normal rainfall during winter, substantial amounts of lake and/or rainwater enter the wastewater collection system via innumerable, small cracks and holes in the pipes and manholes comprising the collection system. This inflow and infiltration (I/I) of nonwastewater into the collection system during wetter than normal years is in excess of the wastewater disposal capability of the District's existing disposal facilities. Consequently, during high lake level induced I/I events the District has two options:

1. Limit the amount of water pumped from the collection system to that quantity which can be handled by the District's wastewater treatment and disposal facilities.

This approach can result in untreated sewage rising out of the collection system and flowing in the streets, ultimately into Clear Lake.

2. Take as much water from the collection system as possible, treat it, and discharge it to the disposal facilities. This approach controls the surfacing of untreated sewage, but results in more flow to the disposal facilities than they can handle resulting in a controlled release of treated wastewater to Clear Lake via overflows from the on-site storage reservoir. The last time this happened was 1986.

Both operational strategies are illegal under the District's Waste Discharge Requirements, the Regional Board's Basin Plan, and County ordinance. Until such time that a project can be implemented to give the District the facilities to control these problems, the District has operated and will continue to operate under the second strategy so as to reduce risk to public health.

One of the principal goals of the Dewante and Stowell Facilities Plan (January 1991 page 1-3) was "Assessment of the significance and consequence of wet-weather infiltration and inflow (I/I) in the SERWS". Dewante and Stowell completed an investigation of the I/I problem under a contract with LACOSAN. The recommendations of that investigation have been initiated. It is estimated that a 1.0 to 2.0 mgd reduction in influent flow could be attained by correction of major inflow sources subject to lake flooding.

Water Conservation

Another possibility for reducing flows is through the use of water conservation measures. Recent Federal and State legislation has mandated the use of low-flow devices, including toilets, in new construction (State of California Health and Safety Code). These are estimated to reduce sewerage generation for a typical household by as much as 30%-50%. The average American uses more than 18,000 gallons of water a year and as much as 40% of this use- results from toilet flushing. Older toilets typically used five to seven gallons of water per flush while newer ones use 3.5 gallons. More recently 1.6 gallons per flush models are available and legislation mandating their use is being proposed by Congress. The retrofitting of homes with low water use plumbing fixtures has been shown to be effective in many areas of the state which have faced water shortages or wastewater capacity problems. A major example is the City of Los Angeles which requires that all homes which are sold must be retrofitted before the sale can be completed. The Goleta Water District is another agency which has implemented a retrofit program which they believe is cost-effective.

A retrofit program would benefit both local water agencies and the Sanitation District and result in energy conservation from the treatment, conveyance, heating and disposal of water. Installing 1,000 retrofit plumbing kits in the service area would cost a total of \$15,000. Each kit contains two showerheads, two toilet dams, dye tables to check for toilet leaks, and water conservation brochures. Each installed hardware retrofit package is estimated to save 11.2 gallons per capita per day, for an average household savings of 33.6 gallons per day, at an average occupancy of 2.5 people per dwelling unit. These savings have been documented in several well-controlled studies during the first few years, as described in the American Water Works Association Water Conservation Guidebook. One thousand such installations would reduce wastewater flows by 10 million gallons per year and save 31.4 acre-feet per year of water.

Installation of 1,000 low-flow shower heads at \$13 each would result in an annual wastewater flow reduction of 7.6 million gallons a year and water savings of 23.5 acre feet a year at an estimated cost of \$13,000. Low flow toilets installed in 1,000 households are estimated to save an additional 14.6 million gallons a year of wastewater flow and 44.8 acre-feet per year of water would be saved. A summary of potential water conservation measures and their potential water savings are presented in Table 3.2-5. An estimate of the proposed cost for retrofitting 1,000 households is shown in Table 3.2-6. It is estimated that a retrofit program could reduce

TABLE 3.2-5

STANDARD WATER CONSERVATION MEASURES AND ASSIGNED SAVINGS

Measure	Water Savings Per Capita	Gallons-Day per Household
Low-Flow Showerhead Retrofit 2.75 gpm @ 80 psi	7.2	21.6
Ultra Low-Flow Showerhead 1.5 gpm or less @ 80 psi	10.5	31.5
Low-Flush Toilet Retrofit 3.5 gallon per flush	8.0	24.0
Ultra Low-Flush Toilet 1.5 gallons per flush	16.0	48.0
Low-Cost Retrofit Kit installed by agency	6.5	19.5
Mass mailed	1.7	5.1
Higher-Cost Retrofit installed by agency	11.2	33.6
Door Hang/Follow up	8.0	24.0

Source: K.P. Lindstrom (1991) modified from Metropolitan Water District of Southern California (1988).
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TABLE 3.2-6

TYPICAL EXAMPLES OF POTENTIAL COSTS
(Per 1,000 installations)

Measure	Term of Agreement	Estimated Water Savings	Program Cost
Ultra-Low Flush Toilet	10 yrs	16 gpcd, or 40 gpd/hh, or 14,600 gal/yr/hh	\$500.00/hh
Ultra-low Flow showerhead 1.1 gpm model	5 yrs	10.5 gpcd, or 21 gpd/hh, or 7,665 gal/yr/hh	\$13.00/hh
Retrofit hardware package*	5 yrs	11.2 gpcd, or 28 gpd/hh, or 10,220 gal/yr/hh	\$15.00/hh
Retrofit kit **	2 yrs	6.5 gpcd, or 16.2 gpd/hh, or 5,930 gal/yr/hh	\$ 1.00/hh

Source: K.P. Lindstrom (1991) modified from Metropolitan Water District of Southern California (1988).
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flows by as much as 10.0 to 22.2 million gallons a year at an average cost of ranging between \$15-513 per household.

While such a program would have benefits in terms of needed future capacity and reduce year-round storage needs, the greatest impact on storage and irrigation needs occurs due to infiltration/inflow due to high lake levels. When lake levels are high and inflow is occurring, inflow is estimated at 1.0-2.0 million gallons a day. Ten days of early spring high lake level inflow can negate a whole years-worth of benefit from conservation.

In conclusion, it would appear that correction of the I/I problem and implementation of flow reduction procedures should both be implemented. The LACOSAN has begun correction of the I/I problem consistent with the CRWQCB Cease and Desist Order No. 91-084. This allows an exemption of 50 new home-equivalents (Item 3a) when an engineering agreement containing an implementation schedule for I/I correction is signed. State law now requires use of low flow devices in new construction, but programs for retrofitting existing facilities should be encouraged.

3.2.9 RANKING OF ALTERNATIVES

To summarize the environmental constraints, the alternative projects were ranked with respect to ten impact areas. Each impact is rated from 0 to 5, with 0 signifying minimal adverse effect and 5 maximum adverse effect. In tabulating the rankings, it was assumed that each impact area had equal importance. Each alternative is ranked for short-term (construction) impacts and long-term impacts. An overall ranking is then achieved by combining the long- and short-term subtotals in the ratio of 4:1. This ratio is based on the long-term 10 year planning horizon (to the year 2000) and the estimated 2.5 year construction time for the project. The results are presented in Table 3.2-7. The following discussion provides briefly the rationale for the ratings.

Geology and Flood

Higher long-term ranking indicates greater potential for landslides; the longer the pipeline, the higher the landslide potential. Alternative A is ranked high because of the dam and reservoir in an area of known fault traces.

TABLE 3.2-7

RANKING OF PROJECT ALTERNATIVES

Impact Area	Project Alternative									
	Land A	Trib. C Cr. B1	Cache Creek B2	N.F.C. Creek C	Clear Lake D	Borax Lake E	Audrey Well F1	Borax Well F2	SERWTP Well F3	The Geysers G
Geology and Flood	4L	4L	3L	4L	3L	5L	2L	2L	5L*	4L
Water Resources	3L	5L	5L	5L	5L	5L	0	0	5L*	0
Biology	5L	4L	3L	5L	5L	5L	1S	1S	0	3S
Air Resources	4L	3S	3S	3S	2S	5S	4S	4S	4S	5S
Noise	1S	3S	3S	2S	3S	2S	2S	2S	1S	4S
Cultural Resources	1S	3S	3S	3S	4S	4S	2S	2S	0	5S
Land Use	5S	0	0	0	0	5L	3L	3L	0	0
Agricultural Land Conversion	2L	0	0	0	0	0	0	0	0	0
Chemical Hazard	1L	4L	4L	4L	5L	5L	1L	1L	1L	1L
Lost Reclamation Potential	0	3L	3L	3L	5L	5L	4L	4L	5L*	1L
Subtotal Short(S) Term	7	9	9	8	9	11	9	9	5	17
Ranking Short Term Imp.s	2	4	4	3	4	5	4	4	1	6
Subtotal Long(L) Term	19	20	18	21	23	30	10	10	16	6
Ranking Long Term Imp.s	5	6	4	7	8	9	2	2	3	1
Weighted Total (4L:1S)	83	89	81	92	101	131	49	49	69	41
Ranking Total	5	6	4	7	8	9	2	2	3	1

Notes:

- L long-term impacts
- S short-term impacts (construction)
- * possible lack of receptive reservoir

Ranking 0 - 5, 0 = none 5 = maximum

The weighted total was computed as 4 times the long-term subtotal plus one times the short-term subtotal (4L + 1S) based on 10 years (planning horizon) to 2.5 years (construction time)

SOURCE: As reproduced by Goddard & Goddard Engineering.

3.0 Description of Alternatives to the Proposed Project

3.2 SERWTP Facilities Plan Alternatives

Water Resources

Disposal to surface waters B1, B2, C, D and E may increase nutrient input and reduce water quality. F3 is rated high because geology indicates lack of receptive reservoir. F1, F2 and G (the proposed project) are rated low because strict requirements for injection well construction and integrity, and injecting below the lowest drinking water level, protect water quality.

Biology

Alternative A is rated high because it involves about 1,000 acres of habitat conversion, including removal of oak trees. Surface water disposal alternatives B1, C, D and E may increase nutrient input and alter biotic communities. Cache Creek is rated slightly lower than North Fork because its water comes from Clear Lake which is a eutrophic lake. The geothermal options will have some short-term impacts on habitat.

Air Resources

Air Resources impacts are predominantly short-term from construction raising dust, as in the Borax Lake alternative E. Alternatives F1, F2 or F3 involve drilling out an existing well or a new well. The Geysers alternative G (the proposed project) is high because of the length of the pipeline route excavation. Land disposal A is rated relatively high because of the acreage in sprinkler irrigation.

Noise

Noise impacts are relatively low and short-term. G is rated higher because of the length of the pipeline construction.

Cultural Resources

Short-term impacts are potentially higher the longer the pipeline, or with proximity to Clear Lake or Borax Lake. However these potential impacts can be mitigated.

Agricultural Land Conversion

There will be minimal land conversion of agricultural land for all alternatives except A. Here about 1,000 acres of land which currently is actual or potential grazing land would be converted

3.0 Description of Alternatives to the Proposed Project

3.2 SERWTP Facilities Plan Alternatives

to 800 acres of improved pasture and 200 acres of reservoir which would provide wildlife habitat. Making the improved pasture available for grazing lease (as is currently done at the SERWTP) would somewhat offset any adverse impact.

Land Use

Alternative A would involve a short term loss of use of the land during construction. Long term land use may be viewed as a higher beneficial use as discussed under agricultural land conversion. Surface waters disposal B1, B2, C and D would involve minimal change in land use. Borax Lake alternative E would involve significant long-term changes in land use. F1 and F2 would have moderate changes around the well areas. An on-site well at the SERWTP (F3) or disposal to The Geysers (G) would not significantly change existing land uses.

Chemical Hazard

Surface water disposal requires higher levels of treatment and more chemicals which must be transported to the SERWTP, stored and disposed of, with associated higher potential risk. Also under upset conditions there is potential for excess amounts of chemicals to be introduced to surface waters.

Loss of Reclamation Potential

Under alternatives A and G the wastewater is a "resource". Land disposal uses wastewater for pasture irrigation to raise animals, and fertilizes the soil. Disposal to The Geysers geothermal reservoir will enable increased steam and electricity production, with benefits to the county tax base. F1 and F2 (Audrey and Borax wells) if implemented might provide recharge which in the long term might benefit a project like the City of Clearlake/Los Alamos Hot Dry Rocks project. The SERWTP well F3 may also provide this benefit but it is rated 5 because preliminary knowledge of the geology indicates an unreceptive reservoir rock. Disposal to surface waters such as Cache Creek and Clear Lake may provide groundwater recharge downstream, or valuable irrigation water if discharge could be managed to occur at the appropriate season.

Environmentally Superior Alternative

The no-project alternative is not considered to be environmentally superior because of its failure to correct the water pollution problems of the SERWS. F3, on-site SERWTP, well ranks first in

3.0 Description of Alternatives to the Proposed Project

3.2 SERWTP Facilities Plan Alternatives

short-term impacts and third in both long-term effects and overall ranking. However preliminary review of the geology indicates a low probability of success. Disposal to The Geysers, G, ranks sixth in short-term effects because of the length of the pipeline but is ranked first in long-term effects and first in overall ranking. Of the surface water disposal alternatives, disposal to Cache Creek ranks first in long-term and overall ranking.

It may be noted that while the environmental effects of Alternative G, The Geysers disposal, have been analyzed in detail in this EIR/EIS, the other alternatives have received less in-depth analysis. Any of these other alternatives would require further environmental review prior to adoption as the environmentally preferred option and/or implementation, including air quality and noise issues.

1991 estimated construction costs of each alternative are listed in Table 3.2-8.

TABLE 3.2-8**SUMMARY OF CONSTRUCTION COSTS OF ALTERNATIVES**

Alternative	Discharge to	Project Construction Cost, \$ ⁽¹⁾
A	Land Disposal	23,390,000
B1	Unnamed Tributary of Cache Creek	14,950,000
B2	Cache Creek	15,870,000
C	Phipps Creek/North Fork of Cache Creek	16,020,000
D	Clear Lake	14,720,000
E	Borax Lake	8,340,000
F1	Audrey Geothermal Well	8,220,000
F2	Borax Lake Geothermal Well	8,220,000
F3	New Geothermal Well at SERWTP	8,900,000
G	Geysers Recharge	17,000,000 ⁽²⁾

Notes:

(1) Based on ENR, 20 Cities Construction Cost Index of 5000

(2) LACOSAN share of actual cost to construct plant improvements and disposal based on avoided costs of proposed project (B2). Total construction costs are much higher.

Source: Dewante & Stowell, September 18, 1991 As reproduced by Goddard & Goddard Engineering

3.3 POSSIBLE FUTURE SYSTEM MODIFICATIONS ALTERNATIVE

In the event that at sometime in the future the geothermal industry would decide to stop or cut back the amount of effluent it would accept for injection in the Southeast Geysers, it may be necessary for LACOSAN to undertake some modifications to the treatment and disposal system. It is important to note that such modifications would not be the result of some type of emergency situation, as the proposed plan addresses this situation. Rather, these modifications would occur because of a longer range change in operation of the system because the industry would see the need to reduce injection operations. At present, this seems unlikely to occur because of the nature of the steam field and its capability to produce steam with all the effluent of the project for its 25 year design life. Additionally, the final Agreements between LACOSAN and the geothermal partners (NCPA, Calpine, Unocal and PG&E) will contain provisions that the industry will provide at least two years' notice of its intent to reduce receipt of effluent. Financial provisions would be established to address emergencies, system modifications or unforeseen replacement costs.

At present, it is not possible to identify the specific nature of the system modifications. Some of these modifications have been evaluated already, as discussed in Section 3.2. Possible system modifications might include the following concepts.

1. Reduce flows of effluent to The Geysers. A smaller volume of effluent would be conveyed in the pipeline to The Geysers. This would likely entail reducing the diversion of lakewater from Clear Lake as a first step in modification of the system.
2. Provide intermittent flow of effluent to The Geysers. This would entail a period reduction of effluent flow for periods when it is needed for power production. These might be seasonal or short-term reductions based on adjustments to the systems operating strategy for injection.
3. Dispose of effluent through a broader program of land irrigation similar to that described in Section 3.2.
4. Use effluent to create wetlands or greenbelts.
5. Apply treatment technologies that provide for a higher quality of effluent, making it available for a wider range of reuse possibilities. This might include tertiary treatment and additional new technologies, such as reverse osmosis.
6. Find new re-uses for the wastewater. New re-uses might be found in future industrial applications, agriculture, golf courses and other types of development.

3.0 Description of Alternatives to the Proposed Project

3.2 SERWTP Facilities Plan Alternatives

Because the possible future system modifications are speculative, it is not possible to evaluate their environmental effects in this EIR/EIS. Additionally, the provision of a plan for back-up systems to wastewater treatment is not a requirement in California. It is assumed that, if such system modifications are required in the future, they will be given to detailed environmental evaluation at that time.

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4.0 AFFECTED ENVIRONMENT

4.1 STUDY APPROACH

The approach to this EIR/EIS is focused on providing information that is useful to the decision makers and concerned public in understanding the nature of the project, the existing conditions of the environment that potentially would be affected by the project, and the impacts that would or could result from the project's implementation. The EIR/EIS attempts to present the information which is most important to understanding these conditions and relationships. For this reason, information presented in this section varies in detail according to several considerations. 1) Information is presented which is needed to understand impacts to the environment that may be significant. In most cases, this information is presented in detail. Exceptions occur where the pertinent information is of a sensitive nature, as in the cases of cultural resources. In these exceptional cases, the EIR/EIS presents only summary information. 2) Information is presented in detail for issues which were noted as matters of public concern, as determined in the public scoping process. For some issues, the findings of the EIR/EIS authors may or may not indicate a potential for significant impact. However, because of the need to present information about how the findings were made, some detailed information on the key issues has been presented. 3) In general, if the proposed project has little potential to affect changes in a given environmental topic, information on the existing conditions is presented in summary form only.

In each of the topical sections of the Affected Environment, an overview of general conditions, classification systems and regulatory/planning framework is presented first. Next, pertinent information to each of the three components of the project is presented, with detail and organization appropriate to the nature of the component and the issues surrounding it. The SERWTP Facilities Plan Component has been taken wholly and without substantive change in text wording from the previous Draft EIR on the Southeast Regional Wastewater System Improvement Facilities Plan, prepared by Goddard & Goddard Engineering. Some text revisions were made to eliminate discussion of items that related to the discharge of effluent into Cache Creek at Peachtree Crossing, a disposal option that has been eliminated from the current SERWTP Facilities Plan. Additionally the current text includes some revisions to the plan initiated after the original Draft EIR was published. It is recognized that there is some inconsistency in presentation style between those sections and other parts of the report. Lastly,

4.0 Affected Environment

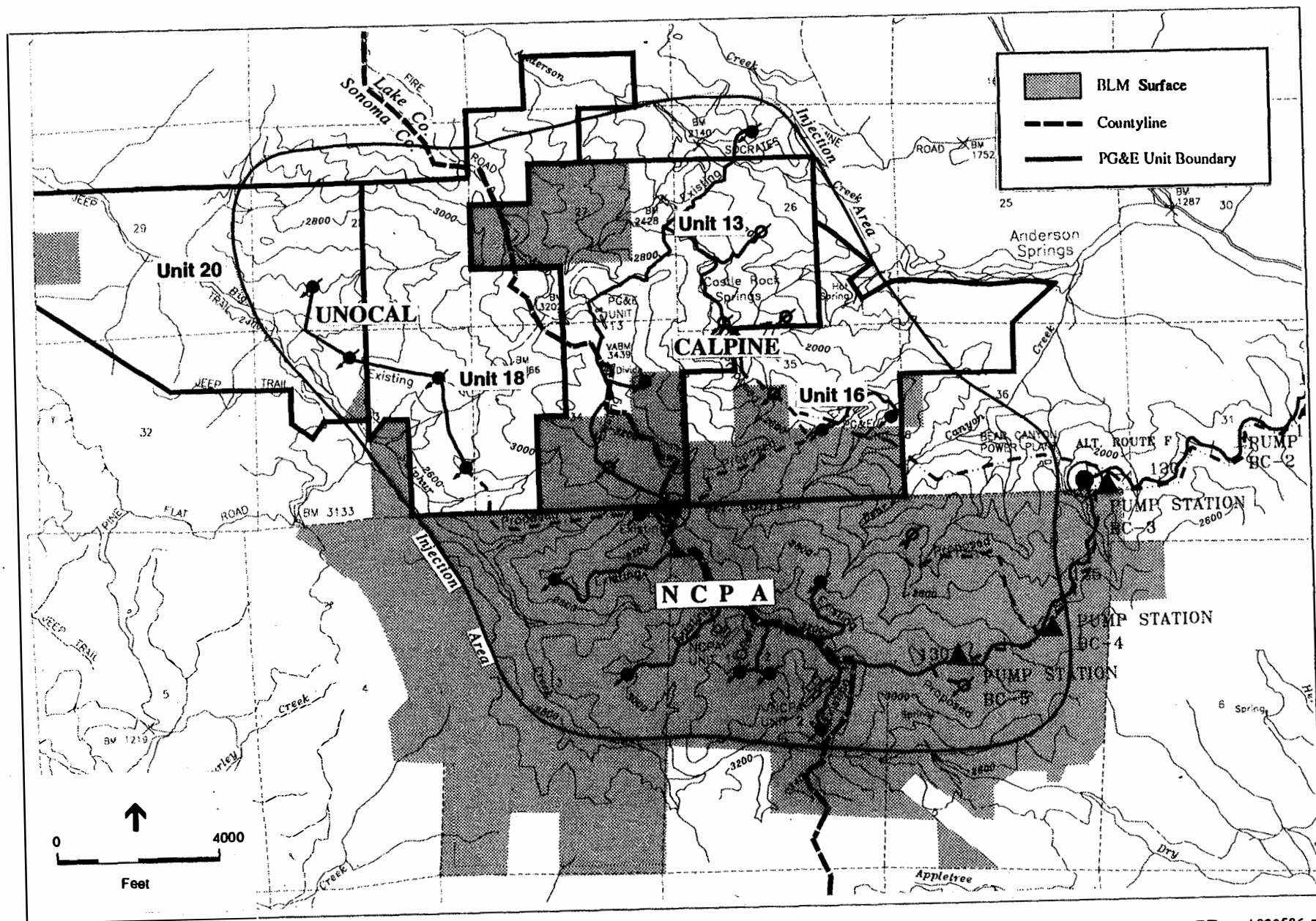
4.1 Study Approach

each topical section presents a discussion of the affected environment specific to alternative designs and locations for the project facilities. To avoid repetition of text, appropriate cross-referencing of similar issue treatments is included in the text of all sections.

4.2 PROJECT LOCATION

The project area is located in the southern portion of Lake County and the northeastern portion of Sonoma County, California (Figures 2.1.3-A through E). Proposed project facilities would be located between Clear Lake on the north and The Geysers on the south. The proposed Lake Diversion is located at the lower arm of Clear Lake and its associated pipeline to the SERWTP would be located in Burns Valley in the northern part of the City of Clearlake. The SERWTP is located immediately north of the city. The Geysers Effluent Pipeline route passes through the City of Clearlake, and crosses the Clear Lake Outlet Channel, which is the city limit. The pipeline passes through lands administered by the County of Lake, through the community of Lower Lake and from that location is located entirely in rural areas to its terminus in The Geysers. South of Lower Lake, the route crosses a low hilly area and then passes through Excelsior Valley following the drainage of Copsey Creek and Highway 29. The route then ascends into mountainous terrain, passing through the Sweet Springs Creek Valley to the ridge just below Childers Peak. This would be the site of the proposed Childers Peak Regulating Tank. The route descends the ridge entering the Big Canyon area. From there it follows local roads, briefly crossing overland and rising over a small ridge before dropping into the Collayomi Valley northwest of Middletown. The route passes through the MWTP property, skirting the edge of Highway 175. At the Bear Canyon Access Road, the route begins its steep ascent into the Mayacmas Range to The Geysers.

The terminus of the Geysers Effluent Pipeline and the end distribution system are located in the high-lying portion of the Southeast Geysers, south and west of the community of Anderson Springs (Figure 4.2-1). The area of the proposed end distribution system and injection is a developed geothermal energy field. The field in this area is both federal land managed by the U.S. Bureau of Land Management (BLM) and also privately owned land in both Lake and Sonoma Counties. The BLM leases the land to NCPA, Calpine and Unocal. Calpine and Unocal lease private lands for geothermal energy development. Leasehold areas included in the project are owned by Calpine to the north, NCPA to the south and Unocal to the west. Calpine operates its steam field and supplies steam to Pacific Gas and Electric Company (PG&E) which owns and operates two power plants (Units 13 and 16) that would benefit from the proposed project. NCPA supplies steam in its leasehold to two power plants, NCPA-1 and NCPA-2, which would benefit from the proposed project. Other PG&E power plants and Calpine's Bear Canyon Power Plant are located in the general area but are not part of this project. Unocal operates its steam field and supplies steam to PG&E's power plants (Units 18 and 20). Other Unocal operations and PG&E power plants supplied by Unocal are not part of this project.



Southeast Geysers Effluent / 920586 ■

SOURCE: Environmental Science Associates

Figure 4.2-1
Project Injection Area in the Southeast Geysers

Sections 4.3 through 4.15 present descriptions of the affected environment within the area described above.

In this EIR/EIS locations are referenced by station numbering which is set at intervals of 1,000 feet (0.0). The 1,000-foot stations are indicated in Figures 2.1.3-B through E. The stationing is indicated in the text in abbreviated format. For example, station post 10,500 feet is indicated as Station 10.5. The initial point for all stations is the SERWTP Pump Station (0.0). Stations in reference to the Lake Diversion Pipeline are preceded by the letter "M". Stationing is not indicated for the secondary distribution lines in The Geysers.

In some tables taken from the Preliminary Design Report, the stationing is reported in slightly different format. In the above example station 10,500 feet is identified as Station 10+50.

4.3 GEOLOGY, SEISMICITY, AND SOILS

4.3.1 OVERVIEW OF GENERAL CONDITIONS

The following discussion presents general regional characteristics of the geology and seismic conditions of the area, followed by a more detailed break-out of information along the alignment presented in an extended table format.

4.3.1.1 GEOLOGY

The project is located in the north central part of the Coast Range Geomorphic Province. This province is bounded on the west by the Pacific Ocean and on the east by the Great Valley Province. The geology of the Coast Range Province is structurally complex and includes several active and potentially active faults of the 60 to 125 mile wide San Andreas Fault System.

Bedrock consists predominantly of rocks of the Franciscan Complex, including marine sandstone, shale, volcanics, and serpentinite. On a regional basis, these rocks are structurally deformed and mildly to moderately metamorphosed (that is, changed by heat and pressure from their parent rocks). Franciscan rocks range in age from 100-150 million years old, and are often referred to as the "basement."

In the Coast Range Geomorphic Province, Franciscan rocks are found to be in contact with thick marine sandstones and shales of the Great Valley sequence. Rocks from this sequence are less voluminous in this province than those of the Franciscan complex, and are also less structurally deformed and less metamorphosed.

Throughout parts of the Coast Range Province, geologically younger bedrock formations have locally been deposited upon the older Franciscan and Great Valley sequence rocks. In Lake County, these younger deposits include the Clear Lake Volcanics (2.1 million years old to 10,000 years old) and continental deposits of the Cache Formation. Units of the Cache Formation are generally soft rock, while the rock units of the Clear Lake volcanics range from very hard (lava flows) to soft.

Surficial deposits within the Coast Ranges and the Lake County region consist predominantly of valley alluvium (stream deposits) and hillslope deposits. Major alluvial plains along the project route include Burns Valley, the Lower Lake area, Excelsior Valley and Collayomi Valley (see

Figures 2.1.3-B through 2.1.3-E). Hillslope deposits are mainly colluvial soils (derived from alluvium combined with rock fragments) and landslide debris. There are lesser and more localized amounts of stream channel deposits and muds, peaty muds, and gravelly deltaic deposits. These latter deposits occupy the margins and bottoms of Clear Lake. Surficial deposits also consist of engineered and unengineered artificial fills associated with various types of earthworks for both public and private improvements, including major roads and highways.

The large, deeply buried body of molten rock (magma chamber) present in the area just south of Clear Lake is responsible for the past volcanic activity of the area which substantially modified the existing pre-historic landscape (Hearn, et al., 1981). The massive amounts of heat produced by this and other related magma chambers have also produced the hot water and super-heated steam resulting in the major energy resource of the county known as The Geysers Geothermal Area.

The underlying bedrock geologic structure within the Lake County region and much of the Coast Ranges is tectonically active (that is, active mountain-building processes are present) and continues to evolve in response to movements along the geographically vast North American and Pacific Plates. The dynamic aspects of this evolution are reflected in Lake County by active faulting, youthful, rugged topography with associated landsliding, and geologically recent volcanism. The depression that forms the Clear Lake Basin owes its origin to this volcano-tectonic activity.

4.3.1.2 TOPOGRAPHY

The topographically rugged Coast Range Province is known for its widespread landslide/soil creep conditions. Principal topographic/geomorphic features in the region of Lake County through which the project traverses include the Clear Lake Basin on the north (water level elevation of about 1,300 feet); a series of rugged northwest trending ridges and canyons of moderate elevation along the central part of the alignment (maximum elevation of about 1,700 feet near Childers Peak); narrow to broad valleys to either side of these ridges; and on the south-southwest, the topographically higher and equally rugged main ridge line of the Mayacmas Mountains (maximum elevation of about 3,500 feet) which contain the steamfield portion of the project.

A regional characteristic of Coast Range topography is the well developed, northwest-southeast alignment of principal ridges and narrow intervening canyons/valleys. This topographic alignment is the result of long term differential erosion controlled by the northwest-southeast trend of the underlying bedrock structure (principal folds and faults). Along the project, this topography is best developed from the vicinity of Sweet Springs Creek southwesterly to the terminus of the project within the steam field. For a few miles south and east of Clear Lake (near the beginning of the project) this topographic trend is absent or not fully developed. This is a result of more recent erosion patterns developed on the geologically much younger Clear Lake Volcanics and Cache Formation. In these areas erosion has resulted in hills and broader valleys that are less linear, more irregular, or rounded and mostly lower in elevation. The valleys in this general area are related to the ancestral Clear Lake Basin and most open toward present day Clear Lake.

4.3.1.3 SLOPE STABILITY AND GEOMORPHIC PROCESSES

Many of the diverse geologic conditions and processes active within the Lake and Sonoma County region, depending on location, can be hazardous or a beneficial resource. For example, the generally high rainfall has promoted deep weathering of bedrock formations, with resultant development of locally thick soil deposits and softening of the underlying rock. On hillsides this often leads to instability and landsliding, which can cause damage to improvements. There is also soil creep on sites of the project components located on steeper slopes.

The same rainfall and rates of weathering have also aided in the production of the region's agricultural soils, which occupy valleys and more gently sloping areas. However, accelerated erosion, caused by the disturbance of the natural surface by such activities as grading, can remove these valuable soil resources and also affect streams. Accelerated erosion is occurring along some parts of the project.

4.3.1.4 SEISMICITY

No active faults are known to cross or closely approach the proposed alignment. A fault is designated as active by the California Division of Mines and Geology (Special Publication 42, 1992) if it has "had surface displacement within Holocene time (about the last 11,000 years)". This does not mean that faults having no evidence of surface displacement within Holocene time are necessarily inactive. Depending on circumstances, it is often prudent or necessary to investigate faults to confirm their inactivity before proceeding with a particular development.

Regionally, the broad, highly segmented Konocti Bay Fault Zone projects southeastward from Clear Lake and extends into the Childers Peak fault, which is of similar southeast trend (see Figure 4.15.2-B in Section 4.15). The Childers Peak Fault is crossed by the effluent pipeline in the general vicinity of Childers Peak. From near Highway 29 and northwestward, most of the segments of the Konocti Bay Fault Zone are designated as active (California Division of Mines and Geology, Special Publication 42, 1992). However, to the southeast, the fault zone is not designated as active (there is no evidence indicating surface movement on the fault occurring within the last 11,000 years), nor is the Childers Peak Fault designated as active.

The northwest-southeast trending Collayomi and Cobb Mountain Faults cross the pipeline alignment in the vicinity of Collayomi Valley. These faults are not designated as active by the division of Mines and Geology, but evidence indicates that both have undergone surface movement in latest Quaternary (Collayomi Fault—somewhat older than Holocene—over 11,000 years before present) to earlier Quaternary (Cobb Mountain Fault—up to two million years before present). The Collayomi is a major fault zone. Empirical relationships based on fault length indicate a fault such as the Collayomi could undergo a few to several feet of surface displacement in the event it experienced a maximum magnitude earthquake. Information is incomplete on the potential for the Collayomi Fault to undergo movement during the lifetime of the project. That the fault is not designated as active suggests that the potential is low, although the evidence is not conclusive.

Ground shaking caused by earthquakes will be episodically experienced by the Lake County region. The vast majority of such shaking should be well below the threshold for damage to properly designed, constructed, and maintained improvements. Good engineering practice requires that facilities such as those comprising the project be designed to withstand the effects of the "design earthquake". A "design earthquake" is developed as part of overall project design. Further discussion of seismicity in the Southeast Geysers is provided in Section 4.15.

4.3.2 GEYSERS EFFLUENT PIPELINE COMPONENT

Table 4.3.2-1 summarizes geologic conditions of the pipeline route. Locations are referenced by station posts along the alignment of the lake diversion pipeline (station numbers preceded by the letter "M") and the main effluent pipeline, as indicated in Figures 2.1.3-B through E.

The classification system used for information developed and for its discussion herein consisted of preparing a tabulation of conditions encountered during the geologic reconnaissance of the project components (with the exception of the SERWTP Facilities Plan Component).

Segments of the pipeline components are identified by station numbers which approximately bracket their locations. Each segment and non-pipe component are discussed in the tabulation under two main topic headings. These are: 1). Alignment Segment (listing the approximate stationing of the segment and describing principal existing and proposed improvements); 2). Existing Geological Environment (describing terrain, drainage, bedrock formations, surficial deposits, spring/seepages and observed geologic hazards; and important conditions and Comments, which provide comment or discussion on environmentally sensitive segments of the pipeline or other project components.

4.3.3 GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT

Geologic conditions in the Geysers injection area are described in Table 4.3.2-1. Seismicity in the injection area and wider region is described in Section 4.15.

4.3.4 SERWTP FACILITIES PLAN COMPONENT

4.3.4.1 PROJECT GEOLOGY AND SEISMICITY

Physiography

Land surfaces in and around the existing treatment and disposal site range from gentle slopes of less than 5 percent grade to steep mountain sides exceeding 50 percent grades. The existing disposal area is located on predominantly 0 to 30 percent slope terrain. Elevations vary from 1,380 to over 1,800 feet above sea level (USGS) in Burns Valley sloping to the southwest toward Clear Lake. Most is between 1,400 and 1,600 feet msl elevation.

Bedrock Geology at the SERWTP

The SERWTP area is underlain by rocks of the Franciscan Assemblage from late Jurassic to late Cretaceous age, with some olivine basalt flows of Quaternary age. The Franciscan rocks consist of a complex assemblage of varied rock types including graywacke, shales, greenstone and metamorphics (Kleinfelder & Associates, 1986).

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations M0.0 to M3.0 <u>Principal Improvements:</u> Existing SERWTP Wastewater Ponds immediately north of Station 0.0	<u>Terrain:</u> Low, rolling, slightly dissected hills immediately north of Burns Valley. Elevation is 1,400 feet ± msl <u>Drainages:</u> Localized, poorly developed, gently sloping drainage swales. <u>Bedrock Formations:</u> Graywacke sandstone/shale of the Franciscan Complex present a few to several tens of feet below ground surface. <u>Surficial Deposits:</u> Older alluvium and terrace deposits of sand and gravel associated with the ancestral Burns Valley. These deposits are probably a few tens of feet or more in thickness. Soils present (SCS) are Phipps complex (north part of alignment segment) and Manzanita gravelly loam (south). The former soil complex is a very deep, well drained clay loam which forms on uplifted and dissected hills. Erosion hazard is moderate due to gentle slopes, the shrink-swell potential is high, and load bearing capacity is low. The latter soil is very deep and well drained, with a gravelly clay subsoil. This soil develops on terraces. Because of gentle slopes it has only a moderate erosion hazard. <u>Springs/Seepages:</u> No springs or seepages observed. However, a shallow, perched groundwater level may be present at shallow depths due to wastewater spraying between about Stations M1.0 and M2.5, and the presence of the large wastewater lagoon just north of Station M1.0. <u>Geologic Hazards:</u> Possible trench wall instability, otherwise adverse geologic conditions or geologic hazards not observed. <u>Important Conditions and Comments:</u> The probable presence of saturated soils in the near surface may result in wet trenching conditions and potentially unstable trench sidewalls during construction. No adverse geologic conditions.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations M3.0 to M9.0	<u>Terrain:</u> Nearly flat to gently rolling terrain along the northern and central parts of Burns Valley. Elevation is about 1,370 feet msl.
<u>Principal Improvements:</u> Alignment traverses along existing roads (Robin Lane, Smith Lane, Reid Lane), and through oak studded grasslands and walnut groves. Exclusive of the oak studded grasslands, the alignment segment passes through or along low density residential subdivision. Road ways are gravel surfaced. At Station M7.5 there is a small structure suggestive of a well house.	<u>Drainages:</u> At Station M3.5 is a small (2½ to 4 feet deep and 4 feet wide) channelized drainage ditch in slightly rocky light brown sandy soil. Drainage is from north to south. Becomes unimproved natural drainage ditch approximately 50 feet to north of alignment. Drains into subdivision immediately south. Not flowing (4/13/93). At Station M4.2 is a small (one foot deep ten feet wide) meandering drainage swale. Surface wetness present on 4/13/93. At Station M5.8 is a small (6 feet wide and 18 inch deep) unimproved drainage ditch. The ditch drains westerly beneath Smith Lane via existing culvert. Smaller tributary drainage ditch parallels the west side of Smith Lane and is tributary to the above described ditch. Between Station M7.7 and M8.5 drainage ditch parallels Reid Lane. At Station 8.5 drainage passes beneath Reid Lane. <u>Bedrock Formations:</u> Graywacke sandstone/shale of the Franciscan Complex present at the base of alluvial fill. <u>Surficial Deposits:</u> Valley alluvium, probably many tens of feet thick. At surface the alluvial soils are light brown, crumbly, slightly gravelly sandy to silty loam. Alluvial deposits are probably several tens of feet thick. Soils present (SCS) are Manzanita gravelly loam described above <u>Springs/Seepages:</u> None observed. <u>Geologic Hazards:</u> None observed. <u>Important Conditions and Comments:</u> No adverse geologic conditions noted. Existing drainage ditches and culverts will have to be replaced/reconstructed as necessary following construction.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations M9.0 to M14.5. <u>Principal Improvements:</u> This segment continues westerly along Reid Lane to the intersection of Burns Valley Road and thence to Arrowhead Road. Alignment leaves Arrowhead Road and trends southeasterly along Washington Street and thence to Lakeshore Drive. Between Stations M10.5 and M11.2 there is an area of surface disturbance to either side of the alignment which may be an abandoned borrow pit. Just north of intersection of Arrowhead Road and Washington street is a school. From this intersection westerly along the alignment denser residential development is present.	<u>Terrain:</u> Terrain is gently rolling to intersection of Arrowhead Road and Washington Street. From this point westerly along the alignment, slopes drop off gently to moderately toward the edge of Clear Lake. Elevations range from about 1,360 to 1,400 feet msl. <u>Drainages:</u> None observed. <u>Bedrock Formations:</u> Clear Lake Volcanics consisting of Rhyolite (Station M9.2 to M14.3) and basalt and dacite (Station M14.3 to M14.5). Short, approximately located faults at Stations M9.4, M11.9, and M13.5 not know to be active. <u>Surficial Deposits:</u> Thin valley alluvium along the north edge of Burns Valley (Kidd-Forward complex), consisting of loam to gravelly loam , shallow (less than 2 feet), excessively drained, moderately rapid permeability, moderate erosion hazard, and poor topsoil. From Station M12.5 to M14.5 Cole Variant clay loam varying from clay loam to clay, deep, low strength, shrink- swell properties and slight erosion hazard. <u>Spring/Seepages:</u> None observed. <u>Geologic Hazards:</u> Possibly weak soils Station M12.5 to M14.5. <u>Important Conditions and Comments:</u> Possibly saturated weak clay in trench sidewalls and foundation excavations (Stations M12.5 to M14.5). Expect very shallow groundwater near lake elevation.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations M14.5 to M16+	<u>Terrain:</u> Between Station M14.5 and M14.7 Lakeshore Drive has a moderate gradient. Beyond Station M14.7 the terrain is flat to the edge of the lake. Elevations are between about 1,400 and 1,320 feet msl.
<u>Principal Improvements:</u> Alignment traverses along existing streets; primarily residential neighborhood. Edge of lake at about Station M15.9. Beyond Station M15.9 for approximately 300 feet pipeline will be offshore. Intake will be at about 30-35 feet below lake surface Pump Station on vacant lot at Station M15.5.	<u>Drainages:</u> Drainage channels not observed. <u>Bedrock Formations:</u> Graywacke sandstone of the Franciscan Complex and rhyolite and dacite of the Clear Lake Volcanics. Both Formations mantled by surficial deposits. <u>Surficial Deposits:</u> Similar to those encountered between Stations M12.7 and M14.5. Artificial fill likely present between Station M15.0 and water's edge. Lake bottom deposits from water's edge to intake opening, likely consisting of an unknown thickness of soft, weak/compressible saturated lake bottom deposits. <u>Springs/Seepages:</u> None observed. <u>Geologic Hazards:</u> None observed, but possible settlement of lake muds with resultant deformation (damage to offshore, subsurface pipeline). <u>Important Conditions and Comments:</u> Geologic hazards as noted. Saturated fine soils and artificial fill anticipated in the shallow subsurface Station M14.5 to edge of lake. Soft lake bottom deposits in the offshore, resulting in unstable excavations and weak foundation materials. (See Section 5.2.2.)

4-14

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
EFFLUENT PIPE ALIGNMENT	
<u>Approximate Stationing:</u> Stations 0.0 to 2	<u>Terrain:</u> Moderate to moderately gentle slopes from Station 0.0 to 0.7 and then gently rolling to nearly flat terrain to Station 2. Elevations range from a few tens of feet below to a few tens of feet above 1,400 feet msl.
<u>Principal Improvements:</u> At Station M0.0 is a proposed pump station located immediately adjacent to existing SERWTP on the west and immediately above a large, concrete lined spillway on the east. Spillway serves wastewater lagoon located a few hundred feet to the north. From Station 0.0 to 1.5 alignment traverses across open grasslands, intersects access road to the wastewater facility, traverses south to the eastwest trending public road and then traverses westerly to Robin Lane. Area south of entrance to wastewater plant is low density residential subdivision and walnut groves.	<u>Drainages:</u> From about Station 0.1 to 0.5 there is a broad deep swale with an incised channel along the bottom which drains southerly. This swale receives water from the wastewater lagoon spillway. <u>Bedrock Formations:</u> Bedrock mantled by surficial deposits, but probably bedrock of Franciscan complex. <u>Surficial Deposits:</u> Surficial deposits consist of sand and gravel associated with the ancestral Burns Valley. These unconsolidated deposits are probably up to a maximum of a few tens of feet in thickness. From Station 0.0 to 0.8. The Soil Conservation Service (SCS) designates the soils as Phipps complex. These soils consist predominately of clay loam to clay in the subsoil, and underlain by a gravelly layer (terrace deposits). Surface runoff from these soils is rapid and the hazard of erosion is moderate. They have high potential for shrink-swell. <u>Springs/Seepages:</u> Surface wetness noted from Station 0.1 to 0.5 and is associated with the broad swale into which the spillway outfalls. <u>Geologic Hazards:</u> Anticipate saturated, potentially unstable soils when trenching; otherwise no geologic hazards observed. <u>Important Conditions and Comments:</u> Between about Station 0.0 and 0.5 anticipate saturated conditions in gravelly clay loam soils. Proximity of drainage swale to alignment will require protection against siltation. Minor to moderate grading required to develop flat space for pump station structure.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Station 2 to 5.5 <u>Principal Improvements:</u> In this segment the alignment traverses south along the west edge of Robin Lane to the immediate vicinity of Burns Valley Creek at Station 4.4 Pipeline then crosses road and crosses Burns Valley Creek below stream channel grade (to be buried beneath stream bed just east of existing bridge). Alignment then continues southerly to Station 5.5. Other improvements consist of low density residential subdivision and interspersed walnut groves.	<u>Terrain:</u> Essentially flat slopes of Burns Valley draining very slightly toward Burns Creek. Elevation on the order of 1,380 feet msl. <u>Drainages:</u> Burns Valley creek is the principal drainage. At the pipe crossing, the creek channel is about 15 to 20 feet wide and incised down through alluvium and topsoil for 10 to 15 feet. Six to eight inches of flowing water in channel on 4/13/93. <u>Bedrock Formations:</u> Bedrock mantled by valley alluvium, but bedrock of clear Lake Volcanics probably present several tens of feet below. <u>Surficial Deposits:</u> Valley floor is covered with several tens of feet of unconsolidated valley alluvium. Principal soil types present (SCS) are Manzanita Gravelly loam, Lupoyoma silty loam and Still gravelly loam. All of these soils are deep to very deep, well drained clayey loams, silty loams, and gravelly loams. They form on flood plains and alluvial plains and have moderate to low erosion hazard. Construction would occur in road. <u>Springs/Seepages:</u> None observed. Anticipate saturated condition in the excavation beneath Burns Valley Creek. <u>Geologic Hazards:</u> Except for saturated, unstable excavations, no hazards observed. <u>Important Conditions and Comments:</u> Anticipate saturated, unstable trench walls at creek crossing. Potential for stream degradation/siltation due to construction. Remainder of segment presents no adverse geologic conditions.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Station 5.5 to 6.8	<u>Terrain:</u> The alignment traverses along low gently rolling hills bordering the southern edge of Burns Valley. Elevations range from about 1,380 to about 1,400 feet msl.
<u>Principal Improvements:</u> From Station 5.5 to 5.8 the alignment continues along the unimproved right-of-way for Robin Drive. At Station 5.7 there is an east west road and to the south of this the alignment continues with a slight jog at 5.7, southerly along Brown Street to Olympic Drive at Station 6.8. Low moderate density residential subdivision, along this segment.	<u>Drainages:</u> Alignment crosses small, natural drainage channel (one to two feet deep and six inches wide) draining north to south through orchard area. <u>Bedrock Formations:</u> Bedrock mantled by alluvium. Soft bedrock of Cache Formation likely present at depth. <u>Surficial Deposits:</u> Valley alluvium present which thins to the south at edge of valley at Station 6.5. Soils present (SCS) are Upyoma siltloam and Manzanita loam. Both soil types are very deep, well drained and have clay loam to gravelly clay loam in the subsoil. The erosion hazard is slight to moderate. The Manzanita loam forms on terraces. Construction would be in roads. <u>Springs/Seepages:</u> At Station 5.2 is a low topographic area of poor drainage. Surface wetness noted on 4/13/93. <u>Geologic Hazards:</u> None observed. <u>Important Conditions and Comments:</u> Anticipate saturated, weak soils in trench excavations between Station 5.0 and 5.4.

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 6.8 to 8.2 <u>Principal Improvements:</u> At Station 6.8 alignment traverses northeasterly along Olympic Drive for approximately 100 feet and then southerly upslope on oak covered hillside with low density residential. At Station 7.8 is a large, steel, municipal water storage tank about 25 feet east of the alignment.	<u>Terrain:</u> From Station 7.0 to 7.8 alignment traverses up moderately steep slopes to hilltop. From 7.8 to 8.2 alignment traverses along essentially flat hilltop. Elevations range from 1,380 feet at Olympic Drive to 1,520 feet msl at hilltop. <u>Drainages:</u> None observed. <u>Bedrock Formations:</u> Hard basalt flowrock of the Clear Lake Volcanics. Bedrock appears to be near or at the surface based on the presence of large, dark grey, very hard blocks exposed at surface with intervening soils. Thin patchy, rocky, sandy soils. <u>Surficial Deposits:</u> Soil types present (SCS) are Konocti-Hambright complex which consists of gravelly to very gravelly loam with rock outcrops and stones from ten inches to fifty feet in diameter. These soils well drained with hard basalt at two feet or less and moderate to severe erosion hazard. Construction would be in roads. <u>Springs/Seepages:</u> None observed. <u>Geologic Hazards:</u> High potential for accelerated erosion on hillslope segment. <u>Important Conditions and Comments:</u> Very difficult excavation conditions; conventional trenching not possible; other form of excavation or blasting required. Potential for accelerated erosion on steep hillslope segment.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Station 8.2 to 15.5 <u>Principal Improvements:</u> At about Station 8.5 the alignment passes beneath State Highway 53 and continues eastward and uphill to Pine Avenue at the base of Schoolteacher Hill. At this location the alignment is near the northwest end of a large old, partially developed hillside subdivision whose streets are laid out on a north-south and east-west grid. The alignment traverses south then easterly and then south again on the subdivision streets to Station 15.5. Dense to low density homes and mobile homes on oak and grass covered hillsides and hilltops.	<u>Terrain:</u> The alignment traverses along gently sloping to moderately sloping and occasionally short moderately steep intervals of hillside and hilltop terrain. Elevations range from about 1,520 to 1,560 feet msl. <u>Drainages:</u> Broad shallow south draining swale between Station 8.2 and 8.7; on Pine Street between Stations 9.4 and 9.6 are moderate slopes leading down to a small east to west drainage ditch passing under Pine Street via culvert; at the intersection of Davis and Cedar Avenues (Station 10.8) is a southwest trending drainage which passes beneath the intersection via culvert and artificial fill. Beyond the culvert outfall on southwest this drainage has eroded into a large gully on moderate to moderately steep sideslopes; on Cedar Avenue at Station 11.3 is a small south draining ditch; at Station 13.5 along 43rd Avenue is a small south draining gully incised into moderate to moderately steep sideslopes, gully channel shows some evidence of accelerated erosion; at Station 15.5 along Irving Avenue is small, west draining, drainage with a gentle gradient which passes beneath the road via culvert. This referred to as Molesworth Creek on the topographic map. <u>Bedrock Formations:</u> From Station 8.2 to 8.0 consists of near surface basalt of the Clear Lake Volcanics. At Station 8 is a short, presumably inactive, northeast trending fault. Beyond the fault to Station 15.5 the bedrock beneath soil mantle is the Cache Creek formation consisting of sandstone, conglomerate, siltstone, and tuff. Bedrock formation mantled by surficial deposits. <u>Surficial Deposits:</u> Between Station 8.2 and 8.7 is an artificial fill over the drainage swale with a culvert at the base of the fill. Remainder of segment consists of silty, sandy, rocky soils, which locally display rutting and rilling. Soil types present (SCS) consist predominantly of Bally-Phipps complex along the northern part of the segment and Phipps complex over the majority of the segment. Bally- Phipps complex consists of gravelly to very gravelly sandy clay loams with grey clay loam to gravelly sandy clay in the subsoil. These soils are deep, with moderate to severe erosion hazard and develop on uplifted, dissected hills. The Phipps complex soils are clayey loam or gravelly loam in the subsoil. They are moderately deep to shallow, moderately well drained, have a high shrink-swell potential and have severe erosion hazards. The third of these soils is very deep, well drained on alluvial planes. The subsoil is a clay loam and has slight erosion hazards. This latter soil occupies that part of the alignment west of Highway 53 in this segment. The Skyhigh-Sleeper-Millshom association occupies the majority of the segment. Construction would be in roads. <u>Springs/Seepages:</u> None observed.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Station 8.2 to 15.5 (Continued)	<u>Geologic Hazards:</u> Potential for slope instability along the outside of the road where there is steep high drop-off and artificial fill. Potential for accelerated erosion. <u>Important Conditions and Comments:</u> Potential for geologic hazards as noted. Anticipate possible difficult trenching conditions due to shallow bedrock, otherwise adverse geologic conditions not noted.
<u>Approximate Stationing:</u> Station 15.5 to 20.0 Segment continues along Irving Avenue which traverses across moderately rocky hill country. <u>Principal Improvements:</u> Subdivision as previously described.	<u>Terrain:</u> South of Molesworth Creek. Elevations are approximately 1,520 to 1,560 feet msl. Slopes range from gentle to occasionally moderate or moderately steep at small drainage crossings. <u>Drainages:</u> At Station 15.5 is Molesworth Creek (previously described). Along the west side of Irving Street between 35th and 36th Streets (Stations 15.7 to 15.9) there is a small drainage ditch which parallels the road. At Station 17.9 a small, seasonal creek which drains to the southwest is crossed by the alignment. Channel has gentle gradient; moderate slopes leading down to creek from north and south. From 17.9 to 18.1 this creek runs diagonal to and down moderately steep slopes from the alignment (Irving Street). The drainage channel is about 3 to 4 feet wide and two to three feet deep and drains westerly. <u>Bedrock Formations:</u> Segment underlain by sediments of the Cache formation as described above. Near south end of segment are a few, nearby, small exposures of basalt of the Clear Lake Volcanics. Bedrock over the remainder of the segment is mantled by surficial deposits. <u>Surficial Deposits:</u> Deposits consist of gravelly, crumbly to dense sandy silty clays. As described by the SCS these soils consist of those of the Asbill clay loam which are moderately deep, well drained and with clay in the subsoil; high shrink- swell potential and moderate erosion hazard. Minor to moderate rutting and rilling present along roadway where slopes are relatively steeper. Construction would be in roads. <u>Springs/Seepages:</u> None observed. <u>Geologic Hazards:</u> Some potential for slope instability between Station 17.8 and 18.1 and potential for accelerated erosion on relatively steeper slopes. <u>Important Conditions and Comments:</u> Potential for slope instability and accelerated erosion as noted. Alignment may encounter occasional large basalt blocks in trench excavation. The only sensitive locations are at the drainage crossing and where drainage channel approach alignment.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> From Station 20.0 to 25.0 <u>Principal Improvements:</u> At Station 20.1 Irving Street terminates and the pipeline continues south along the unimproved right-of-way for a few hundred feet turning easterly for about 700 feet and then southerly on Boyles Avenue. Alignment continues south on Boyles Avenue to the termination of the street at Station 23. From Station 22 the subdivision is largely undeveloped. From Station 23.1 to Station 24.1 the alignment runs down brushy slopes past a few scattered homes and intersects Dam Road, a two lane paved county road. At Station 25.0 is the Clear Lake Outlet Channel and the north abutment of the bridge crossing the creek.	<u>Terrain:</u> From Station 20.0 to 21.0 the alignment traverses along mostly gently hilltop slopes. From Station 21.0 to Station 22 the alignment traverses down the moderately gentle gradient of Boyle Avenue. From 22 to 23.0 the road traverses up moderate slopes to the hilltop. From 23.0 to about 24.5 the alignment traverses southerly down moderate brush covered moderate to occasionally moderate steep slopes to Dam Road at the slope base. Elevations range from about 1,420 to 1,480 feet msl. <u>Drainages:</u> At Station 21.7 is a small flat gradient drainage a few feet wide and up to about 1 foot deep. The drainage is from east to west and passes beneath the road via culvert. At Station 25.0 is the north edge of the Clear Lake Outlet Channel (Cache Creek). <u>Bedrock Formations:</u> To about Station 22.0 the alignment is underlain by sediments of the Cache Creek formation as previously described. Bedrock is mantled by surficial deposits. From Station 21.5 to 24 alignment is underlain by bedrock of the Clear Lake Volcanics, which consists of hard blocky dacite. Numerous, large, hard rock blocks are exposed at the surface and indicate the surficial deposits are shallow in this interval. <u>Surficial Deposits:</u> From Station 20.0 to 21 sandy silty soils were observed which contain occasional to numerous 1 foot to 3½ feet in diameter blocks of hard volcanic rock. From 21 to 22 surficial soils were observed to consist of sands and silt which were dense to crumbly and containing minor amounts of rock fragments. From 22 to Station 23.5 occasional to very numerous rock blocks were noted at the surface consisting of hard dacite volcanics. According to the SCS the soils up to about Station 22 consist of the Asbill clay loam soils as previously described. From Station 22 to 24 the soils are Benridge-Sodabay loams consisting of locally deep well drained loams to gravelly clay loam in the subsoil. The erosion hazard is moderate and these soils develop over dacite, breccia or tuff. Some rutting and rilling was observed along the road. From Station 24 to 25.0 (along the base of the slope adjacent to Dam Road) the terrain flattens as it approaches Cache Creek. In this flatter area deeper soils (Benridge-Sodabay loams) with included blocks of hard volcanic rock should be anticipated. Artificial fill associated with the construction of Dam Road and adjacent residences may also be present. Construction would be mostly in roads. <u>Springs/Seepages:</u> None observed. <u>Geologic Hazard:</u> None observed. <u>Important Conditions and Comments:</u> From Station 22 to 23.6 and possibly beyond, anticipate locally very difficult excavation conditions due to presence of hard rock blocks. Blasting may be required. Potential for accelerated erosion particularly on steep slopes between Station 23.1 and 24.8.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Station 25.0 to 29.5 <u>Principal Improvements:</u> In this segment the alignment traverses southerly along Lake Street. From Station 25.0 to 25.1 is the bridge structure across Cache Creek. The pipe will make this crossing either hung on the eastern side of the bridge or cored through the hollow bridge structure. The alignment continues southerly on Lake Street and it will be located either in the roadway or along the western edge. To about Station 27.0, there are several residential structures along the east side of Lake Street, and then few improvements along the road until Station 28.3 through 29.5. where a large high school campus occupies the area along the east side of the road and for several hundred feet to the east.	<u>Terrain:</u> From Station 25.0 to Station 27.0 the alignment traverses across essentially flat terrain at the west edge of Anderson Flat. From Station 27.0 to 29.5 the alignment traverses along the western edge of a low rolling upland which represents the western edge of Anderson Flat in this interval. The incised banks and active channel of Seigler Creek meander southerly and roughly parallels the alignment in this segment just to the west. Elevations range from about 1,340 feet msl across Anderson Flat to about 1,380 feet msl along the southerly, hilly part of the segment. <u>Drainages:</u> Seigler Creek a principal tributary to Cache Creek drains northerly and roughly parallels the alignment in this segment. The creek meanders slightly, has a channel a few to several tens of feet wide and is incised into the alluvium of Anderson Flat to a depth of about ten to fifteen feet below Lake Street. Dense tree growth and other riparian vegetation are present along the sides of the channel. The creek was actively flowing on 4/14/93. From Station 26.5 to 27.4 Lake Street and the alignment are closely adjacent to the east banks of the creek. North and south of this segment the road is well away from the creek. <u>Bedrock Formations:</u> From Station 27 to 28 dacite of the Clear Lake Volcanics is present at depth beneath surface soils. From 28 to 29.5 are poorly consolidated sandstone, conglomerate, tuffaceous siltstone and claystone of the Cache formation. These latter materials are partially exposed in roadcuts along Lake Street at the southern end of the segment. <u>Surficial Deposits:</u> Relatively deep alluvial soils are present between Station 25 and 27. Thinner soils are present from 27 to 28 and soils grading into unconsolidated Cache formation are present from Stations 28 to 29.5. Principal soils in this segment (SCS) consist of Still loams, Sobrante-Guenoc-Hambright complex and Benridge Variant loam. The first of these soils occupies the northern part of the interval and consists of very deep loams which are well drained and with clay loam in the subsoil. These soils develop on alluvial plains and have slight erosion hazard. The second of the soils occupies the central part of the segment is present on hills and consists of shallow to moderately deep, well drained loam, clay loam and gravelly loam. Included are small areas of rock outcrop and loose rock fragments at the surface. The soils are present on hills and have slight to moderate erosion hazard. The third soil type consists of moderately deep, well drained, loams at the surface and gravelly clay in the subsoil. These soils develop on hillslopes and valley sides and have a moderate erosion hazard. Construction would be in roads. <u>Springs/Seepages:</u> None observed, but seasonably shallow groundwater levels may occur in the northern part of the segment (Anderson Flat).

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Station 25.0 to 29.5 (Continued)	<u>Geologic Hazards:</u> Those areas of the alignment which are adjacent to the top of bank along Seigler Creek have some potential for future bank slumping. Seasonally high groundwater levels along the north part of the segment should be anticipated and may cause wet and/or unstable trenching conditions. <u>Important Conditions and Comments:</u> Geologic hazards as noted. The middle part of the segment occupied by Clear Lake Volcanics may locally have large rock blocks which could result in difficult excavation conditions.
<u>Approximate Stationing:</u> Station 29.5 to 32.8 <u>Principal Improvements:</u> In this segment the alignment runs through the town of Lower Lake. From Station 29.5 the alignment continues down Lake Street to the south turns easterly on Second Street for a few blocks and then southerly on Mill Street for one block intersecting Morgan Valley Road, the alignment then moves easterly on Morgan Valley Road for several hundred feet to Station 32.8 just beyond the edge of town.	<u>Terrain:</u> At 29.5 the alignment drops in elevation a few tens of feet to the base of the low upland and continues southerly across a low flat to gently sloping valley area. This area trends east-west and is reentrant from Anderson Flat on the west. Where the alignment turns easterly on Second Street and then south on Mill Street it is traversing along gently sloping terrain to the north. This area is along the south edge of the reentrant valley and the slopes probably represent a narrow alluvial fan shed from the higher hills to the south. Elevations range from about 1,350 to 1,380 feet msl. <u>Drainages:</u> Seigler Creek lies a few hundred feet or slightly less to the west of that portion of the alignment on Lake Street. No other drainages observed. <u>Bedrock Formations:</u> Valley alluvium obscures bedrock, but the Cache formation is present at depth. <u>Surficial Deposits:</u> The segment is mantled with alluvial deposits which appear to merge with shallow alluvial fan deposits along Second Street, Mill Street, and Morgan Valley Road. The soils (SCS) are Kilaga Variant loams. These soils are very deep, well drained and develop on alluvial plains and stream terraces. They consist of loams to sandy loams and clay loam to clay in the subsoil. They have slight erosion potential. <u>Springs/Seepages:</u> None observed. Higher than normal, localized seasonally saturated conditions may be present within the surficial deposits. <u>Geologic Hazards:</u> None observed. <u>Important Conditions and Comments:</u> If perched groundwater is present, locally saturated soils may be encountered in the trench excavation. Anticipate numerous buried utility lines within community of Lower Lake.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 32.8 to 33.8	<u>Terrain:</u> Morgan Valley Road traverses along the south edge of a narrow east-west valley. Slopes to the immediate south are moderately steep. The elevation along this segment is about 1,380 feet msl.
<u>Principal Improvements:</u> Alignment traverses along Morgan Valley Road, a paved two lane county thoroughfare.	<u>Drainages:</u> None observed. <u>Bedrock Formations:</u> Great Valley sequence consisting of marine sandstones and shales is likely present at relatively shallow depth below the edge of valley alluvium. <u>Surficial Deposits:</u> Relatively shallow alluvium along the south edge of the valley merging with shallow fan or colluvial deposits shed from steeper slopes immediately to the south. Soil types present (SCS) consist of the Kilaga variant loam as described above. <u>Springs/Seepages:</u> None observed, but possibly seasonally saturated soils caused by runoff from steeper slopes to south. <u>Geologic Hazards:</u> If seasonally high water levels are present, wet and/or unstable trenching conditions may be encountered. <u>Important Conditions and Comments:</u> Morgan Valley Road is a wide road and there appears to be sufficient space on either side of the road for the alignment. Depending on season, saturated conditions may locally be encountered in the trench excavation.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 33.8 to 37.0	<u>Terrain:</u> In this segment the alignment travels southerly up mostly moderately steep slopes to the crest line of a west northwest trending ridge. The alignment crosses the ridgetop in a broad windgap and then traverses down moderately steep slopes near the bottom of a small canyon to the north edge of Excelsior Valley. The ridgetop elevation is about 1,580 feet msl and the valley elevations to either side are about 1,375 feet msl.
<u>Principal Improvements:</u> For about the first 700 or 800 feet the segment has been located within or close to the right-of-way for an existing overhead power transmission line. The remainder of the segment is undeveloped except for an exiting 4-wheel-drive road from about Station 34.8 to the end of the segment along which the alignment has been sited.	<u>Drainages:</u> From Station 34 to 34.5 the alignment traverses up a narrow north sloping, secondary ridge. Immediately below on steep slopes to either side of this small ridge are seasonal drainages. The drainage to the west is the most deeply incised. At Station 34.6 the alignment intersects an existing 4-wheel-drive road. This road has a mild grade. From Station 34.6 to 35.0 the alignment continues along the road. There is a steep approximately 15 foot maximum drop-off into the north draining gully described above. From 35.0 to 35.6 the alignment continues along the now moderately steep gradient 4-wheel drive road and there is a shallow, natural drainage course parallelling the road on the east. This drains into the aforementioned gully. At Station 35.5 the road starts down grade to the south. Drainage swales and natural drainage ditches cross beneath road from east to west and enter the upper reaches of a major, deeply incised gully which the pipeline and the road parallel just upslope of the gully bottom to the east (Station 36.6). This gully continues to the base of the slope. <u>Bedrock Formations:</u> Occasional outcrops along the segment show that the ridgeline is underlain by massive sandstones and probably interbedded siltstones and mudstones of the Great Valley sequence. <u>Surficial Deposits:</u> Most of the segment is mantled with colluvial or residual soils which probably range from several feet in thickness to thin and patchy with exposed bedrock. Soils present (SCS) are Skyhigh-Millshom loams and consist of shallow to moderately deep clay loams and gravelly clay loams with clay subsoil. They have high shrink-swell potential and high to severe erosion potential. Erosion potential is borne out by presence of ruts and rills in 4-wheel-drive road. <u>Springs/Seepages:</u> None observed but seasonal seepage and runoff should be anticipated from the sideslopes above road. <u>Geologic Hazards:</u> Outside edge of 4-wheel- drive road in steeper areas may be potentially unstable. Steep upslope areas above road in southern part of segment are potentially unstable. High potential for accelerated erosion.

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Alignment Segment:</u> Stations 33.8 to 37.0 (Continued)	<u>Important Conditions and Comments:</u> Relatively steep slopes and soils present potential for geologic hazards as noted. Massive, shallow sandstone bedrock noted on sloping parts of alignment and difficult excavation conditions should be anticipated along portions of the segment. The presence of several hundred feet of adjacent drainage courses make this segment sensitive.
<u>Approximate Stationing:</u> Stations 37.0 to 43.3	<u>Terrain:</u> Most of the segment traverses across flat valley lands of Excelsior Valley or immediately adjacent low, gently rolling uplands. Elevations range from 1,375 feet msl in the valley areas to 1,400 feet msl across the rolling uplands at the south end of the segment.
<u>Principal Improvements:</u> From Station 37.0 to Clayton Creek Road at Station 39 the alignment traverses an unimproved open valley area. From Station 39 southward the pipeline traverses along Clayton Creek Road to Station 43. There are buried cable lines along both sides of the road along portions of this segment. There is some scattered rural residential south of Station 39 and beyond this several hundred feet of commercial development west of the road which gradually approaches Highway 29 as it moves southward. South of the commercial development Clayton Road becomes Riata Road and continues through agricultural lands with sparse residences.	<u>Drainages:</u> The northern one-half of the segment has several intervals where the alignment traverses closely adjacent to Clayton Creek. Clayton Creek is an important tributary to Copsey Creek one of the two significant creeks in the immediate area. Intervals where the alignment and the creek are in close proximity are Stations 37.5 to 39.5 and 40.2 to 40.8. Short gullies and drainage ditches cross the alignment and enter the creek (drainage ditch parallel to the northeast side of Clayton Creek Road). North of Clayton Creek Road (about Station 37.5 to 39) the creek is approximately 50 feet wide banktop to banktop and has incised vertical banks 10 to 15 feet into alluvium or totally decomposed bedrock. The active channel is about 6 to 8 feet wide. Numerous, abandoned meander loops are present in this interval. South of the road, the channel is less pronounced but still has vertical banks incised 6 to 8 feet deep. The creek was lightly flowing on 4/14/93. <u>Bedrock Formations:</u> Between about Station 40.2 and 40.7 (just north of commercial development), the steep slopes immediately east of Clayton Creek Road exhibit large blocky fragments of Great Valley sequence sandstone. The remainder of the segment is mantled with valley alluvium and alluvium of the low uplands. Great Valley sequence bedrock is probable present at depth beneath the surficial materials. <u>Surficial Deposits:</u> Most of the segment is underlain by valley alluvium and alluvium of the low uplands. The exception is the area of shallow bedrock noted above. these deposits are less than 10 feet deep in the northern portion of the segment and along this interval the surficial deposits rest on severely weathered to totally decomposed Great Valley sequence rocks. Soils (SCS) consist of Kilaga Variant loam and Skyhigh-Sleeper-Millshom association. The first of these soils predominates for all but the last several hundred feet of the segment. The soils are deep, well drained and develop on alluvial planes and stream terraces. They are loams to sandy loams and clay loams/clay in the subsoil and classed as having slight erosion hazard. However, our field observations along the alignment suggest moderately high erosion hazard. The second of the soils consists of loam, clay loam, and clay in the subsoil. They are shallow to moderately deep, well drained, have a high shrink-swell potential and present severe erosion hazards. From Station 39 and southward in this segment, construction would be in the road.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 37.0 to 43.3 (Continued) At about Station 39 the alignment intersects Clayton Road and traverses across the creek at the existing bridge. The crossing of the creek will be on piers immediately adjacent to the downstream (north) side of the bridge. An alternative crossing would be about 200 feet north of Clayton Creek Road.	<u>Springs/Seepages:</u> None observed. <u>Geologic Hazards:</u> Where, as described, the alignment is in close proximity to Clayton Creek there is potential for bank slumping and erosion which could encroach upon the alignment. There is also high potential for accelerated erosion in the soils overall. Geologic hazards as noted. <u>Important Conditions and Comments:</u> Due to the presence of Clayton Creek this segment is relatively sensitive. Between about Station 40.2 and Station 40.6 the alignment is on a relatively narrow road with steep drop-offs into the creek immediately west and steep upslopes immediately to the east. There is limited space here and potential for both instability from the creek banks and potentially difficult excavation conditions due to the probable presence of massive sandstone blocks and possibly in place massive sandstone. There is potential for stream siltation due to construction at those described locations where the alignment is in close proximity to the creek banks and at the creek crossing at Clayton Road.
<u>Approximate Stationing:</u> Station 43.3 to 54.0 <u>Principal Improvements:</u> Alignment continues south and then west along Riata Road to Station 45. At this location the alignment leaves the road and traverses up gentle slopes on a short segment of abandoned roadway and intersects with the south edge of Highway 29. The	<u>Terrain:</u> The road grade is gentle but circles around the base of higher terrain to the west. The outside edge of the road (south) drops off steeply to moderately steeply into Copsey Creek. At about Station 44 the drop-off is high and abrupt down into the creek. The elevation along the road is about 1,390 feet to 1,400 feet msl. From Station 45.5 to 49, the terrain is flat. From Station 49 to 54 the terrain is hilly, with cuts made for Highway 29. The elevation is about 1,445 to 1,480 feet msl. <u>Drainages:</u> The deeply incised Copsey Creek meanders through the area and the alignment parallels it from about Station 44 to 45. Steep to moderately steep slopes are present between the outside edge of the road and the channel bottom. The lateral distance to the channel bottom ranges from several tens to a few tens of feet msl. From Station 45.2 to 45.5, the route follows a drainage swale between the highway fill and the hills to the west. The route crosses a partially channelized drainage ditch with flowing water (4/15/93). At Station 52, the route crosses another culverted drainage that flows into a marsh.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Station 43.3 to 54.0 (Continued) alignment will be bored and jacked beneath Highway 29 on a diagonal and emerge on the west side of the highway near the bottom of a southwest draining swale and then commence southwesterly paralleling the west side of the highway to Station 53.0. There are 2 to 3 residences in this segment. After crossing Highway 29, the route crosses a drainage and continues along the western edge of the highway ROW. It follows an abandoned road.	<u>Bedrock Formations:</u> The segment is underlain by bedrock of the Great Valley sequence and limited outcrops exposed in roadcuts indicate that massive sandstones predominate in this area. The rock in the exposures varies from hard to moderately hard. In the flat valley areas, alluvium overlies the bedrock. <u>Surficial Deposits:</u> Sandy clayey soils of variable depths are present. Anticipate bedrock at or very near surface along inside of road and deeper soils and/or artificial fill along outside of road. Soil types (SCS) consist of Skyhigh-Sleeper-Millshom association, Skyhigh-Sleeper loams and Still loam. The first of these soil types has been previously described. Thick to thin alluvium is present along most of the segment. At the base of the slope on the west, the alluvium merges with sandy clayey colluvial soils from the hillsides. Artificial fill is present beneath portions of Highway 29. <u>Springs/Seepages:</u> Seasonal seepages are present between the west side of the highway and the base of the hills. <u>Geologic Hazards:</u> High potential for accelerated erosion where construction occurs off-road. Some potential for occasional highway cutslope failures and seasonally wet/unstable excavations. <u>Important Conditions and Comments:</u> Geologic hazards as noted. Potential for stream siltation due to construction at locations where alignment closely approaches Copsey Creek. Difficult excavation conditions anticipated, particularly along inside edge at road where massive sandstone exposed. Groundwater conditions may be encountered in the excavation depending upon season of the year. Shallow bedrock should be anticipated along the base of existing highway cutslopes. These areas may present difficult excavation characteristics. This segment is not sensitive except for the actively flowing drainages.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 54.0 to 58	<u>Terrain:</u> The alignment traverses along the easterly edge of the narrow stream valley of Copsey Creek closely following the base of steep hills. The elevation is about 1,500 feet msl.
<u>Principal Improvements:</u> At Station 54.5 the alignment traverses easterly on a private driveway to the edge to the edge of Copsey Creek. After crossing the creek the alignment traverses southwesterly on an existing dirt road, crossing Copsey Creek again at Station 56.8 and continuing several hundred feet along the east edge of Highway 29 to Station 58 where it crosses beneath Highway 29 (bored and jacked). In addition to the road along which the alignment traverses there is one private residence and a few small scattered outbuildings and fencing.	<u>Drainages:</u> The principal drainage is Copsey Creek which has a deeply incised channel with steep soil covered banks and locally heavy riparian vegetation. At Station 54.6 the pipeline will cross Copsey Creek. At the crossing location there are banks fifteen to twenty feet in height which are near vertical and which are potentially unstable, especially on the east side. The crossing will probably be supported on piers. At Station 56.8 the alignment again crosses Copsey Creek but here the banks are very low and slopes are gentle. The crossing will be below the stream bed. From 57.0 to 57.3 there is an incised drainage ditch a few tens of feet north of the alignment. This drains into Copsey Creek just downstream of the alignment crossing of the creek. Immediately southeast of Station 58.0 is the confluence of Harris Creek and Copsey Creek. Also, at 58.0 on the west edge of Highway 29 there is deeply incised drainage ditch which empties directly into Copsey Creek at the confluence and which is adjacent to the highway at this location. The ditch is deeply eroded and has progressively eroded deeper as it approaches and enters Copsey Creek ten to fifteen feet below. <u>Bedrock Formations:</u> Sandstone and probably shale of the Great Valley sequence are present beneath the valley alluvium and the shallower hillside soils. Along the base of the hills where the alignment follows the dirt road shallow bedrock is likely present. <u>Surficial Deposits:</u> Valley alluvium occupies the stream valley floor and shallower sandy clay soils are present along the base of the bordering hillslopes. Soil types present (SCS) are Still loams as previously described. Artificial fill may underlie portions of the private property and dirt road. Between about Station 55.8 and 56.6 there is a broad upslope area immediately east of the alignment which appears to be an old landslide. No sign of present activity was observed. If the slide exists the alignment runs along its toe. <u>Springs/Seepages:</u> None observed. <u>Geologic Hazards:</u> Potential bank instability at alignment crossing of Copsey Creek at Station 54.6. Potential instability at location of old landslide described. Potential instability at Station 57.8 where alignment crosses deeply eroded drainage ditch near Highway 29. <u>Important Conditions and Comments:</u> Potential for instability as noted. Anticipate localized intervals of shallow bedrock along dirt road, particularly along the north one half. The sensitive areas are in vicinity of Stations 54.6, 56.8 and 57.8 where Copsey Creek and the drainage ditches are crossed or closely approached.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 58 to 60 <u>Principal Improvements:</u> Alignment traverses along an unpaved dirt road in this interval. Improvements consist of farm outbuildings and fencing.	<u>Terrain:</u> The alignment traverses away from Highway 29 west southwest along the north edge of a narrow stream valley to about Station 59. Westward of this station, the valley narrows from 200 to 300 feet msl to on the order of 150 feet msl or less and slowly narrows further into a stream canyon bottom. At about Station 60 the canyon narrows and the sideslopes steepen and heighten. Elevations along the alignment range from about 1,500 feet msl on the northeast to about 1,520 feet msl on the southwest. <u>Drainages:</u> The principal drainage over most of this segment is the upper reaches of Copsey Creek. Buried crossing of Copsey Creek at Station 59.6. At 59.6 is the confluence of Sweet Springs Creek and Copsey Creek. From this station the alignment follows the canyon of Sweet Springs Creek up drainage. Along this segment numerous small gullies and occasional secondary streams enter Copsey and Sweet Springs Creek. On 4/15/93 both Copsey and Sweet Springs Creek were actively flowing. <u>Bedrock Formations:</u> Sandstones and shales of the Great Valley Sequence are present at variable depths beneath surficial materials along this segment. <u>Surficial Deposits:</u> Surficial deposits consist of shallow valley alluvium and older stream gravel associated with Copsey and Sweet Springs Creeks. Soil types (SCS) are Kelsey fine sandy loam and Skyhigh-Millsholm loams. The first of these soils occupies the narrow stream valley at the northeast end of the segment and consists of deep, well drained fine sandy loams with slight erosion hazard. The soils form on flood planes. The second of the soils occupies the majority of the segment and has been previously described. It has a high shrink-swell potential and severe erosion hazard. <u>Springs/Seepages:</u> None observed. <u>Geologic Hazards:</u> From Station 58.5 to 59 the alignment is in close proximity to the steep banks of Copsey Creek and there is potential for either slope instability or bank erosion to encroach on the alignment. Upstream to Station 60 the creek banks are lower but the stream is meandering and there is potential that meander loops may eventually enlarge and encroach into the nearby road and the alignment. <u>Important Conditions and Comments:</u> Potential instability and erosion/siltation problems as noted. The sensitive areas are where the alignment is in close proximity to Copsey and Sweet Springs Creeks.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Station 60 to 63.7 <u>Principal Improvements:</u> Improvements consist of the existing, narrow 4-wheel-drive road through unimproved hill country. The road is up to about 12 feet wide.	<u>Terrain:</u> In this segment is a narrow steep sided stream canyon which carries Sweet Springs Creek. At Station 60.2 the road slowly climbs up onto the lower portion of the easterly canyon wall and remains between 15 and 20, to as high as 40 feet above the stream bottom. The side slopes are steep to very steep below the road and somewhat less steep to occasionally moderate above the road. The outside edge of the road has been narrowed by erosion and slope failures. Localized failures have also occurred on the uphill side of the road. Elevations range from slightly less to slightly more than 1,600 feet msl. <u>Drainages:</u> The principal drainage is Sweet Springs Creek which flows along the narrow, moderate gradient canyon bottom. Sweet Springs Creek is crossed at Station 60.2. Several natural, small drainages pass across the road or under via culvert and empty below into Sweet Springs Creek. <u>Bedrock Formations:</u> Scattered small to large blocks of hard sandstone indicate that this segment is primarily underlain by sandstone of the Great Valley sequence. Interbedded shales are also likely present. Near- surface bedrock is probably present along the inside edge of the road at various locations. <u>Surficial Deposits:</u> Soil mantels most of the segment, but is occasionally thin and patchy as evidenced by the presence of sandstone blocks. Artificial fill is present along the outside edge of the road. Principal soil type (SCS) present are those of the Maymen-Hopland-Mayacama association which consist of gravelly to very gravelly loams which are shallow, excessively drained and have a severe erosion hazard. These soils develop on hilly and mountainous areas and contain rock outcrops and rock blocks randomly scattered throughout. <u>Springs/Seepages:</u> Areas of seepage and ponded water were noted along the roadway at a few locations where positive drainage does not exist. <u>Geologic Hazards:</u> There is high potential for slope instability to occur at several locations. There is potential to lose the entire road section at some of these locations and damage the pipeline from natural or induced slope failure. There is also high potential for accelerated erosion along the roadway and resultant stream siltation. <u>Important Conditions and Comments:</u> Geologic hazards as noted. This entire segment is very sensitive due to slope steepness, slope instability, existing erosion and potential for accelerated erosion due to project construction. Large blocks of hard sandstone will probably be locally encountered in excavations.

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TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Station 63.7 to 65 <u>Principal Improvements:</u> Undeveloped hill country.	<u>Terrain:</u> In this segment the alignment continues southwest and then southeast along the canyon bottom of Sweet Springs Creek, approaching near the upper reaches of the creek at the end of the segment. The width of the canyon, and thus space available for construction varies along the segment. From about Station 63 to 63.5 the alignment traverses along a narrow (one hundred feet±) alluvial-filled stream valley with a relatively gentle gradient. From about Station 63.5 to 63.6 the valley narrows to a canyon bottom a few tens of feet in width. The active channel, which has incised a few feet through the alluvium, and in some cases to bedrock, meanders back and forth across the narrow width of the canyon bottom. The base of the canyon sidewalls at creek elevation are steep. South of Station 63.5 the canyon bottom widens to a narrow stream valley through which the active channel continues to meander. Except where small side tributaries enter, the valley width usually ranges between 60 to slightly over 100 feet. Progressing toward the southern end of the segment, the active channel again begins to narrow and is less incised. Commencing at about Station 65 the canyon once more narrows with the base of the steep canyon sideslopes terminating near the edges of the narrow active channel. Elevations along the segment range from about 1,600 feet msl on the north to about 1,700 feet msl on the south. <u>Drainages:</u> The principal drainage is Sweet Springs Creek with side tributaries entering at about Stations 63.5 (from the east), 64 (entering from the east) and 65 (entering from the east). Four to five smaller side tributaries were also noted. Due to the meandering nature of the creek, the alignment crosses the active channel on the order of 15 times throughout the length of this segment. The channel is incised into shallow alluvial deposits between about 2 and 6 feet in the northern part of the segment and 1 to 2 feet in the southern part. Banks are vertical or nearly so. <u>Bedrock Formations:</u> Scattered rock outcrops visible in the bottom of the active channel at the base of shallow valley alluvium consist of hard, massive, fractured, graywacke sandstone which has been mapped as belonging to the Great Valley sequence. Other rock types possibly present include shale and siltstone. <u>Surficial Deposits:</u> Surficial deposits present along the narrow canyon bottom and stream valley consist of sands, silts and gravels deposited by Sweet Springs Creek. These deposits are mostly 2 to 6 feet in thickness and are thinner to absent near the north end of the segment. At the base of the canyon sidewalls and stream valleys, colluvial soils transition into the periphery of these stream deposits. These consist of sandy clay soils with intermixed rock fragments. Soil types present (SCS) on nearby sideslopes consist of Millshom-Bressa-Hopland association, Mayem-Etsel-Mayacamas complex, and Mayem-Millsholm-Bressa complex. The first of these soils occupies a small portion at the north end of the segment and has been previously described. The second of these soils occupies most of the segment. It consists of shallow, gravelly to very gravelly loams which are excessively drained and have high erosion hazard. The third of the soil types occupy a southern part of the segment, are shallow, gravelly loams which are excessively drained and which have severe erosion hazard. Rock outcrops and large rock fragments are present.

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TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Station 63.7 to 65 (Continued)	<u>Springs/Seepages:</u> None observed on 4/15/93, but considering the steep sideslopes and colluvial soils present, seasonal seepages may develop. <u>Geologic Hazards:</u> High potential for accelerated erosion. <u>Important Conditions and Comments:</u> Erosion hazards as noted. The numerous (25±) stream crossings by the alignment within the narrow confines of the stream canyon/valley result in <u>very sensitive</u> conditions. Along the northern part of the segment (narrow canyon area) very limited space is available to gain access for construction equipment. Because of shallow, hard bedrock, special excavation techniques including blasting will likely be necessary, or the pipe will have to be constructed on piers with aerial stream crossings.
<u>Approximate Stationing:</u> Stations 65 to 66.3 <u>Principal Improvements:</u> Unimproved hill county. A narrow, abandoned 4-wheel-drive trail traverses along the north side of the steep canyon sideslope a few to several feet above the active stream channel.	<u>Terrain:</u> At Station 65 the stream canyon turns easterly and narrows. Slopes drop moderately steeply directly into the stream channel which is about 1 to 2 feet wide and incised to a depth of 1 to 2 feet. The alignment has been positioned along the 4-wheel-drive trail which is no more than six to eight feet in width, with steep slopes below and above. Three small side canyons come in from the north between Stations 65 and 66. At Station 66 the alignment turns southward and climbs up a steeply inclined portion of the narrow trail. Below the outside edge of the trail slopes drop off steeply into one of the small drainages comprising the headwaters of Sweet Springs Creek. The drop-offs are up to 25 feet high. Cutslopes above the inside edge of the road are up to 10 to 15 feet and near vertical. At Station 66.5 the 4-wheel-drive trail tops out at the drainage divide. The divide is about 350 feet below and west of Childer's Peak, the prominent geographic feature of the immediate area. Elevations along this segment range from about 1,680 feet msl on the west to 1,720 feet msl at the top of the drainage divide. <u>Drainages:</u> This segment continues along the upper reaches of Sweet Springs Creek. At Station 66.1 the alignment pulls away from the main branch of the creek and continues upslope on the trail along one of the creek's smaller tributaries. Along the central part of the segment well-incised, secondary canyons drain into Sweet Springs Creek from the north at the Stations indicated above. On 4/19/93 the creek and main tributaries were flowing. <u>Bedrock Formations:</u> Several outcrops of hard, fractured graywacke sandstone were observed along the creek and on adjacent sideslopes to the east. This bedrock possibly belongs to the Franciscan complex. If so the contact between the Franciscan complex and Great Valley sequence rocks would be located at approximately Station 65.0 to 65.5. At Station 66.1 serpentine fragments were noted in the soil indicating the presence of serpentine bedrock beneath soils at this location. From Station 66.1 to 66.3 serpentine bedrock is exposed along the 4-wheel-drive trail cutslopes and on the ridges above. This rock varies from blocky and hard to highly fractured to crushed and sheared.

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TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 65 to 66.3 (Continued)	<u>Surficial Deposits:</u> From Station 65 to 66 soils are thin and patchy and are primarily gravelly clayey sands. At Station 66 a small fan shaped deposit of clayey soils derived from serpentinite is exposed. These soils are at least a few feet deep, soft and compressible when wet and highly expansive. From this location to about Station 66.5, the soil cover is very thin and patchy and consists of rocky sands to clay weathered from serpentine bedrock. Artificial fill is present along the outside edge of the 4-wheel-drive trail. Soil types present (SCS) are Maymen-Millsholm-Bressa complex and have been described previously. <u>Springs/Seepages:</u> At Station 66.1 an area of surface wetness was noted which included the above described serpentine soils. The area was saturated on 4/19/93. <u>Geologic Hazards:</u> Between Stations 66.1 and 66.3 there is potential for slope instability along the outside and inside edge of the existing 4-wheel-drive trail. In the event of such failures the pipe alignment would be at risk. About a ten foot section of this road has been removed by accelerated erosion due to upslope runoff being intercepted by the sloping road surface. The described soft serpentine soils are likely subject to soil creep and present poor foundation conditions. <u>Important Conditions and Comments:</u> Geologic hazards as noted. Very difficult trenching conditions due to shallow bedrock. From Station 66.1 to 66.3 conditions are very sensitive due to the narrowness of the 4-wheel-drive trail, potential instability, serpentine soils and the steep drop-off into the tributary creek. The remaining areas of segment are moderately sensitive to sensitive due to mostly steep short drop offs into creek channel and resultant erosion/siltation potential.

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TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 66.3 to 67.6 <u>Principal Improvements:</u> Unimproved hill country. Alignment sited along existing 4-wheel-drive trail. At about Station 67 is one of two sites for the surge equalization facility. It is located immediately east of the alignment. The second site is immediately to the west of the alignment at Station 67.0. The westerly tank site is the preferred site (probably less grading required) and the easterly site is the alternate.	<u>Terrain:</u> The northern part of the segment traverses across moderate to moderately gentle sideslopes which drain to the west. These slopes are contained within a large, gently to moderately sloping declivity located just below the drainage divide downslope of Childer's Peak. The south, southwesterly portion of the segment is on sideslopes which steepen beyond this declivity and which drain into the upper reaches of a creek which is tributary to Big Canyon Creek. Elevations range from about 1,720 feet msl on the north to about 1,680 feet msl on the south southwest. <u>Drainages:</u> The principal drainage is the unnamed tributary to Big Canyon Creek which is located downslope to the west southwest from the alignment. The slopes are moderately gentle to moderately steep. The stream channel is narrow and there are steep slopes immediately above the channel on both sides. The slopes flatten somewhat in the upslope direction on to the east, northeast as the alignment is approached. Small side tributaries enter the channel from both sides of the stream canyon. <u>Bedrock Formations:</u> The entire segment is underlain by serpentine associated with the Franciscan complex. The Childer's Peak fault, located a short distance to the northeast is the geologic contact between a serpentine/Franciscan complex rocks and the Great Valley sequence rocks which lie along the northeastern side of this fault. The fault is not considered active. <u>Surficial Deposits:</u> Thin and patchy soils up to few feet in thickness are present. They consist of serpentinite rock fragments intermixed with smaller amounts of sandy material with clays at the base of thicker soils. Some fragments of volcanic rock intermixed with serpentinite. These fragments are derived from upslope beyond the boundaries of the serpentine body. Soil types present (SCS) consist predominantly of Mayem-Etsel-Snook complex which consist of shallow, well drained gravelly loams with large rock fragments and rock outcrops. They have severe erosion hazard. <u>Springs/Seepages:</u> At Station 67.1 a small seepage was noted across the alignment (4-wheel-drive trail). Seepage was active on 4/19/93. <u>Geologic Hazards:</u> If deeper serpentine soils are present, weak, clayey foundation materials may be encountered beneath the surge equalization facility sites. <u>Important Conditions and Comments:</u> Possibly weak soils as noted. Locally shallow bedrock will likely result in difficult trenching conditions. This segment is not particularly sensitive. Tank sites require foundation investigation (geotechnical investigation).

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TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 67.6 to 72.5 <u>Principal Improvements:</u> Unimproved hill country with alignment located along existing 4-wheel-drive trail.	<u>Terrain:</u> The entire segment traverses along the east, northeast base of the moderately well-dissected canyon side walls tributary to Putah Creek whose slopes range from steep to moderate. The west southwest canyon sidewalls are formed by a lower, less dissected linear ridgeline. Elevations along the alignment range from about 1,780 feet msl along the north end of the segment to 1,550 feet msl at the south end. <u>Drainages:</u> The principal drainage is an unnamed tributary to Big Canyon Creek. There are numerous secondary drainages entering the stream canyon particularly from the east-northeast side. At the north end of the segment the stream is well-incised into a narrow stream canyon. As the southern end of the segment is approached this canyon slowly widens into a narrow stream valley through which the channel meanders, and into which it has incised. Channel width varies from 1 to 2 feet to up to 8 feet along the segment and has incised between 1 and 3 feet into stream deposits. Along this segment the alignment crosses the creek channel on the order of ten times. Between Station 68.0 and 69.1 the alignment pulls away from the stream along the 4-wheel-drive trail reducing the potential for stream degradation in this interval. <u>Bedrock Formations:</u> Rock consists of fractured , massive graywacke sandstone and interbedded shales. These rocks probably belong to the Great Valley sequence. <u>Surficial Deposits:</u> Surficial deposits consist of clayey soils developed on the shale and sandstone bedrock. On more steeply sloping areas they exhibit soil creep and local potential for slope failure. The soils appear to be at least moderately expansive. Artificial fill is likely present along the outside edge of the jeep trail. Soil types present (SCS) consist of Millsholm-Bressa loams which vary from loams to rocky loams. They are shallow, well drained with clay loam in the subsoil. The erosion hazard is severe. These soils develop over sandstone and shale bedrock. <u>Springs/Seepages:</u> Active spring and seepages were not observed. <u>Geologic Hazards:</u> The soils and weathered bedrock present on the slopes within this segment are locally undergoing soil creep and have the potential for accelerated erosion. There is also the potential for localized slope failures. No active landslides were noted crossing the alignment.

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TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 67.6 to 72.5 (Continued)	<u>Important Conditions and Comments:</u> Potential for geologic hazards as noted. Intervals of shallow bedrock should be anticipated which, depending upon the degree of weathering may result in difficult trenching conditions. Most of this segment is sensitive due to the close proximity of the alignment to the stream channel and the several crossings of the stream channel by the alignment.
<u>Approximate Stationing:</u> Stations 72.5 to 77 <u>Principal Improvements:</u> The pipeline traverses along the 4-wheel-drive jeep trail for the entire segment. There is a 500 foot long alternate segment between about Station 74.5 and Station 75.5 where the alignment travels directly down steep slopes as opposed to taking the somewhat longer but less steep route along the 4-wheel-drive trail. This segment consists of unimproved hill country.	<u>Terrain:</u> In this segment, the alignment traverses westerly upslope to the drainage divide along a major northwest-southeast trending ridge that separates the tributary of Putah Creek on the east from big Canyon Creek on the west. At the top of the divide (elevation 1,540 feet) the alignment turns southerly and travels down the western slopes of the ridge at an oblique angle. The elevation at stream bottom on the Big Canyon Creek tributary is about 1,500 to 1,520 feet msl and the elevation on the other side along the bottom of Big Canyon Creek is about 1,300 feet msl. The gradient of the 4-wheel-drive trail is moderate to steep. <u>Drainages:</u> There are two principal drainages along this segment. The first is the previously described tributary to Big Canyon Creek and the second is the much larger Big Canyon Creek. The alignment crosses the Big Canyon Creek tributary at the beginning of the segment (Station 72.7) and at this location the channel is about 12 feet wide with a 15 foot high bank on the east and a 6 foot high bank on the west. Bank slopes are moderate to moderately steep. At the Big Canyon Creek Crossing (Station 76.6) the approach from the east to the creek channel is gentle. The channel is approximately 120 feet wide with springtime flows occupying a channel width of approximately 15 to 20 feet. This is the active part of the channel. The remaining width is seasonally occupied by highwater flows. The western side of the creek has a low moderately sloping bank up to about 6 feet wide, and then beyond to the west what appears to be stream terrace a few feet higher in elevation. This flat terrace area extends to Big Canyon Road on the west a distance about 200 feet. <u>Bedrock Formations:</u> Serpentine bedrock associated with the Franciscan Complex is present from about Station 72.8 to Station 74.0. From Station 75.3 there is a narrow band of mudstone and siltstone of the Great Valley sequence. Serpentine then continues to about Station 76.4. From 76.7 to the end of the segment siltstones, sandstones and shales of the Great Valley sequence are likely present beneath the alluvial cover. The serpentine bedrock ranges from highly crushed and sheared to extremely hard and blocky. Serpentine bedrock is nearly continuously exposed along the alignment. Great Valley sequence rocks exposed in the 4-wheel-drive trail are weathered, well-bedded and moderately hard to soft at the surface. <u>Surficial Deposits:</u> Soils along the serpentine interval are thin and patchy to non-existent. They consist predominantly of serpentine fragments and clays derived from the weathering of crushed and sheared serpentine. Soils along the interval underlain by Great Valley sequence rocks are sandy clays to clayey sand. Soil types (CSC) present are

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TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 72.5 to 77 (Continued)	Henneke-Montara-Rock outcrop complex, Millsholm-Bressa-Hopland association, and Xerofluvents-Riverwash complex. The first of these soils is present over the serpentine bedrock and is shallow, well-drained consisting of gravelly loam and clay loam which has a severe erosion hazard. The second of the soils has developed over the Great Valley sequence rocks and is shallow, well-drained loam with a clayey loam subsoil. The hazard of erosion is severe. A third of these soils has developed along the channel and nearby floodplain of Big Canyon Creek and consist of very gravelly sandy loam with underlying very gravelly loamy coarse sand and very gravelly coarse sand. There is generally no hazard of erosion except along stream for there is streambank erosion during high intensity storms. Intermixed with the soils are numerous sub-rounded to sub-angular hard cobbles. <u>Springs/Seepages:</u> None observed. <u>Geologic Hazards:</u> Due to the locally steep to very steep gradients of the 4-wheel-drive trail as well as the short alternate segment, there is a high potential for accelerated erosion. Between about Station 74.8 and 75.3 on the prime alignment the 4-wheel-drive trail crosses very steep sideslopes. An extensive cutslope failure has developed along this interval. This failure plus the steep slopes below make this interval very hazardous in its present condition. More localized areas of deep clayey serpentine soils are present. They will be weak and expansive. <u>Important Conditions and Comments:</u> Geologic hazards as noted. Due to massive serpentine bedrock along the portions of the segment, expect very difficult excavation conditions. Smaller areas of deeper serpentine clay soils where present will result in poor foundation conditions and the possibility of unstable trench sidewalls. The short segment of alternate alignment is preferable. Both stream crossings present potential for erosion/siltation. Big Canyon Creek Crossing is very sensitive due to the large size of the stream and the under-stream crossing proposed.

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TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 77 to Station 86.2 <u>Principal Improvements:</u> Throughout this segment the alignment has been positioned within the right-of-way of Big Canyon Road. This road is wide, well-maintained, paved and generally has a strip or shoulder area beyond both edges of the paved thoroughfare that is a few to several feet wide. The segment traverses through either undeveloped hill country or pasture lands. Numerous high cut slopes associated with Big Canyon Road are present, particularly in the northern part of the segment.	<u>Terrain:</u> The segment traverses southerly along the west side of the narrow stream valley formed by Big Canyon Creek. The last few thousand feet of the segment similarly parallel the valley Putah Creek. The gradient of Big Canyon Road is relatively gentle, with elevations gradually decreasing southward along the road. Through much of its length the road and the alignment are located at the eastern base of a major northwest trending ridgeline. Slopes at the base of this ridge range from occasionally moderate and moderately gentle to often steep. Elevations along the segment range from slightly less than 1,200 feet msl at the north end to about 1,000 feet msl on the south. <u>Drainages:</u> The principal drainage along the majority of the segment is Big Canyon Creek, a principal creek of the region. The active channel is generally a few tens of feet wide and the remaining channel width (highwater flows) is up to several tens of feet in additional width. There are localized intervals where the width narrows due to the presence of resistant bedrock on either side. In overview the channel has a mild sinuosity, has incised itself a few to several feet into its alluvial deposit and is confined to its relatively narrow stream valley which contains long intervals which are up to 200 to 250 feet in width with intervals which are not much more than 100 feet in width. Secondary drainages from upslope on the west and which cross the alignment include Cockerell Creek at Station 84.5 and small unnamed creeks. The channel of Cockerell Creek is 10 to 12 feet wide and has incised banks up to 8 feet in height. The smaller drainages are 8 to 10 feet in width and incised up to about 2 feet. There are several intervals along this segment where Big Canyon Creek is close or very close to the outside edge of Big Canyon Road. At these locations there is typically a steep drop-off of 10 to 20 feet and at one location up to 30 feet. The principal intervals where the creek closely approaches the road are Stations 79.5 to 79.8, Stations 81.2 to 81.6, Stations 82.5 to 82.8, Stations 84.6 to 85.4, and Stations 85.4 to 85.8 (up to 30 feet before drop-off). At Station 82.5 the creek is not only close to the road but has actively eroded into the outside edge of the road at one location presenting a stability problem. Between Station 81.7 and 82.5 there is a small back channel from the creek which is close to the inside edge of the road. <u>Bedrock Formations:</u> The entire segment is underlain by bedrock of the Great Valley sequence which, based on cuts and exposures consists predominantly of massive sandstone, likely containing thick intervals of shale and siltstone. As exposed in the cutslopes, the sandstone is massively bedded, mostly moderately fractured and often hard.

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TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 77 to Station 86.2 (Continued)	<u>Surficial Deposits:</u> Natural surficial deposits upslope immediately west of the alignment are hillside soils consisting of slightly to moderately rocky clayey sands and sandy clays. Natural soils just east of the road consist of stream-laid deposit of sand, silt and gravel associated with big Canyon Creek. Along the road right-of-way which contains the alignment, artificial fill likely occupies most of the outside shoulder along the segment and thin artificial fill to shallow bedrock occupies the inside portions and shoulder of the road. Soil types (SCS) in the vicinity consist of Millsholm-Bressa loams and Xerofluvents-Riverwash complex, both of which have been previously described. The first of these soils has a severe erosion hazard. <u>Springs/Seepages:</u> None observed. <u>Geologic Hazards:</u> Major geologic hazards were not noted along the segment. However, several intervals of raveling and sloughing cutslopes were noted. At about Station 79.6 a 150 foot wide cutslope failure was noted. Between Station 82.5 and 82.6 the previously mentioned bank erosion encroaches into the outside edge of Big Canyon Road on a near vertical 20 foot high slope. This could eventually encroach into the road and the alignment. The several interval where there are steep drop-offs into the creek or narrow stream valley along the outside edge of the road may or may not possess artificial fill that is uniformly stable and/or suitably stable for the alignment. There is the potential for accelerated erosion at the various creek drainages noted which the alignment will cross. <u>Important Conditions and Comments:</u> Geologic hazards as noted. Anticipate a few to several thousand feet of shallow bedrock along the inside edge of the road which will likely present difficult to very difficult excavation conditions. The most sensitive parts of the segment are where the active channel of Big Canyon Creek approaches the outside edge of the road, and where the noted secondary drainages come in from the west. At these locations there is potential for stream erosion/siltation.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued).

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 86.2 to 95	<u>Terrain:</u> The alignment continues along the right-of-way of Big Canyon Road which pulls away from Putah Creek and traverses southerly along the west part of the wide stream valley cut by Putah Creek and its tributary from the southwest, Harbin Creek. The stream valley is up to 1,000 feet wide and contains a few isolated, small, rounded hills. At Station 94.9 the road and alignment exits the southwest edge of the valley and enters a narrow canyon containing Harbin Creek. Elevations along the segment are slightly less to slightly more than 1,100 feet msl.
<u>Principal Improvements:</u> Improvements consist of the Big Canyon Creek Road and associated facilities. The area is undeveloped and is predominantly used mostly for grazing. All creek crossings will be buried.	<u>Drainages:</u> The principal drainage in the vicinity of the alignment is Putah Creek, which for the most part, is located about 1,000 feet to the east of the alignment. Small, seasonal creeks approach and cross the alignment from the west. These generally flow across moderately sloping ground occupied by the west edge of the valley of Putah Creek. The principal of these is an unnamed creek at Station 93.2. On the order of two to three thousand feet of this segment has slightly eroded to deeply eroded drainage ditches paralleling the east or the west edges of Big Canyon Road. These ditches have eroded into soils and are at some locations are 4 to 6 feet deep. <u>Bedrock Formations:</u> Nearly the entire segment appears to be underlain by serpentine bedrock, and by sandstone of the Great Valley sequence. The sandstone is located near the north and south ends of the segment. Exposures of rock are generally limited to cutslopes and nearby small hills. Serpentine bedrock characteristically varies from massive hard and blocky, to intensely sheared and soft.
	<u>Surficial Deposits:</u> Nearly the entire segment is mantled with soils. Soil thickness ranges from a few to several feet. Extensive segments of the roadbed are elevated on artificial fill which in some locations reaches heights of 10 to 15 feet. The soils present are derived principally from serpentine and are highly clayey, expansive and locally contain numerous serpentine rock fragments and blocks. Soils developed from the Great Valley sequence rocks are sandy clays. Soil types present (SCS) are predominantly Maxwell clay loams which are very deep, poorly drained and contain clay in the subsoil. These soils have high shrink-swell properties, low load bearing capacity and slight to moderate erosion hazard (site observation indicate that the potential for erosion is moderate to high). These soils form in basins over serpentine bedrock.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 86.2 to 95 (Continued)	<u>Springs/Seepages:</u> None observed, but due to the poor drainage characteristics of the surficial materials seasonally saturated conditions in the shallow subsurface should be anticipated. <u>Geologic Hazards:</u> Field observations show the surface soils have a moderate to high potential for accelerated erosion and are expansive. Gullyng could result that would be deep enough to expose a buried pipeline if proper drainage is not established. <u>Important Conditions and Comments:</u> Geologic hazards as noted. The serpentine soils present poor foundation conditions. Occasional large serpentine and sandstone blocks in the shallow subsurface may locally cause difficult trenching conditions. Serpentine soils may be poor trench backfill. The most sensitive portions of the segment are the stream-crossing locations. There is potential for erosion/siltation at these locations. The actively eroding drainage ditch would be a poor location to locate the pipeline.
<u>Approximate Stationing:</u> Stations 95 to 97 <u>Principal Improvements:</u> In this segment the alignment continues along Big Canyon Creek Road. Unimproved hill country. The Crossing of Harbin Creek will be on the east side of the canyon road immediately adjacent to the existing bridge and will be a below grade (buried) crossing.	<u>Terrain:</u> In this segment the alignment traverses though a deep, steep sided canyon cut by Harbin Creek. The canyon has been cut through the south end of a major northwest southeast trending ridgeline. At the bottom of the canyon Harbin Creek has eroded out a very narrow stream valley whose width fluctuates from a few tens of feet to occasionally 150 feet. The road gradient through this canyon section is gentle and the elevation changes along the road are minor. The elevation is about 1,150 feet msl. <u>Drainages:</u> The principal drainage in this segment is Harbin Creek which flows north northeasterly through the described canyon. At Station 94.5 Harbin Creek passes from the north to the south side of the road via bridge. At this location the active channel is about 25 feet wide and has steep to moderately steep banks 5 or 10 feet high in surficial deposits. Between Station 94.5 and 96.5, the creek closely approaches the road and has steeply incised banks dropping off into the active channel. <u>Bedrock Formations:</u> The principal rock type present consists of massive sandstone of the Great Valley sequence. Subordinate amounts of shale are probably present. Artificial fill is likely present along the outside edge of the road. <u>Surficial Deposits:</u> Generally thin sandy clay loams mantle much of the area in close proximity to the alignment.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 95 to 97 (Continued)	Soils present (SCS) are predominantly Bressa-Millsholm loams which are moderately deep, well-drained with clay subsoil and which have a severe erosion hazard. These soils develop on hillsides above sandstone bedrock. <u>Springs/Seepages:</u> None observed. <u>Geologic Hazards:</u> None observed. <u>Important Conditions and Comments:</u> The sensitive intervals are the stream crossing at Harbin Creek and the two locations where the creek is in close proximity to the roadway and alignment. At these locations there is potential for erosion/siltation.
<u>Approximate Stationing:</u> Stations 97 to 99.5 <u>Principal Improvements:</u> At Station 97 the alignment leaves Big Canyon Road and traverses westerly across a small valley area intersecting Harbin Springs Road at about Station 98. The valley area is used for livestock grazing. Also commencing at Station 97 is an alternate section of the alignment which continues to traverse southerly along Big Canyon Road until the intersection of Big Canyon and Harbin Springs Roads. The alignment swings sharply to the northwest traversing along Harbin Springs Road to about Station 98.1 where it intersects the preferred route.	<u>Terrain:</u> In this segment the alignment traverses across the edge of a small valley formed by Harbin Creek. It traverses westerly and then southwesterly along this valley for about 1,800 feet. The western part of the valley is gently sloping to the northeast. Harbin Springs Road traverses through the center of the valley. The valley is encircled by moderately steep to steep hill country. The valley elevations is about 1,150 feet msl. <u>Drainages:</u> The eastern half of the preferred route traverses along the northern edge of the valley, adjacent to Harbin Creek. A few shallow, natural drainage ditches cross the alignment from the south and enter into Harbin Creek. From Station 98.5 to 99.1 a more deeply incised, longer drainage gully traverses sub-parallel to the alignment and is crossed twice by the alignment. The more deeply incised part of this gully is on the west and has banks of variable heights with maximums of 8 to 10 feet in height. The headwaters of this long gully are upslope to the west-southwest. <u>Bedrock Formations:</u> About the eastern one-half of the alignment segment is underlain by massive sandstone of the Great Valley sequence and the western part by shale and sandstone of the Franciscan Complex. The contact between the two formations is northwest trending and lies somewhere in the vicinity of Harbin Springs Road. Bedrock is mantled by surficial soils with rock exposures limited to cutslopes and a few natural exposures on nearby hill sides. <u>Surficial Deposits:</u> The preferred alignment is mantled by valley alluvium. The first half of the alternate route (easterly) is underlain by sandy clayey loams of variable thickness and by artificial fill along the west side of Big Canyon Road. This portion of the alternate segment has a high, long bedrock cutslope. The remainder of the alternate route traverses along the westerly edge of the valley within the right-of-way of Harbin Springs Road and somewhat deeper soils are present. Soil type present (SCS) are Maxwell clay loams along the preferred route. They are deep, poorly drained and have a clay subsoil. These soils have a high shrink-swell potential, low load bearing capacity and

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 97 to 99.5 (Continued)	have slight erosion hazard. They typically form in basins. Field observations suggest the erosion hazard is moderate to high. Along the alternate route both Maxwell clay loam and Jafa loam are present. the Jafa loam is deep, well-drained with a clay loam to gravelly cobbley subsoil and has moderate erosion hazard. <u>Springs/Seepage:</u> None observed. <u>Geologic Hazards:</u> Drainage gullies present suggest some potential for accelerated erosion. Expansive soils likely present. <u>Important Conditions and Comments:</u> Geologic hazards as noted. Expansive soils may result in poor foundation conditions. Along the southern part of the alternate route shallow bedrock may present difficult trenching conditions. The most sensitive part of this segment is along the eastern one-half of the preferred route where the alignment approaches to within 100 feet of Harbin Creek. The alternate route is longer, but less sensitive.
4-44 <u>Approximate Stationing:</u> Stations 99.5 to 102.4 <u>Principal Improvements:</u> In this segment the alignment traverses through unimproved hill country. Except for the last several hundred feet on the west, the alignment has been positioned along a narrow 4-wheel-drive trail.	<u>Terrain:</u> From Station 99.0 to 101.2 the alignment traverses upslope to the top of a principal northwest trending ridge. From Station 101.5 it descends the westerly slopes of this ridge, which are considerably steeper, to its termination point along the east edge of Collayomi Valley. Between Station 100 and 101 there is a narrow, short valley with moderately sloping sides which occupies a depression along the ridge top. The elevation at the ridge top is about 1,340 feet msl and the elevation at the east edge of the Collayomi Valley is about 1,120 feet msl. <u>Drainages:</u> The principal drainage present has its headwaters at the ridgetop. It flows southeasterly and then easterly closely paralleling the alignment. Flows are seasonal. The drainage is deeply gullied throughout much of its length and the banks are actively eroding, particularly between Station 99.5 and 100.0. Gully banks are steep and up to 20 to 25 feet deep on the east and 6 to 8 feet deep further to the west at the edge of the small upland valley. They then flatten once again west of the valley to about Station 101.5. About the last 500 feet of the segment is located on steep, even slopes above a deeply incised bedrock gully which drains from the ridge crest westerly to the edge of Collayomi Valley.

(Continued)

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 99.5 to 102.4 (Continued)	<u>Bedrock Formations:</u> Serpentine bedrock associated with the Franciscan Complex is exposed in the 4-wheel- drive trail from near Station 99.5 to 100.0. From this point to about Station 100.5 bedrock is obscured by alluvium of the upland valley. At Station 100.5 to Station 100.7 sheared shale bedrock was noted. From Station 100.7 to the end of the segment serpentine bedrock is once again present. The serpentine ranges from closely fractured and highly sheared to massive, hard and blocky. The sheared shale is possibly a tectonic sliver along a branch of the Collayomi fault, which in this area consists of several subparallel branches. It is possible that the upland valley was formed by one of these fault branches. According to the California Division of Mines and Geology, the Collayomi fault is not "sufficiently active and well-defined" to be designated as presently active. "Active" implies surface movement along the fault within Holocene time (last 11,000 years). <u>Surficial Deposits:</u> With the exception of the upland valley, surficial deposits consist of thin to patchy, rocky clays to clayey rock fragments. Maximum thicknesses are probably on the order of a few feet. At several locations soils are absent or only a few inches thick. In the upland valley soil is uniformly thicker, but still probably not much more than 5 feet maximum. The soils are derived from serpentine bedrock and have high shrink-swell properties. Soil types present (SCS) consist predominantly of Heneke-Montara-Rock outcrop complex. The soils consist of shallow gravelly loams to gravelly clay loams which are excessively drained and have a severe erosion hazard. They form on hills and mountains over weathered serpentine. The soils within the small upland valley are Maxwell clay loams. The soils are deeper, somewhat poorly drained and have a moderate erosion hazard. They have a seasonally high water table and a high shrink-swell potential, with low load bearing capacities. The soils develop in basins and on basin rims over weathered serpentine bedrock. <u>Springs/Seepages:</u> None observed, but seasonally shallow seepage should be anticipated within the soils of the upland valley. <u>Geologic Hazards:</u> There is high potential for accelerated erosion along the described drainage gully. This could result in instability of gully walls which could encroach upon the alignment at several locations. Stream siltation would result from the erosion. The serpentine soils have a high shrink-swell, particularly in the upland valley area. The Collayomi fault consists of several branches in this general area, is thus ill-defined and probably does not present a significant hazard of surface rupture to the alignment. Further research should be done to confirm this lack of rupture hazard.

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TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 99.5 to 102.4 (Continued)	<u>Important Conditions and Comments:</u> Geologic hazards as noted. Anticipate difficult trenching foundation conditions due to shallow serpentine bedrock. The proximity of the alignment to the gully makes the eastern portion of this segment very sensitive for erosion/siltation. Sensitivity along the gully to the west is not as great due to heavy brush and somewhat less steep slopes. Some further study or investigation of the Collayomi fault is advisable to confirm its inactivity.
<u>Approximate Stationing:</u> Station 102.4 to 110 <u>Principal Improvements:</u> Between Station 104.2 and 106.2 the alignment traverses along the access road leading to and past the existing Middletown Wastewater Treatment Plant. Between Stations 106 and 106.8 the pipeline will traverse along the south edge of this facility. From Station 106.8 to Station 108 the alignment will traverse along the east right-of-way of Highway 175. At Station 109.5 the pipeline will cross westerly beneath Highway 175 and continue through the entrance to the Bear Canyon Power Plant access road. The crossing of Putah Creek by the pipeline will be underground.	<u>Terrain:</u> In this segment the alignment traverses northwesterly westerly and then northwesterly across and along Collayomi Valley. The valley width varies from slightly over 2,000 feet at the beginning of this segment to about 800 feet near the end of the segment on the northwest. The terrain is essentially flat and the elevations vary from about 1,120 feet msl at the south southeast end of the segment to about 1,180 feet msl up valley at the north end of the segment. <u>Drainages:</u> Putah Creek drains southeasterly along the east edge of the valley. This is a major Lake County stream. The channel is approximately 100 wide where the alignment crosses the stream at Station 102.5. On the east, the bank is up against a base of the ridge bordering the valley, while on the west there is a steep roughly 10 foot high bank caused by the gradual down-cutting of the stream channel. The bank materials consist of sandy gravel and gravelly sands. At Station 109.6 is the mouth of a small seasonal creek whose headwaters are located on steep ridgeside slopes above on the west. <u>Bedrock Formations:</u> along the southeast end of the segment serpentine bedrock is exposed in the large northwest trending ridge which borders the valley on the east. On the westerly side of the valley at about Station 106.2 to the end of the segment sandstones and shales of the Franciscan Complex are exposed at various locations immediately to the west and upslope. These rock types occupy all of the terrain lying to the northwest and west. Alluvium obscures bedrock through the center of the valley. Somewhere within the valley is a northwest trending contact between the serpentine on the east and the Franciscan Complex sandstones and shales on the west. The contact boundary is probably one of the traces of the Collayomi fault. <u>Surficial Deposits:</u> Valley alluvium consisting of sands silts and gravel are present along the entire segment. These materials range from a few feet deep along the edges of the valley to many tens or hundreds of feet deep in the central part of the valley.

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TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Station 102.4 to 110 (Continued)	Soil types present (SCS) consist of Kelsey fine sandy loam. These soils occupy the central part of Collayomi Valley and are very deep, well-drained loams containing areas of Xerofluvents and Riverwash soils in the vicinity of Putah Creek . Due to the essentially flat slopes of the valley, the erosion hazard of these soils is slight. Jafa loams occupy the west edge of the valley along Highway 175. These loams are well-drained and have a clay loam subsoil. The erosion hazard is slight and they develop on alluvial fans along the edges of the valleys. Talmadge very sandy loams occupy an area of several acres along the west edge of the valley near the entrance road to the wastewater treatment plant. These loams are deep, well-drained and have gravelly sandy loam subsoils. They have slight erosion hazard due to gentle slopes. These soils develop on alluvial fans along the edges of valleys. In the area occupied by the entrance to Bear Canyon Power Plant Road there are Xerofluent soils. These consist of very gravelly sandy loams with low erosion hazard. They have formed at the mouth of the previously described small seasonal creek which drains off of the very steep slopes to the west at Station 109.6. <u>Springs/Seepages:</u> None observed. <u>Geologic Hazards:</u> A branch, possibly the main branch of the northwest trending Collayomi fault is present beneath the valley alluvium. As previously discussed, this fault is not considered to be presently active and thus does not likely present the risk of surface rupture across the alignment. In the immediate vicinity of the Putah Creek stream crossing, there is some potential for accelerated erosion/siltation due to disturbance by construction. <u>Important Conditions and Comments:</u> Potential for accelerated erosion as noted. The most sensitive part of this segment is the short interval at the crossing of Putah Creek. Shallow bedrock may be encountered, particularly along the east side of the channel where serpentine bedrock is exposed near stream elevation. If encountered in the shallow subsurface the serpentine will very likely present very difficult excavation conditions. Potential for erosion/siltation at the crossing is high.

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 110 to 117	<u>Terrain:</u> In this segment and additional segments, the alignment traverses via road up the main ridge of the Mayacmas Mountains. Natural slopes are generally steep with numerous side canyons and intervening narrow ridge lines. Elevations range from about 1,160 feet msl at the edge of the valley floor to about 2,200 feet msl at Station 115.2.
<u>Principal Improvements:</u> In this segment the alignment traverses along the existing access road to the Bear Canyon Power Plant. The road is a two-lane gravel surfaced all-weather road. In this segment the road grades are moderate to locally steep and there are a number of switch-backs. To the north of Station 115.5 and east of Station 116.7 there are large artificial fills. These fills contain excess earthen material generated from grading of the Bear Canyon Power Plant Project and associated steamwell pads.	Both Pump Station Sites BC-1 and BC-2 are located in areas where there is sufficient space to construct the improvements without major grading. Site BC-1 will require minor grading to provide access due to the presence of the cut along the inside of edge of Bear Canyon Road. The alternate pump station site is located on gently sloping terrain and sufficient space is available for its development.
In addition to the pipeline, improvements include Pump Station BC-1 and BC-2 located at Station 112.5 and 114.4. In both cases the pump facilities would be located immediately adjacent to the road on gentle slopes. BC-1 is located just in back of an 8 foot high cutslope at the edge of the road. Minor to moderate grading would be necessary to provide access.	<u>Drainages:</u> As the alignment progresses up the road, it crosses 3 deeply incised, narrow, steep gradient short (about 1 mile maximum) drainage courses. A number of smaller drainages are also crossed. Where the road crosses these drainages, culverts are present. Major streams are not crossed. Drainages are not associated with either Pump Station Sites BC-1, BC-2 or the alternative pump station site.
	<u>Bedrock Formations:</u> The entire segment is underlain by bedrock types of the Franciscan complex. The predominant rock type is graywacke sandstone. Subordinate amounts of shale, greenstone, chert, and pods of higher grade metamorphic rocks are present. In general, the rocks are closely fractured to sheared, hard to locally soft, and often deeply weathered.
	<u>Surficial Deposits:</u> Much of the area adjacent to and beneath the existing road and alignment are mantled by rocky, clayey sands and sandy clays derived from the above named rock types. Pockets of deeper colluvial soils are present and occasional landslides are present. Artificial fill is present beneath parts of the road, particularly the outside edge. Soil types present (SCS) are Speaker-Maymen-Millshom association and Speaker-Marpra-Sanhedrin gravelly loams. The former soil is a moderately deep, well-drained loam with a cobbly clay loam subsoil. It has severe erosion hazard due to steep slopes. The former soil type is a moderately deep, well-drained gravelly loam with a clay loam subsoil. It too has severe erosion hazard due to steep slopes. The erosion hazard of both soils is displayed by localized gully erosion and rilling/rutting of some cutslopes along the road.
	<u>Springs/Seepages:</u> None observed along segment and none observed at or in close vicinity to the pump station sites.
	<u>Geologic Hazards:</u> While active landslides were not observed in this segment, there is some potential for slope instability to locally occur over time. This is due to steep slopes, deep weathering and localized deposits of deeper colluvial soils. There are no major slope failures associated with cut and fill slopes along this segment of Bear Valley

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TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 110 to 117 (Continued) The alternative pump site location would be located on a gently sloping area just inside the Bear Canyon Power Plant gate west of Station 109.5. Between about Stations 112.8 and 113.4 the pipeline departs from the access road in order to avoid two long loops in the road alignment. <u>Approximate Stationing:</u> Stations 117 to 121.0 <u>Principal Improvements:</u> In this segment the alignment continues along the existing Bear Canyon Power Plant Road. The road generally follows along contour with minor fluctuations in grade.	Canyon Road, and overall the road has performed well since its construction some years ago. Geologic hazards were not observed at or in close vicinity to the pump station sites. Because of steepness there is some potential for accelerated erosion along the short alternate segment of alignment which bypasses the switchbacks in Bear Canyon Road. The presence of an old skid trail in this interval somewhat reduces this potential. Pump Station BC-2 appears to be located in an area where artificial fill is present. The stability of this fill must be confirmed or re-engineered to avoid potential slope stability problems. <u>Important Conditions and Comments:</u> Geologic hazards as noted. The presence of the alignment along the road and the presence of nearby pump site locations greatly reduce the sensitivity of this segment. Pump Station BC-2 is in an area of questionable slope stability. <u>Terrain:</u> Elevations along this interval of the road range from about 2,150 to 2,200 feet msl. Side slopes above and below the road range from moderate to steep. <u>Drainages:</u> As the alignment progresses along the road it crosses a few deeply incised gullies within which culverts and engineered fills have been placed. <u>Bedrock Formations:</u> As described in the previous segment (Stations 110 to 117). <u>Surficial Deposits:</u> As described in the previous segment (Stations 110 to 117). <u>Springs/Seepages:</u> None observed along this segment.

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TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 117 to 121.0 (Continued)	<u>Geologic Hazards:</u> An area of existing slope instability was noted between about Stations 117.1 and 117.3. Instability exists immediately upslope of the road. It is not known if the instability is restricted to the upslope area or may extend beneath the road. The road show no signs of deformation. However, geotechnical study of this area should be undertaken. Over time there will probably be some localized cutslopes failures along the road. These would not be a hazard to a buried pipeline.
<u>Approximate Stationing:</u> Stations 121.0 to 124.0 <u>Principal Improvements:</u> In this segment the new connector road will be constructed. The road alignment will traverse southwesterly along the side of a prominent ridgeline. Near the south end of the alignment a large canyon fill will be constructed. Other cuts and fills along the road will range from a few feet in height to about 50 feet. The pipeline will traverse along the road and will be buried. Pump Station BC-3 will be located along the road where a small secondary ridge permits construction of a wider area immediately adjacent to the road.	<u>Important Conditions and Comments:</u> Geologic hazards as noted. <u>Terrain:</u> The terrain consists of steep to very steep sideslopes below the road and a rounded ridgetop beyond the road on the upslope side. The steep dropoff is into a canyon bottom to the west. The road terminates at Well Pad M, a large flat location a few hundred feet by a few hundred feet in surface dimensions. Elevations range from about 2,200 feet msl at the road's commencement point to 2,350 feet msl at Well Pad M. <u>Drainages:</u> The principal drainage is the deeply incised canyon stream west and below the road alignment. This is an ephemeral stream and eventually becomes tributary to Bear Canyon Creek. <u>Bedrock Formations:</u> Same as the previous segment. <u>Surficial Deposits:</u> Same as the previous segment. <u>Geologic Hazards:</u> Active landslides were not noted along the New Road alignment. However, cutslopes may develop localized instability and fills to be located on colluvium filled swales or possible old landsliding could eventually fail. These conditions will require geotechnical investigation and correction as necessary. <u>Important Conditions and Comments:</u> Geologic hazards as noted. There is also a potential for significant stream siltation and possibly accelerated erosion as a result of the road construction. With respect to these conditions the road alignment should be considered environmentally sensitive.

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TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Alignment Segment	Existing Geologic Environment
<u>Approximate Stationing:</u> Stations 124.0 to 139.0 <u>Principal Improvements:</u> In this segment the pipeline continues along existing, maintained roads which are part of the steamfield road system. Beyond Station 139 is the effluent distribution pipeline system. These smaller diameter pipelines will also traverse along the existing steamfield road system to the various designated well pads and their injection wells. West of approximately Station 134.5 is the Y Pad. At this location a 100,000 gallon surge control tank is sited. The tank will be constructed on a flat space to be graded near the top of the existing Y Pad cutslope. It is roughly estimated that up to a few thousand cubic yards of rock spoil will have to be disposed of.	<u>Terrain:</u> This portion of the Geysers Steamfield is located immediately east of and along the main ridgetop of the Mayacamas Mountains. Maximum elevations are on the order of 3,500 feet msl. Side slopes drop off gently to steeply. In the general area along the ridgetop are located P.G.& E. Power Plants Unit 13 and 16 and NCPA Power Plants Number 1 and Number 2. There are also numerous steamwell pads and their associated access roads. <u>Drainages:</u> To either side of the main ridgetop there are the upper reaches of numerous gullies and ephemeral streams. <u>Bedrock Formations:</u> The ridgetop area is underlain by an extensive serpentine intrusion and Franciscan complex rocks to either side. The Franciscan rock types are primarily graywacke sandstone with subordinate amounts of shale greenstone chert and pods of higher grade metamorphic rocks. All rock types are moderately to closely fractured and locally sheared. The rocks are also locally deeply weathered and hydrothermally altered. <u>Surficial Deposits:</u> The surficial deposits present are similar to previous segments with the exception of the soils which have locally formed over the serpentine bedrock. These soils are gravel to gravelly clays and are locally expansive. <u>Geologic Hazards:</u> Along the existing road network there are intervals of high cutslopes. These cutslopes occasionally undergo localized instability which requires cleanup and repair. In general, the roads have performed well since their construction several years ago. <u>Important Conditions and Comments:</u> Geologic hazards as noted. Due to the placement of the proposed pipeline in or along existing road networks, the steamfield portion of the project is not sensitive from a geologic standpoint.

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Injection Area	Existing Geologic Environment
NCPA and Calpine Injection Area	<u>Terrain:</u> This portion of the Geysers Steamfield is located immediately east of and along the main ridgetop of the Mayacamas Mountains. Maximum elevations are on the order of 3,500 feet msl. Side slopes drop off gently to steeply. In the general area along the ridgetop are located P.G.& E. Power Plants Unit 13 and 16 and NCPA Power Plants Number 1 and Number 2. There are also numerous steamwell pads and their associated access roads. <u>Drainages:</u> To either side of the main ridgetop there are the upper reaches of numerous gullies and ephemeral streams. <u>Bedrock Formations:</u> The ridgetop area is underlain by an extensive serpentine intrusion and Franciscan complex rocks to either side. The Franciscan rock types are primarily graywacke sandstone with subordinate amounts of shale greenstone chert and pods of higher grade metamorphic rocks. All rock types are moderately to closely fractured and locally sheared. The rocks are also locally deeply weathered and hydrothermally altered. <u>Surficial Deposits:</u> The surficial deposits present are similar to previous segments with the exception of the soils which have locally formed over the serpentine bedrock. These soils are gravel to gravelly clays and are locally expansive. <u>Geologic Hazards:</u> Along the existing road network there are intervals of high cutslopes. These cutslopes occasionally undergo localized instability which requires cleanup and repair. In general, the roads have performed well since their construction several years ago. <u>Important Conditions and Comments:</u> Geologic hazards as noted. Due to the placement of the proposed pipeline in or along existing road networks, the steamfield portion of the project is not sensitive from a geologic standpoint.
Unocal Injection Area and Pipeline	<u>Terrain:</u> This portion of the Geysers Steamfield is located immediately west of and along the main ridgetop of the Mayacamas Mountains. Maximum elevations are on the order of 2,780-2,840 feet msl. Side slopes drop off steeply. In general, the area has steam well pads and associated access roads. <u>Drainages:</u> Predominantly minor, shallow drainages that are the upper reaches of ephemeral streams. There is one intermittent stream which the 4-wheel drive trail crosses. The stream drains to the west-southwest, has a gentle gradient at the site of the crossing, and is incised about 2 feet deep. Course gravels line the stream bottom.

TABLE 4.3.2-1: GEOLOGICAL CONDITIONS ON THE PROPOSED ALIGNMENT AND FACILITIES SITES (Continued)

Injection Area	Existing Geologic Environment
<u>Principal Improvements:</u> Unocal's 12-inch pipeline would be located in or along the existing service road between the NCPA C-Site and H-Site. At the H-Site, the pipeline would allow an existing 4-wheel drive road that would be widened to create better access. The pipeline would be placed on the surface along the road. A fill would be placed in a small creek.	<u>Bedrock Formations:</u> The predominant rock types are soft to moderately hard, hydrothermally altered serpentine containing variably sized harder fragments of serpentine and sandstone. Greenstone and sandstone units are present adjacent to the southern end of the Jeep trail, with highly fractured and hydrothermally altered rocks. <u>Surficial Deposits:</u> The northern part of the Jeep trail is located on debris associated with ancient landsliding and consists of clay loam with rock fragments of serpentine and sandstone. Los Gatos loam soils occur in the same area. Disposal fill up to 12 feet thick overlies natural soils. The fill consists of rocky sandy clayey loam. The toe of a large ancient landslide may cross the existing Jeep trail just south of the intermittent creek crossing. The slide feature, if it exists, is several hundred to thousands of years old and exhibits no observable signs of recent activity. Surficial deposits at the three-point turnaround and nearby Jeep trail consist of thin sandy clayey gravels no more than a few feet thick. The deposits show evidence of disturbance by heavy equipment, probably having occurred many years ago when the trail was constructed. South of the 3-point turnaround to the H-Pad, surficial deposits along the Jeep trail consist of gravelly clay loam a few feet in thickness (Los Gatos loam). The portion of the pipeline in the existing road between the H-Pad and C-Pad would occur in fill materials. <u>Springs and Seeps:</u> None of significance observed. Near the proposed turnout east of the D&V 18 steam well pad, some surface dampness (probable seasonal saturation) was observed; it probably is related to the placement of disposal fill in this area which altered the surface runoff. <u>Geologic Hazards:</u> Possible expansive soils are present which could present soft soil conditions along the Jeep trail during the wet season. Ruts may be vented during the the wet season. Rills and ruts are a few inches deep. Landslides present along the Jeep trail are ancient and not likely to pose a hazard to the road and pipeline. There is some potential for accelerated erosion due to the gradient of the proposed improved road near the intermittent creek crossing. <u>Important Conditions and Comments:</u> Geologic hazards as noted above. Because of a slightly greater steepness in sideslopes and road gradient in about 600 feet of the road (about 500 feet north of the intermittent stream crossing and 100 feet south of it), there is a potential for soil erosion. Final cutslopes will be slightly higher than for other segments, but will mostly be six feet or less in height.

Geologic Hazards at the SERWTP

Potential geologic hazards for the project area are discussed in general in the Seismic Safety Element of the Lake County General Plan, Lower Lake Area Plan, and City of Clearlake General Plan. The potential risks associated with these hazards which could affect the actual project area were further discussed by others (Kleinfelder and Associates, 1986).

Several northwest-trending active fault zones exist within several miles of the project area (Brown, 1970; Bortugno, 1982). Kleinfelder & Associates (1986) noted fault traces within the project area as shown in Figure 4.3.4-A. There are no known mapped active or potentially active faults that cross the pipeline alignment or that are located at any of the proposed facility sites including the SERWTP.

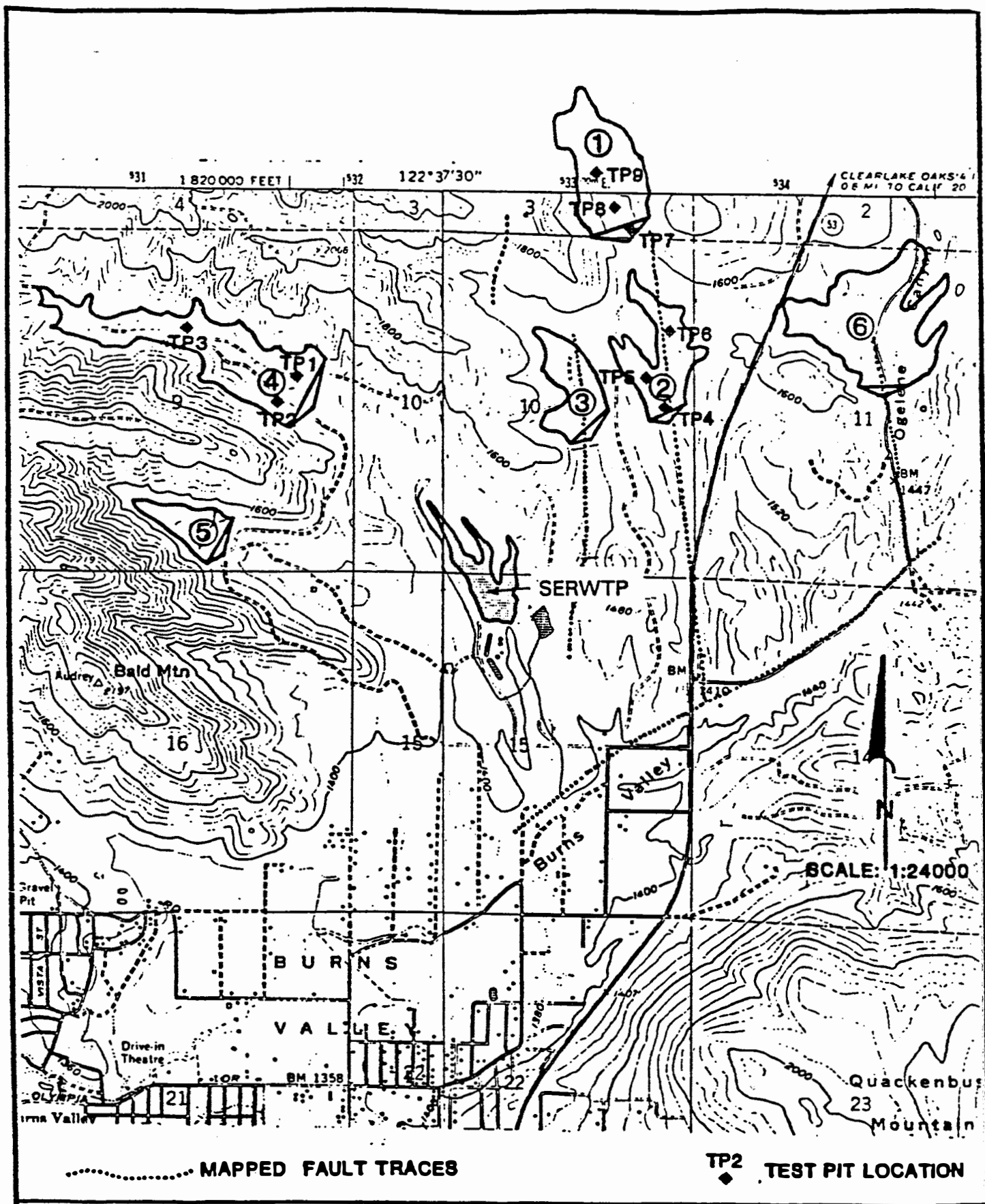
The maximum probable intensity of shaking is estimated to be similar to that which was experienced during 1906, estimated to be a modified Mercalli intensity VIII. Therefore, structures should be designed according to current seismic codes to resist strong shaking with a maximum (peak) ground acceleration of approximately 0.3+g. It may be noted that, in general, geothermal facilities at The Geysers Known Geothermal Area (KGRA) are designed using accelerations which range from 0.15 g to 0.25 g (Nolte, 1986).

Landslides of varying age were noted by Kleinfelder and Associates (1986) north of the SERWTP at the six sites analyzed (shown in Figure 4.3.4-A). Landslide hazards in the Eastern Clear Lake Area have been mapped by Manson (1989). No landslide features are at the SERWTP site. Definitions are given in the map key.

Seiches (wave oscillations) are caused by seismic disturbances, volcanic eruptions or submerged landslides. Seiches can be expected to occur in lake shore areas with an elevation of 1,330 feet or less. The risk of potential seiche inundation of the project is considered low. There has been no recorded occurrence of seiches at Clear Lake.

Surficial Geology at the SERWTP

Soils in the region are of volcanic origin consisting largely of graywacke which is sandy and silty near the surface with an increasing clay-component at depth (18 inches). Soil creep commonly occurs with graywacke soils, particularly on steep hillsides.



SOURCE: Kleinfelder & Associates (1986) graphic as reproduced by Goddard & Goddard Engineering

Figure 4.3.4-A
Fault Traces in the Vicinity of the SERWTP

There are ten different soil series represented within the existing treatment plant/disposal area. These are predominantly of the Phipps Complex with a minor inclusion of the Subrante-Guenoc-Hambright complexes with smaller pockets of Millsholm, Bressa, Bally, Wolfcreek and Manzanita series soils. These are described in more detail and mapped in the soils and geotechnical report prepared by Kleinfelder & Associates (1986). They are generally residual soils resulting from the weathering of the underlying sandstone, shale and basalts. Some area is covered with alluvium from the adjacent hillsides. Soil depth to bedrock ranges from 10 to 72 inches, with the lesser depth associated with steeper slopes and ridges. The steeper sloped areas typically have less than 45 inches of soil, with over 20 percent of the area having less than 10 inches of soil. Areas most suitable for irrigation disposal are the gently-sloped, deeper soil zones which can accommodate construction more cost effectively and which can take a higher rate of water application. Conversely, the steeper slopes and shallower soils areas will result in higher irrigation development costs because of slope construction constraints and lower irrigation application rates per acre.

Local soil conditions are highly variable, requiring that local studies be conducted prior to project design where soil features are of importance. Soil logs for the 9 test pits (TP1 - TP9) north of the SERWTP are shown in Figure 4.3.4-B. Soil logs for the 3 monitoring wells bored by Herzog Associates at the SERWTP (March 1991) are shown in Figure 4.3.4-C.

The liquefaction of loose, saturated, fine-grained granular soils can occur as a result of strong earthquake shaking. The potential for this phenomenon in the SERWTP area appears to be low.

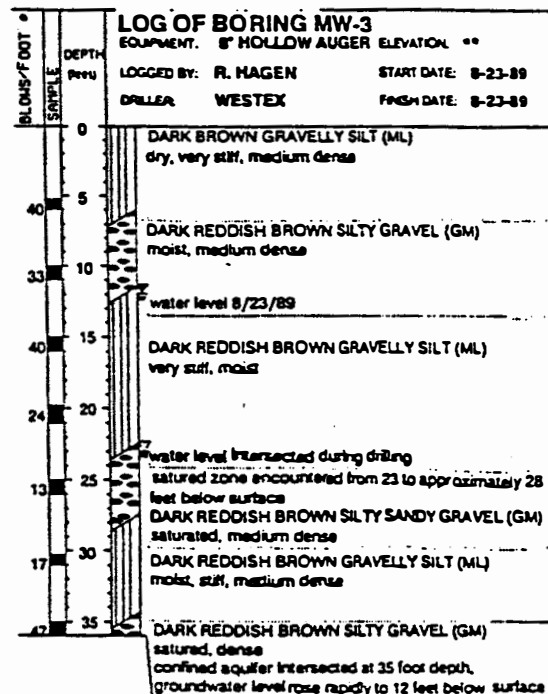
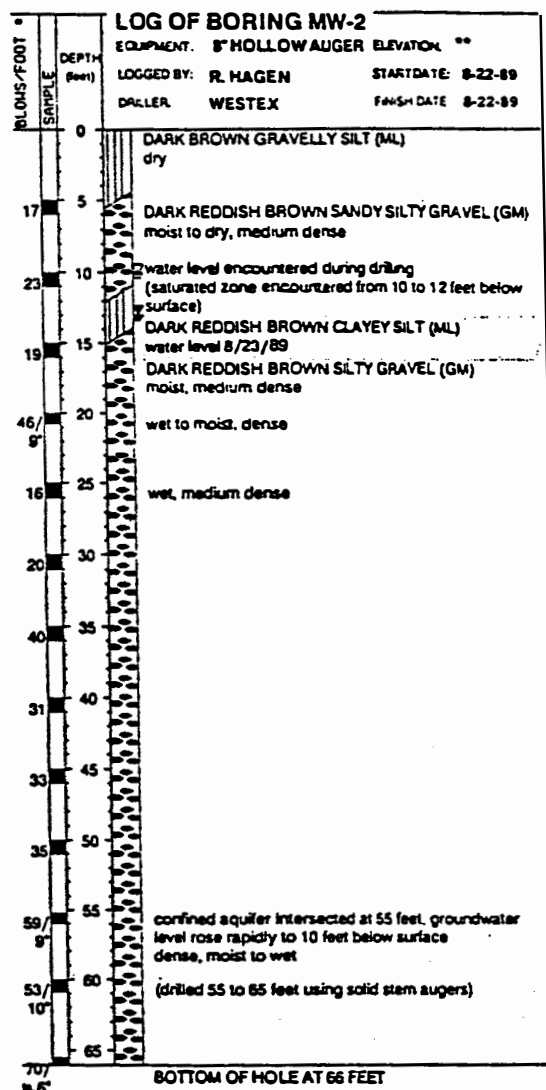
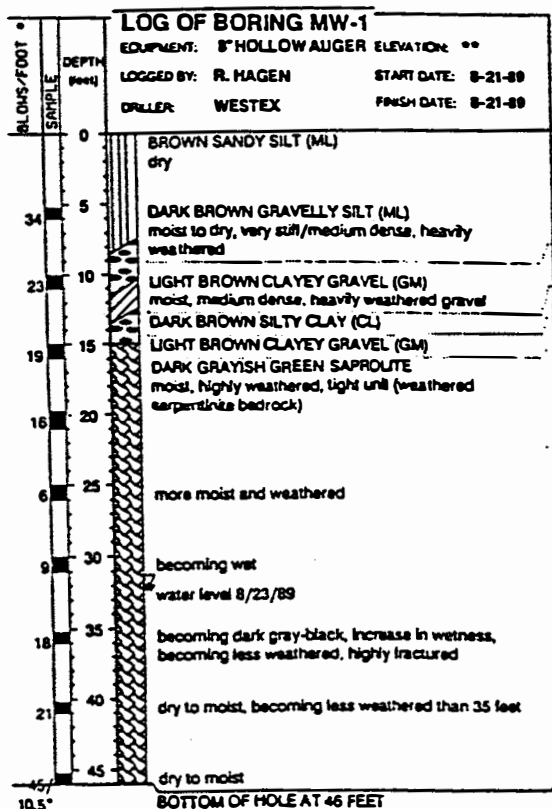
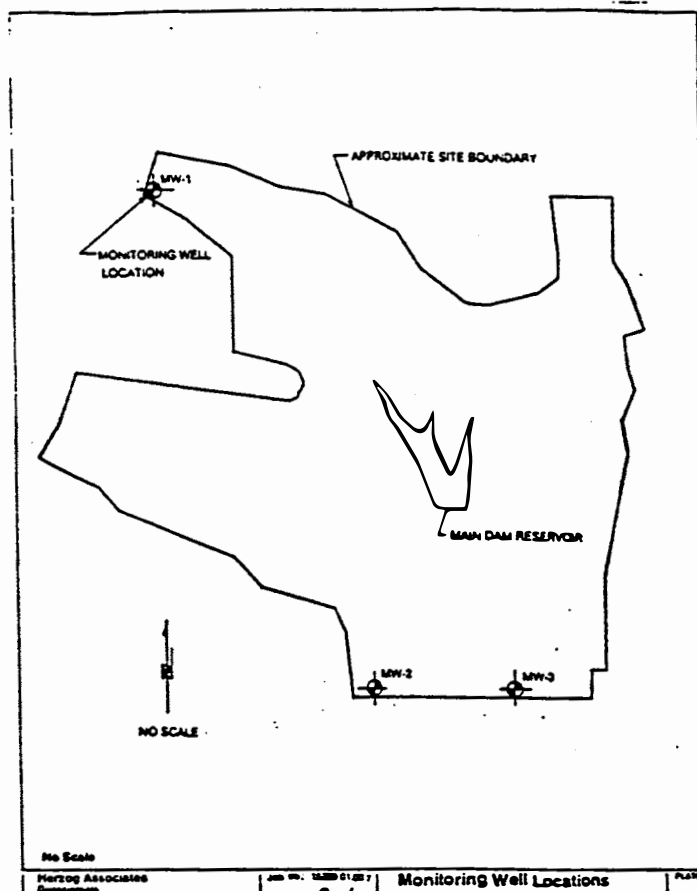
Groundwater at the SERWTP

The Cretaceous rocks which form the basement rocks in the area of the SERWTP are essentially non water-bearing and yield, at most, a few gallons per minute to water wells. The nonmarine Cache formation, present in the project area, is water-bearing and is considered one of the more important sources of groundwater. Water percolates into the Cache unit through surface infiltration. Where capped by permeable, vertically fractured volcanics, such as at Quackenbush Mountain, southeast of the SERWTP, a considerable amount of water travels through fractures in the overlying rock and infiltrates the Cache formation. Groundwater movement below the zone of saturation in the Clear Lake basin is generally considered to be toward Clear Lake and, when uninterrupted by barriers such as faults, or topographic irregularities, discharges as springs

TEST PIT NO. TP1		TEST PIT NO. TP2		TEST PIT NO. TP3	
DESCRIPTION		DESCRIPTION		DESCRIPTION	
ML	SILT - fine to coarse sandy, clayey, some pea gravel, red brown, moist, stiff approximately 20% weathered rock pieces, generally less than 3/8" diameter grades more sandy and gravelly	SH SM G1 WX RX	SAND - fine to coarse grained, very silty, 15% gravel, brown, moist, loose SAND - fine to coarse grained, very silty, some clay, some gravel, moist GRAVELS - gravels and small cobbles, sandy, silty, clayey matrix, brown, saturated WEATHERED ROCK - variably weathered sandstone, weathers to light tan to light blue gray, fine sandy, slightly clayey silt, moist, dense heavy excavation effort required	ML ML SM	SILT - very sandy, fine to coarse grained, clayey, brown, slightly moist, medium stiff SILT - sandy, fine to medium grained, light gray, moist, stiff SAND - fine to medium grained, very silty, tan to light gray, moist, medium dense, appears to be totally weathered sandstone
ML	SILT - fine to coarse sandy, trace of clay, very rocky, light brown to brown, moist, stiff				
SM	SAND - fine to coarse grained, 30% to 40% small rock less than 1/2", very silty, light brown, moist, medium dense				
	Test pit terminated at 14 feet. No free groundwater encountered. No caving of sidewalls noted.		Test pit terminated at 13 feet. Free groundwater at 5 feet during excavating. No caving of sidewalls noted.		Test pit terminated at 12 feet. No free groundwater encountered. No caving of sidewalls noted.
TEST PIT NO. TP4		TEST PIT NO. TP5		TEST PIT NO. TP6	
DESCRIPTION		DESCRIPTION		DESCRIPTION	
SH	SAND - fine to coarse grained, very silty, some gravel, some cobbles to 4", brown, dry, medium dense	ML	SILT - clayey, fine to medium grained sandy, brown, moist, stiff	SM	SAND - fine to coarse grained, very silty, trace of clay, some pea gravel, brown, dry to slightly moist, medium dense
G1	SILT - clayey, fine to coarse sandy, some gravel, light yellow brown, very moist, stiff	G1	GRAVELS - generally 1/2" with some 3/4"; variably weathered, slightly clayey, very silty, sandy matrix, brown, very moist, medium dense		grades clayey, very moist to saturated
ML					
SM	SAND - fine to coarse grained, very silty, gravelly, trace of clay, gravel is variably weathered, brown, moist, medium dense	SM	SAND - fine to coarse grained, very silty, slightly clayey, brown, moist, medium dense	G1	GRAVELS - gravels and small cobbles, very silty sandy matrix, brown, saturated, loose, some caving
	Test pit terminated at 13 feet. Perched ground-water level at 3 1/2 feet. No caving of sidewalls noted.		grades light olive gray Test pit terminated at 13 feet. No free groundwater encountered. No caving of sidewalls noted.		Test pit terminated @ 12 feet. Free groundwater encountered at 7 feet during excavating. Some caving of sidewalls in the saturated gravels.
TEST PIT NO. TP7		TEST PIT NO. TP8		TEST PIT NO. TP9	
DESCRIPTION		DESCRIPTION		DESCRIPTION	
ML	SILT - fine sandy, slightly clayey, brown, dry, medium stiff	ML	SILT - very sandy, fine to coarse grained, slightly clayey, brown dry, medium stiff	SM	SAND - fine to coarse grained, very silty, some weathered gravels, dark brown to brown, moist, medium dense
	SILT - very fine sandy, slightly clayey, highly weathered rock, moist, medium stiff, light gray	CL	CLAY - very silty, fine to coarse sandy, some highly weathered gravels, light brown, moist, stiff		grades very moist, slightly clayey
ML				ML	SILT - fine to coarse sandy, clayey, approximately 20% weathered gravels, light brown gray, moist, stiff
		ML	SILT - very fine sandy, trace of clay, some highly weathered rock, light yellow brown and gray, moist, stiff	G1	GRAVELS - weathered gravels, clayey sandy matrix, light brown, medium dense
	Test pit terminated @ 13 feet. No free groundwater encountered. No caving of sidewalls noted.		Test pit terminated @ 13 feet. No free groundwater encountered. No caving of sidewalls noted.		Test pit terminated @ 12 feet. No free groundwater encountered. No caving of sidewalls noted.

SOURCE: Kleinfelder & Associates (1986) graphic as reproduced by Goddard & Goddard Engineering

Figure 4.3.4.-B
Soils Information from 9 Test Pits (TPI-TP9) Near SERWTP



SOURCE: Herzog (1991) graphic as reproduced by
Goddard & Goddard Engineering

Figure 4.3.4-C

within the lake. Permeabilities are generally slow, varying from 0.06 to 2.0 in/hr based on a one-half inch hydraulic head. The percolation rate from the existing SERWTP reservoir has been estimated at 0.4 inches per day.

4.3.5 PROJECT DESIGN ALTERNATIVES

Lake Diversion Pumps and Pipeline on Pier

The site has the same soft lake bottom deposits as for the proposed project.

Bear Canyon Single Pump Station

The site is gently sloping, located along the edge of the Collayomi Valley. The site consists of colluvial soils. Erosion hazard is low.

One-Way Surge Tank in The Geysers

The site has conditions similar to those of the Southeast Geysers (see Stations 124 to 139). The site is a constructed pad.

By-Pass Pipeline at the SERWTP

The site conditions are the same as those described for the SERWTP (see Section 4.3.4).

Alternate Route A-1 and A-2

The conditions are similar to those for the proposed route (see Stations 20.0 to 25.0). Slopes are moderate. Bedrock consists of Clear Lake Volcanics. Surficial deposits and soils are shallow. Soils are Benridge-Sodabay loams. Erosion hazard is moderate.

Alternate Route B

As with the proposed creek crossing, the site is relatively sensitive to erosion and bank instability. The same conditions exist at the alternate site (see Station 37.0 to 43.3). Gullying and bank erosion are evident at the site in alluvium that forms the steep banks of the creek channel.

Alternate Route C

The conditions are the same as for the proposed route (see Station 46.0 to 54.3).

Alternate Route D

The route follows a four-wheel-drive road that is steep and eroded. Rocks consist of fractured massive graywacke sandstone, probably of the Great Valley sequence. Soil creep occurs on most of the route. Soils are shallow and rocky.

Alternate Route E

Geologic conditions are the same as those described for the proposed route (see Stations 96.5 to 99.2). Much of the route is located in road fill. Slopes are gentle.

Alternate Route F

The route follows in the Bear Canyon Access Road which is constructed of cut and fill. Immediately behind the Bear Canyon Power Plant, the alternate route would follow along the edge of an existing, steep, high cut. For all but about the first 300 to 500 feet above the top of the cut slope, the ridgeline is narrow and has steep precipitous dropoffs to either side. A deeply incised canyon bottom stream is located directly below on the northeast and a similarly incised stream is present on the southwest but at a somewhat greater distance laterally from the ridgeline. Bedrock in this area appears to be very near the surface. The rock may be quite firm. The combination of a very narrow ridgeline with steep sideslopes presents a high potential for earth and rock debris falling or rolling into the canyons below.

Alternate Distribution Pipeline Route G

Conditions are the same as those in the Southeast Geysers. Part of the alternate route follows an existing pad and road constructed of fill. The northerly part of the route is located on moderately sloping topography with bedrock near the surface. Shallow soils are present in this area. The route follows an existing trail or four-wheel-drive road. It is located adjacent to an existing streamcourse. Erosion hazard is moderate.

Alternate Site for Childers Peak Regulating Tank

The site is similar to that of the proposed project site (see Station 66.3 to 76.6). Slopes are somewhat steeper, as the site is located closer to the adjacent slopes of Childers Peak.

4.4 HYDROLOGY AND WATER QUALITY

4.4.1 OVERVIEW OF GENERAL CONDITIONS

4.4.1.1 HYDROGRAPHY

The project area is located in three master drainages of the Coast Range: Cache Creek, Putah Creek and Big Sulphur Creek. Two of the master streams drain eastward to the Sacramento Valley, eventually discharging to the Sacramento-San Joaquin Delta and San Francisco Bay. The lower Cache Creek drainage passes through Yolo County. Lower Putah Creek passes through Napa, Solano and Yolo counties. Big Sulphur Creek is tributary to the Russian River which drains westward and discharges to the Pacific Ocean. Within the first two watersheds, the project area includes major tributary drainages, identified below. Cache Creek and Putah Creek originate in Lake County. These drainages are located in two hydrologic units which are separated on their drainage divide. These units are called the Lower Lake Hydrologic Unit and the Middletown Hydrologic Unit (Lake County General Plan, 1981). Big Sulphur Creek originates on the west side of the Mayacmas Mountains in Sonoma County, and is located in the hydrologic unit called the Russian River Drainage Basin (Sonoma County General Plan, 1989).

Cache Creek Drainage

The project area includes parts of the tributary watersheds of Cache Creek and is located in the County's Lower Lake Hydrologic Unit. All project components north of the Childers Peak Regulating Tank (Station post 67) are included in drainages that ultimately discharge into Cache Creek. The principal water features are described below.

Clear Lake. The principal water body of Lake County is Clear Lake. The lake is the largest natural lake wholly within the State of California. The Clear Lake drainage area is 2,682 square miles. While the surface area of the lake is large, approximately 68.5 square miles, the lake is relatively shallow, with a maximum depth of 60 feet, and an average depth of 26 feet (Lake County, 1981). The storage capacity of the lake is 1,153,000 acre-feet (af) (Lake County, 1981). The irrigation storage of the lake is 303,000 af (Lake County, 1981). This storage volume, which may be termed the "reservoir" is available for withdrawal for multiple uses. Clear Lake is located in a mountainous region and is largely surrounded by hills and mountains. Mt. Konocti (elevation 4,299 feet msl) is located directly on the shore of the lake. The large size of the lake, the surrounding topography and the mild climate of the area have made Clear Lake the major area for both development and recreation/tourism. The great majority of the population in Lake

County is concentrated in communities along the lake shore. Boating, fishing and other forms of water-oriented recreation occur year-round on the lake. The mild climate prevents the lake from freezing over in winter.

The warm summers in Clear Lake, combined with its shallow depth, reduced inflow from tributary systems, and nutrient loading result in substantial growth of blue-green algae in the lake. During the summer and early autumn, algae growth is particularly heavy. This process of algae "bloom" occurs most frequently during August and September. The cause and controls of the algae bloom are under investigation by the Clear Lake Algae Research Unit. Additional information on water quality of Clear Lake is presented in Section 4.4.4.

Clear Lake has several natural "arms" divided by the relative locations of topographic features along the shore. The largest and deepest parts of the lake, and the contributing drainage area are located outside the project area. The project is located within the drainage of the Lower Arm of the lake. The Lower Arm has an average depth of about 34 feet. The contributing drainage area is about 192 square miles.

The principal outlet of Clear Lake is Cache Creek. The Creek drains the lake through the Lower Arm. A dam was constructed across Cache Creek for the purpose of raising the level of the lake and increasing water storage. The dam was constructed by Yolo County, and is owned and operated by the Yolo County Flood Control and Water Conservation District (YCFCWCD). The lake level varies according to climatic conditions, but the operation of the dam also affects the water level. By the Gopcevic Decree of 1920, the YCFCWCD must maintain the lake flow so as not to rise above 7.56 feet on the "Rumsey Gauge." The Rumsey Gauge established zero datum at elevation 1,318.64 feet above mean sea level. Higher inflow during large storms can raise the lake level faster than the capacity of the outlet channel to pass flows. As a result, the lake can rise above 7.56 feet Rumsey for short periods. Under the Decree, the lake level may reach +9.0 feet Rumsey, but for a period of no longer than 10 consecutive days.

Because of the dam, the YCFCWCD owns the water which is stored in the lake above the natural lake level. If Clear Lake is full (7.56 feet Rumsey) on May 1, the YCFCWCD may begin to drain 150,000 acre-feet (af). If the lake is 3.22 feet Rumsey or lower, water releases for irrigation are not permitted. Also, the level of the lake on October 31 may not fall below 1.25 feet Rumsey. These restrictions are established in the Solano Decree of 1978, which are intended to ensure that the level of the lake does not drop to unacceptably low level because of

excessive withdrawals by the downstream users in Yolo County or others who purchase lake water from the YCFCWCD.

Clear Lake Outlet Channel (Cache Creek). The dam on Cache Creek has resulted in a normal bank full condition between the dam and Slater Island, located at the most southerly end of the Lower Arm of Clear Lake. This channel is called the Clear Lake Outlet Channel and its water level is the same as that in the lake. The Central Valley Regional Water Quality Control Board (CVRWQCB) regards the Outlet Channel as part of Clear Lake. Cache Creek begins below the dam. Cache Creek is not within the project area. Cache Creek below the dam is located in a mountainous rural area with little development and few points of access. It is predominantly used for recreational activity, including sport fishing and rafting in this area. At Rumsey, the creek enters the broader alluvial Capay Valley in the Coastal Ranges where agricultural becomes the dominant land use. Near Capay, Cache Creek enters the Sacramento Valley, an extensive agricultural region.

Burns Valley Creek. This is an intermittent watercourse (contains water seasonally, and predominantly in the October to June period). It is the principal watercourse flowing through the City of Clear Lake. The creek is unregulated. No flow records are kept on the creek. The creek drains into the Lower Arm of Clear Lake. Most of the watershed is rural, with land used for grazing, watershed and agriculture (orchards). The lower segment of the creek passes through the developed parts of the City of Clearlake.

Molesworth Creek. This is an intermittent stream that flows from the City of Clearlake to the Lower Arm of Clear Lake. It is unregulated and lacks flow records. Most of the watercourse flows through developed areas of the city.

Seigler Creek. This watercourse is a perennial stream (contains water year-round) with 7,800 af average annual runoff (Lake County, 1981). Its headwaters are in the mountains south of Clear Lake. It flows through rural areas with little development until reaching the community of Lower Lake. From Lower Lake to the Clear Lake Outlet Channel, it is located in developed areas interspersed with open space near Anderson Marsh State Park.

Copsey Creek. Copsey Creek, and its main tributary Clayton Creek, is an intermittent stream system. Its headwaters are in the rural mountains south of Clear Lake. The watershed is predominantly rural with open space, grazing and agricultural use. The lower reaches of the

stream between Morgan Valley Road and the Clear Lake Outlet Channel have low density residential development.

Sweet Springs Creek. This is an intermittent stream that is tributary to Copsey Creek. It is unregulated and there are no flow records. It is located entirely in mountainous, forested lands with some use for grazing. The creek flows in a steep-walled canyon. In the upper channel where the proposed pipeline would be located, it flows in a shallow channel with short meandering loops located on the narrow valley floor. The source of the stream is the area around the northwest side of Childers Peak.

Putah Creek Drainage

The project area includes parts of the tributary watersheds of Putah Creek and is located in the County's Middletown Hydrologic Unit.

Big Canyon Creek. This is one of the main tributaries of Putah Creek. It is a perennial stream that drains a forested mountainous area southwest of Childers Peak. The stream is not regulated or gauged. The watershed is entirely rural, with open space and little settlement. Principal uses include watershed, forestry, recreation and grazing.

Harbin Creek. This is also a main tributary of Putah Creek. It is a perennial stream that drains forested mountains south of the Big Canyon region. The stream is not regulated or gauged. The watershed is entirely rural with open space and little settlement. Principal uses include watershed, grazing and forestry. The Harbin Hot Springs area, located upstream and out of the project area, has tourist use.

Putah Creek. The portion of Putah Creek within the project area is in the Collayomi Valley. In this area, Putah Creek is an unregulated perennial stream. The headwaters of Putah Creek include the Southeast Geysers. Most of the watershed above Collayomi Valley is forested. Principal land uses includes the geothermal steam fields in The Geysers, scattered residential uses, small communities like Anderson Springs, recreation, forestry and grazing. There are two gauges on Putah Creek in the study area. The median annual flow measured at Guenoc downstream of the study area is approximately 197 cfs, equivalent to about 143,000 AF per year (Bohren, 1983). The mean minimum daily discharge is about 2 csf, and the minimum discharge has dropped to zero (dry).

Unnamed Tributary to Bear Creek. This tributary is an intermittent stream on the north-facing slope of the mountains above Anderson Springs. It is the creek that would be crossed by the proposed road connecting the Bear Canyon Access Road and M-Pad. Its characteristics are similar to others in the area such as Cub Creek, Anderson Creek and other watercourses in the steep, forested mountains. The stream is short with a steep gradient, the channel being deeply confined within the steep canyon slopes. The channel drops between a series of pools, some of which may contain water all year-round in years of above-average precipitation. In the area of the proposed road and pipeline crossing, the channel ranges from five to ten feet wide enclosed by steep slopes on each side. The entire area of the watershed at and above the crossing point is forested and the sole uses are for watershed lands and geothermal development.

Big Sulphur Creek Drainage

The project area includes a part of the tributary watershed of Big Sulphur Creek and is located in Sonoma County's Russian River Drainage Basin.

Big Sulphur Creek. The portion of Big Sulphur Creek in the project area is in The Geysers Geothermal Resource Area of Sonoma County. The project area is in the headwaters of the creek which originates in the southern portion of The Geysers, flowing in a northwesterly direction through northeastern Sonoma County. In this area, Big Sulphur Creek is a monitored, but unregulated, perennial stream. Most of the watershed area is steep and forested. The principal land use is geothermal steam fields in The Geysers and watershed, with small amounts of recreation, forestry, grazing, and scattered residential. There is one gauge on Big Sulphur Creek. The median annual flow measured directly below PG&E's Unit 20 was 17.1 cfs in 1981 and 19.4 cfs in 1982, equivalent to about 12,500 to 14,000 af per year (Boles, 1984, Boles and Lacey, 1983).

Unnamed Tributary to Big Sulphur Creek. This tributary is an intermittent stream and is not directly gauged. It is a creek that would be crossed by the proposed Unocal distribution pipeline and jeep trail upgrade which would extend between the NCPA H-Pad and Unocal's D&V 18-1.6 well pad. The creek's main channel is approximately five feet wide and two feet deep at the point of crossing. The flood channel is approximately eight to ten feet wide. The stream has a boulder/cobble substrate and is confined. It has a steep gradient just upstream of the point of crossing. The creek goes underground about 25 feet beyond the point of crossing. The entire

area of the tributary's watershed at and above the crossing point is forested and the sole uses are for watershed lands and geothermal development.

4.4.1.2 HYDROLOGY AND FLOOD HAZARDS

The hydrologic regime in the project area is dominated by the seasonal characteristics of precipitation. As is typical in California, the great majority of precipitation occurs in the November - April rainy season. The May - October period generally is the dry season, with few storms passing through the area. Average annual precipitation at Clear Lake is 29 inches, almost all received from rainfall. Snow events account for a minor amount of the precipitation.

Most of the precipitation in the region occurs in the nearby mountainous areas. Precipitation in The Geysers is on average 60 - 80 inches per year. Most of the precipitation occurs as rainfall. At higher elevations, north-facing slopes retain snow for short periods in winter. However, essentially all runoff occurs in direct response to rainfall events.

Storm events typically occur as frontal storms lasting 3 - 5 days. Thunderstorms are infrequent occurrences. The winter frontal storms can bring very significant precipitation. Approximately 95 percent of the precipitation occurs in the October through April period.

Precipitation is highly variable from year to year. Extreme droughts have reduced annual precipitation to 40 percent of normal. Periods of extended drought have been recorded, most recently a 5-year drought that ended in 1993 and affected almost all of Northern California. Periods of above normal precipitation also are characteristic. Extreme wet years may produce 200 percent of normal precipitation (Ott, 1986).

The 10 year storm with 24 hour duration produces 4 to 8 inches of precipitation in the area, with the higher intensity occurring in the mountains. The 24 hour storm with a recurrence of 100 years produces 8 to 10 inches.

Because most of the project pipeline alignment and facilities are located in the upper watersheds of the major rivers of this region, flooding is an infrequent hazard. Minor local flooding probably occurs on most of the tributary courses. The areas of significant flood hazard are confined largely to the flood plains of Big Canyon Creek and Putah Creek. Both of these

watercourses at the location of the pipeline crossing display wide flood plains (100+ feet), with evidence of substantial scour and erosive power (large cobbles and boulders).

4.4.1.3 WATER QUALITY

Water quality data are available for only a few of the water bodies within the project area including Clear Lake, Big Canyon Creek, Putah Creek and Big Sulphur Creek. In general, water quality is good for all the watercourses in the area except Big Sulphur Creek, a reflection of the rural and undeveloped nature of most of the study area.

No data are available on water quality of the unnamed tributary of Big Sulphur Creek which would be crossed by the proposed Unocal pipeline and maintenance road. Visual inspection of the unnamed tributary to Big Sulphur Creek by ESA in spring of 1994 indicated clear cold water containing *Spyrogyra* and a few aquatic invertebrates, indicators of good water quality. No fish or other vertebrates were observed.

Visual inspection of the watercourses by ESA in winter and spring of 1993 and spring of 1994 indicated few locations of degraded water quality. Most watercourses displayed clear water with little evidence of problematic conditions. A few water courses, including Burns Valley Creek and Copsey Creek indicated slightly turbid waters. It is also anticipated that coliform may be present in most of the watercourses given the widespread presence of grazing. Agricultural pesticides, herbicides and fertilizers may be present in Burns Valley Creek, Copsey Creek, Clayton Creek and Putah Creek. Burns Valley Creek has experienced some short term degradation related to occasional overflows at the SERWTP. These were of short duration, primarily during storm events. Molesworth Creek reportedly has had problems with degradation of water quality from the Eastlake Landfill.

Pertinent water quality information about Clear Lake is presented in Section 4.4.4. In general the quality of Clear Lake water is good. The principal problem is turbidity, which is caused by sediments and algae growth throughout the lake. Low concentrations of various metals, such as mercury and boron, are evident in samples of the lake water. However, these metals are present in concentration, within acceptable limits for drinking water.

4.4.1.4 GROUNDWATER

There are few useful data on groundwater conditions for most of the study area near the pipeline alignment. Groundwater in The Geysers is discussed in Section 4.4.3. Because most of the facilities proposed for the project would be located at a depth no greater than 8 feet, and because no use of groundwater is proposed for the project, groundwater is not a resource likely to be affected by the project except in the event of a slow leak. The principal concerns relate to the need to locate The Geysers Effluent Pipeline at least 50 feet from existing wells to protect their water from leaks of effluent into the well, and possible construction constraints related to saturated soil conditions where groundwater is present near the surface.

The project facility would be located in the general vicinity of numerous wells, but reconnaissance of the project pipeline route indicated only one well that is located within 50 feet of the proposed effluent pipeline. It is located at about station post 46, just west of the Caltrans ROW and fenceline along Highway 53. The well is apparently used for orchard irrigation. Areas of potentially saturated soils, where present, are presented in discussions of each of the project components.

4.4.1.5 REGULATORY AND PLANNING FRAMEWORK

Water resources are protected and regulated under a complex set of federal, state and local regulations and policies. The roles of key regulators are briefly summarized below:

The County of Lake regulates shoreline land uses in unincorporated areas and manages the lake bottom of Clear Lake, that is, the area lake-ward of 11.5 Rumsey. The county also has responsibility for shoreline land uses which are regulated through the Clearlake Shoreline Ordinance. The YCFCWCD operates the Clear Lake dam and is responsible for the lake "reservoir," that is, the water level above zero, Rumsey.

The Regional Water Quality Control Board, Central Valley Region (CVRWQCB) has responsibility for protecting water quality and beneficial uses of the lake, as well as all other water bodies. The CVRWQCB enforces its delegated authority under the Federal Clean Water Act and State Porter - Cologne Water Quality Control Act, in cooperation with the U.S. Environmental Protection Agency (EPA) and other federal and state agencies. The CVRWQCB issues permits under the National Pollutant Discharge Elimination System for projects discharging wastes into surface waters. The CVRWQCB has developed a Basin Plan for

Clear Lake that prohibits wastewater discharge to the lake. The North Coast Regional Water Quality Control Board (NCRWQCB) has similar responsibilities to the the CVRWQCB, but for the Big Sulphur Creek drainage. The State Water Resources Control Board (SWRCB) regulates the water resources of the state including lake withdrawals, administered by the Division of Water Rights (DWR). Additionally, through its Inland Surface Waters Plan, DWR established water quality objectives and standards to protect human health and wildlife/fisheries/aquatic life. The Inland Surface Waters Plan has not been formally adopted, pending the outcome of a decision before the Superior Court of California, County of Sacramento. The CVRWQCB used the Water Quality Control Plan of the SWRCB's Inland Surface Waters Plan as the basis for the Basin Plan for Clear Lake. Under Lake County policy (as well as the Inland Surface Waters Plan, if adopted), the discharge of wastewater into Clear Lake is prohibited. The water proposed for diversion from Clear Lake is owned by the YCFCWCD. The State Department of Health Services (DHS) issues permits to operate public water supply systems. Clear Lake is a source of public drinking water, as is Big Canyon Creek and Putah Creek and smaller tributaries in their basins. Big Sulphur Creek is not a drinking water source, but is tributary to the Russian River, which is a source of potable water. Unocal currently holds a permit to divert water from Big Sulphur Creek for purposes of its geothermal operations.

The Army Corps of Engineers has the delegated responsibility for permitting of fills in the lake and in all "waters of the United States" under provisions of the federal Clean Water Act. Additionally, it regulates all dredging and channel alteration of the lake and water courses under provisions of the federal Rivers and Harbors Act. The Corps also would be responsible for ensuring compliance with Executive Order 11988 which requires federal agencies to prepare floodplain assessments for proposals located within or affecting floodplains. All of the project stream crossings would include a flood zone, but most streams are in small confined channels lacking flood plains. Large flood plains are present only at the crossings of the Clear Lake Outlet Channel (Cache Creek), Big Canyon Creek and Putah Creek.

The California Department of Fish and Game (CDFG) exercises an indirect authority over all alterations of water courses. While not a delegated regulator, CDFG provides oversight to protect water resources and wildlife habitats. This is achieved through the Stream Alteration Agreement which establishes permit-like conditions on development affecting water courses. CDFG similarly participates in the issuance of a Lake Alteration Agreement.

Groundwater resources in the Southeast Geysers are regulated by the California Division of Oil and Gas and Geothermal Resources (CDOG&GR), and the County of Lake and County of Sonoma. Permits for injection are secured through the CDOG&GR with appropriate review from the CVRWQCB. Additional regulation is provided by the U.S. Bureau of Land Management (BLM) with delegated authority under the Federal Land Policy and Management Act (FLPMA) and Geothermal Steam Act. The BLM, under FLPMA and the Geothermal Steam Act and other federal laws, also is responsible for protection and management of water resources in the BLM lands and may issue injection permits.

None of the water courses in the project area are designated or candidate Wild and Scenic Rivers under either national or state programs for such designation and protection.

4.4.2 THE GEYSERS EFFLUENT PIPELINE PROJECT COMPONENT

Table 4.4.2-1 presents data (using stations for reference location) about hydrologic conditions along the proposed route of the pipeline and related facilities. Refer to Figures 2.1.3-B through 2.1.3-E for locations of the stream crossings.

Lake Diversion Pipeline

The proposed lake diversion pipeline crosses a number of small ephemeral channels that drain the Burns Valley area. One of the stream courses is located at the edge of a large meadow area (M3.5). The stream appears to have been partly relocated into a graded channel and has spread into a swampy area. Groundwater appears to be relatively high in this area, as evidenced by seasonal saturated soils. The crossing of the unnamed creek at M 4.2 is at a location where the channel is incised with fairly steep banks. This is a ditch-like channel, but appears natural in form.

Geysers Effluent Pipeline

There are four stream crossings in Clearlake (Burns Valley Creek, Molesworth Creek, and two unnamed creeks). Of these, the crossing of Burns Valley Creek presents the greatest constraint because it is deeply incised. The crossing would occur on the upstream side of a small bridge culvert carrying Robin Lane. At that location, the stream flows in a channel with steep wooded banks. The stream carries of substantial flow in winter. A local resident noted that the creek

TABLE 4.4.2-1: STREAM CROSSINGS AND THEIR PREDOMINANT CHARACTERISTICS

Station	Stream Name	Flow Type	Approximate Channel Depth (feet)	Approximate Channel Width (feet)	Observations
Lake Diversion					
M 3.5	unnamed	ephemeral	4	4	Culvert just downstream
M 4.2	unnamed	ephemeral	under 2	10	High groundwater drains meadow, altered channel
M 5.8	unnamed	ephemeral	under 2	6	Culvert under Smith Lane
Geysers Effluent Pipeline					
4.4	Burns Valley Creek	intermittent	15	20	Deeply incised, small bridge crossing
5.2	Unnamed	ephemeral	4	3	Stream crosses Robin Lane, ponds in road
15.5	Molesworth Creek	intermittent	2	3 - 4	Road crosses in creek
17.9	unnamed	ephemeral	3	4	Canyon - form boulder bottom
25.0	Clear Lake Outlet Channel	perennial	20	30	Span of creek on Lake Bridge Drive
36.6	unnamed tributary of Clayton Creek	ephemeral	10	5	--
37.2	unnamed tributary of Clayton Creek	ephemeral	2	4	--
39.1	Clayton Creek	intermittent	20	50	Bridge crossing, debris in channel
45.5	unnamed tributary of Copsey Creek	intermittent	15	30	Flow in 6-foot culvert at pipe crossing
52.0	unnamed tributary of Copsey Creek	perennial	3	6	Possibly regulated flow, flow in small culvert at pipe crossing, adjacent wetland
54.6	Copsey Creek	perennial	25	100	El Roble Grande Ranch wide deeply incised channel: span crossing of pipe

(Continued)

TABLE 4.4.2-1: STREAM CROSSINGS AND THEIR PREDOMINANT CHARACTERISTICS
(Continued)

Station	Stream Name	Flow Type	Approximate Channel Depth (feet)	Approximate Channel Width (feet)	Observations
56.8	Copsey Creek	perennial	15	25	Road crossing of creek
59.6	Copsey Creek	perennial	4	10 - 15	--
60.2	Sweet Springs Creek	intermittent	5	8 -- 12	--
61.6	unnamed tributary of Sweet Springs Creek	intermittent	0.5	under 2	Gullied road crosses creek
61.8	Sweet Springs Creek	intermittent	under 2	8	Road crosses creek
62.5 - 67	Sweet Springs Creek	intermittent	2 -- over 4	3 -- 8	Approximately 25 crossings of meandering creek
68 - 72	unnamed tributary of Big Canyon Creek	intermittent	2 -- over 4	3 -- 10	Approximately 10 crossings of meandering creek
72.5	unnamed tributary of Big Canyon Creek	intermittent	3.5 -- 10	15	Span crossing where road turns along the creek
76.6	Big Canyon Creek	perennial	2 -- 8	100	Braided channel, wooded, cobble bottom
83.0	unnamed tributary of Big Canyon Creek	ephemeral	2 -- 5	12 -- 15	Cobble and boulder channel
84.5	Cockerell Creek	intermittent	10	15 -- 20	Cobble and boulder channel, willows about 150 feet above confluence with Putah Creek
93.2	unnamed tributary of Harbin Creek	intermittent	3	15 -- 20	Crossing is near meadow area just west of road

(Continued)

4.0 Affected Environment
4.4 Hydrology and Water Quality

TABLE 4.4.2-1: STREAM CROSSINGS AND THEIR PREDOMINANT CHARACTERISTICS
(Continued)

Station	Stream Name	Flow Type	Approximate Channel Depth (feet)	Approximate Channel Width (feet)	Observations
94.5	Harbin Creek	perennial	4	25	Boulder bottom, steep eroded banks, crossing of pipe on downstream side of bridge
98.5	unnamed tributary of Harbin Creek	intermittent	3 -- 4	8 -- 10	Located in cow pasture
99.1	unnamed tributary of Harbin Creek	intermittent	10 -- 12	20	Deeply incised channel in cow pasture, denuded banks
100.0	unnamed tributary of Harbin Creek	intermittent	2	2 -- 5 -- 3	Drains marshy area, road crosses bottom
102.4	unnamed tributary of Putah Creek	intermittent	4	2	Steep gradient, crossing of pipeline at the base of the creek near Putah Creek flood plain
102.5	Putah Creek	perennial	5 -- 10	20 -- 200	Cobble and boulder bottom, low steep banks
108.2	unnamed tributary of Putah Creek	intermittent	6	2 -- 4	At Bear Canyon Access Road, flows in culvert under Highway 175
120.8	unnamed	intermittent	2 -- 4	2 -- 4	In deep ravine, flows in culvert, pipeline would be in road fill above culvert
123.8	unnamed tributary of Bear Creek	intermittent	2 -- 5	5 -- 10	In deep ravine with steep side slopes, fill and culvert proposed for crossing
Unocal Jeep Trail	unnamed tributary of Big Sulphur Creek	intermittent	1-2	5 -- 8	In ravine with steep side slopes, fill and culvert proposed for crossing

SOURCE: Environmental Science Associates, 1993.

water is sometimes polluted by discharge from the SERWTP. In Spring 1993, the water appeared to be of good quality. All the streams in Clearlake likely carry carbon pollutants in the runoff.

Between the Clear Lake Outlet Channel and Clayton Creek, there are two small drainages on the route. Each are small channels and appear to be carrying largely unaltered ephemeral flows. Clayton Creek and Copsey Creek are each deeply incised streams with steep, soft alluvial banks. Flow in both creeks is substantial in winter, and both creeks display evidence of channel erosion. Water quality appears to be good in both creeks, although slightly turbid. Both creeks drain areas with livestock grazing and it is assumed that coliform may be occasionally elevated.

From station 60 to the Childers Peak Regulating Tank, the pipeline route follows the drainage of Copsey Creek and its tributary Sweet Springs Creek. The route follows a dirt road which crosses Copsey Creek and then parallels the course of Sweet Springs Creek. The road is located well above the creek channel, but steep wooded slopes drop directly into the channel. The road crosses a number of tributary streams flowing in steep gradient channels into Sweet Spring Creek. Between station 62.5 and 66.5, the proposed route heads cross-country in a roadless area. The route follows the canyon bottom of Sweet Springs Valley. This segment of the route is confined by the steep slopes of the valley slopes and the narrow valley bottom that carries the stream. The stream meanders from one side of the narrow valley floor to the other in a channel that is several feet deep and 3 to 8 feet wide. The soils are predominantly soft alluvial (stream-laid) sediments. Much of the valley floor is grasslands with scattered oaks and pines. To negotiate this route, approximately 25 crossings of the channel would be made. In some places there is little room available to avoid the channel and/or the route parallels the creek on its immediate bank. The water quality (observed in spring 1993) appeared to be very good, with no evidence of turbidity. Newts (Taricha) were observed in the creek, indicating very good aquatic habitat.

The crossing of Big Canyon Creek would occur at a site where the creek is relatively wide. The channel is braided (that is, broken into several channels by low rises in the channel bottom) and the banks and bars are wooded. The active channel of the creek is approximately 75-100 feet wide, although the part carrying water in summer is reduced to an area perhaps ten feet wide and a couple of feet deep. The channel bottom contains substantial boulders, cobble, gravel and sand. The banks of the channel are comprised of similar soft materials, and there appear to be at least two stream terraces bordering the creek. In winter, the flows in the channel appear to be substantial, as evidenced by debris lines and evidence of bank erosion that are several feet above

the channel bottom. Water quality in the creek probably is good. The water appeared to be clear and unpolluted when observed in the spring of 1993.

Between Big Canyon Creek and Putah Creek, the proposed route crosses a number of streams that drain the wooded slopes of the adjacent mountains, including Cockerell and Harbin Creeks. These watercourses flow in canyons and have relatively steep gradients. The stream channels are typically strewn with boulders and cobbles, and the banks are slightly incised and support willows and other riparian plants. Each has good water quality. There is some pollution from livestock, as grazing uses are located along the watercourse areas.

Putah Creek presents the largest stream crossing along the route. The creek is approximately 100 feet wide in the crossing site. The channel is somewhat braided, but the flow is concentrated in a single channel along the southern bank. Much of the channel bottom is comprised of cobbles and boulders. The channel is relatively open, with few trees and willows in this area. The low flow channel is on the order of a foot in depth and 20 feet wide. The high flow is substantial. Debris lines and bank erosion indicate that Putah Creek in flood would rise four to six feet and occupy the entire channel between the base of the hill on the north and the bank on the south. Like Big Canyon Creek, Putah Creek in flood has tremendous erosive power and appears capable of moving along large bed load. Water quality appears to be good.

From Collayomi Valley (Putah Creek) to The Geysers, the route climbs along an existing road that crosses many small steep drainages. All of these flow in culverts and are contained in steep-walled ravines that are heavily forested. There are few disruptive land uses in this area, and the water quality is likely very good. The proposed new road connecting the Bear Canyon Access Road and the NCPA M-Pad would cross an unnamed tributary of Bear Canyon Creek that flows down to Anderson Springs. The creek drains a small watershed on north-facing slopes that are heavily wooded with oaks, madrone, pine and other plants. The canyon in this area has steep slopes that form a deep V-shaped ravine. The stream course has a high gradient and drops in a series of ponds formed in bedrock and stream rubble. The water course is intermittent, but in some years may flow year-round. The water course is spring-fed and, when observed in spring and summer of 1993, contained clear and cold water with no evidence of pollutants. Water flows probably reach a couple feet deep following storm events. The bank-full channel is on the order of 5 to 10 feet wide. The water course flows to the Bear Canyon steamfield and west of the power plant downstream. At that location, it flows through a culvert in a fill that carries the road to the

power plant site. From that location, it flows into Bear Creek to Anderson Springs and into Anderson and Putah Creeks. There are no diversions on the stream and its flow is unregulated.

The proposed maintenance road connecting the NCPA H-Pad and Unocal's D&V 18-1.6 injection pad would cross an unnamed tributary of Big Sulphur Creek. The stream is intermittent and drains a small, steeply sloped, heavily forested watershed. The canyon in this area is steeply sloped, although the stream gradient is low at the point of crossing. The bank-full channel is approximately eight feet wide, and the stream goes underground about 25 feet beyond the point of crossing. The watercourse enters Big Sulphur Creek in the area of the D&V 18-1.6 injection pad. There are no diversions on the stream and the flow is unregulated.

4.4.3 THE GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT

4.4.3.1 SURFACE HYDROLOGY

The injection area is located in the high-lying portions of the Mayacmas Mountains. This area receives up to 80 inches of precipitation annually. The topography is rugged and runoff is quickly directed into stream channels. There is no snow pack during winter. Much of the injection area for this project comprises headwaters of stream courses (Anderson Creek, Bear Canyon Creek and Cub Canyon Creek), and there are few large permanent streams. The streams are located at the bottoms of deep ravines.

The Geysers is an area for which some data are available on surface hydrology. The Aquatic Resources Monitoring Program (ARMP) has developed a data base that is specifically oriented to obtaining data on water quality and aquatic life in water bodies that have been or potentially could be affected by geothermal energy development and operations in The Geysers. Bear Canyon and West Ford Flat are included in the ARMP and studies were conducted during 1990 - 1992 (Brown, et al., 1991). Some previous studies also had been conducted on a more limited scale. The key water courses include Bear Canyon Creek, Hot Springs Creek (north and south forks), Anderson Creek and Gunning Creek. The streams were sampled for a series of water quality and biological parameters (not all parameters were measured for each water course) including physical properties of temperature, specific conductance, dissolved oxygen (DO), flow, total suspended solids (TSS), total dissolved solids (TDS), turbidity, presence of oil and grease, bicarbonate, carbonate, alkalinity, hardness, ammonia, nitrate, sulfate, chloride, pH (hydrogen ion concentration), coliform, and 16 chemical elements (calcium, iron, boron, mercury and others). Substrate conditions also were studied. In general, the water quality of the

water courses is good. Some of the water quality parameters of potential concern identified by Brown *et al.* include ammonia, oil and grease, pH, iron, zinc, copper, and arsenic. These water quality parameters in the sampled water courses appear largely to be of concern for aquatic organisms rather than a threat to human health. Nonetheless, the water courses are used for a variety of beneficial uses by residents in Anderson Springs and downstream areas, including drinking water.

Winter rainstorms result in rapid runoff in the area. The high flows flush sediments and debris from the watercourses. In summer, the flows are reduced. Most of the tributary water courses dry up within the area. In lower reaches, mostly beyond the injection area, during the low flow period, water quality is characterized by low dissolved oxygen levels and higher water temperatures. The lower water courses contain fish including rainbow trout, roach and riffle sculpin.

The water quality of Big Sulphur Creek drainage is influenced by natural surface geothermal activity, mineral deposits, and historical mining operations. Measured water quality parameters were highly indicative of highly mineralized water with at least some influence from erosion. Ammonia, suspended solids and ten metals (aluminum, arsenic, boron, chromium, copper, iron, manganese, mercury, nickel and zinc) exceeded US EPA recommended criteria. These metals were distributed throughout the drainage and probably resulted, in large part, from past mercury mining operations. Natural geothermal activity also contributes metals including aluminum, iron, nickel, and perhaps mercury and zinc (Boles and Lacey, 1983).

4.4.3.2 HYDROGEOLOGY

Groundwater is the term used to describe water that occurs below the earth's surface within void spaces in unconsolidated sediments or in pores and/or fractures in bedrock. Saturated geologic materials that can transmit significant quantities of water through the void spaces are called aquifers. Three types of aquifers are commonly recognized:

- An "unconfined aquifer" is one with relatively permeable materials above it, and relatively impermeable materials below it. In an unconfined aquifer, the standing water table occurs at the height of the top of the saturated zone.
- A "confined aquifer" is one that has relatively impermeable materials (a confining layer) above it. The water level in a confined aquifer is described as the height that the groundwater would reach in a well tapping the aquifer. Since water in confined aquifers

may be under greater-than-atmospheric pressure, the water may rise above the top of the aquifer when tapped by a well.

- In addition to groundwater contained in aquifers below a regional water table, localized "perched groundwater bodies" may occur where saturated permeable hydrogeologic units exist above less permeable materials that may, or may not, be saturated.

Based on available evidence (Johnson and Treleaven, 1990) unconfined and perched groundwater conditions are present near the site.

Regional Hydrogeology

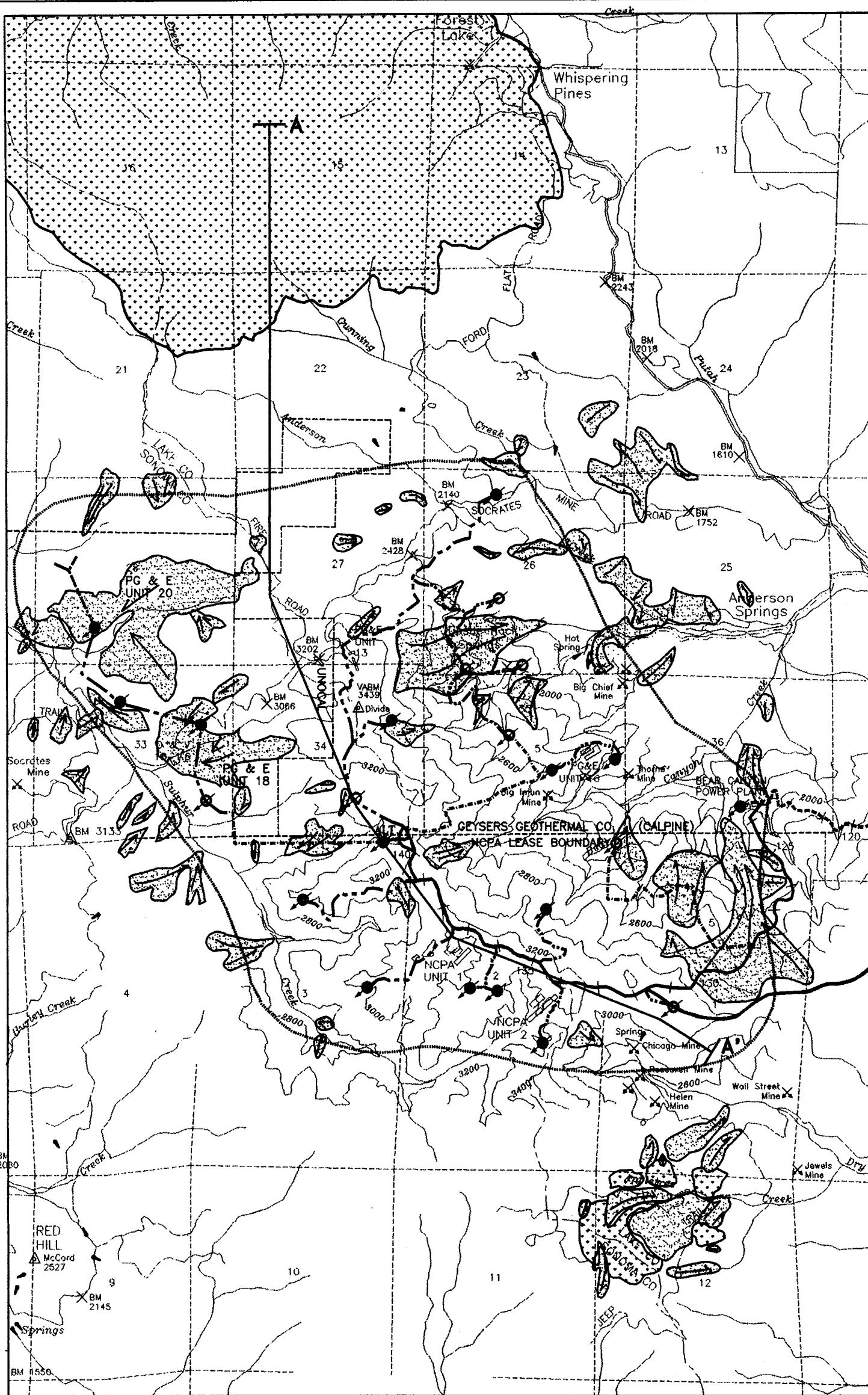
Groundwater resources in the vicinity of the Geysers geothermal field are described in detail by Johnson and Treleaven (1990), and the hydrogeology of the geothermal reservoir is described in Eneedy, Grande and Smith (1990), Beall and Box (1992), and numerous other sources.

Figures 4.4.3-A and 4.4.3-B are a surface map and cross-section, respectively, modified from several of these sources, that show the general relationship of major hydrogeologic units, structural geology, the geothermal reservoir, and groundwater. No regional groundwater aquifers of significant yield have been reported in the Mayacmas Mountains near the Geysers Geothermal area. However, groundwater does occur in the region in five major hydrogeologic units and settings, including the Clear Lake Volcanics, landslide deposits, stream channel deposits, and the geothermal reservoir and nonreservoir rocks of the Franciscan Assemblage. The following discussion, modified from Johnson and Treleaven (1990), summarizes important groundwater occurrences and resources.

Clear Lake Volcanics. The most significant and extensive unit with the capacity to yield good quality groundwater in the region is the Clear Lake volcanic unit of Tertiary to Quaternary age. No volcanic rocks directly overlie the geothermal reservoir rocks in the proposed reinjection area. In the region, thick deposits of Clear Lake volcanics unconformably overlie Franciscan reservoir rocks to the north at Cobb Mountain, and thinner deposits of the volcanics occur at Pine Mountain to the south.

For the Cobb Mountain area, Vantine and Spittler (1986) have estimated that 95 percent of the approximately 203 centimeters of total annual precipitation is captured as recharge, and infiltrates through the volcanics in fractures until it reaches the underlying and less permeable Franciscan Assemblage. At the contact with the less permeable assemblage, it forms a "perched water table" (Johnson and Treleaven, 1990) and groundwater then flows laterally along the

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PROJECT FACILITIES

Main effluent pipeline
Lake water intake pipeline
Injection Area
Existing Pipeline
Proposed Pipeline
Existing injection well
Proposed injection well

SCALE: 1 INCH = 3000 FEET
CONTOUR INTERVAL 200 FEET
Date 4/09/93



CLEAR LAKE VOLCANICS
(PLIOCENE TO HOLOCENE)

Commonly contains perched groundwater of good quality above the contact with the Franciscan Formation.



LANDSLIDE DEPOSITS
(QUATERNARY)

Approximate boundaries of areas containing landslide deposits.
Commonly contains small volumes of perched groundwater of moderate to good quality.



FRANCISCAN FORMATION

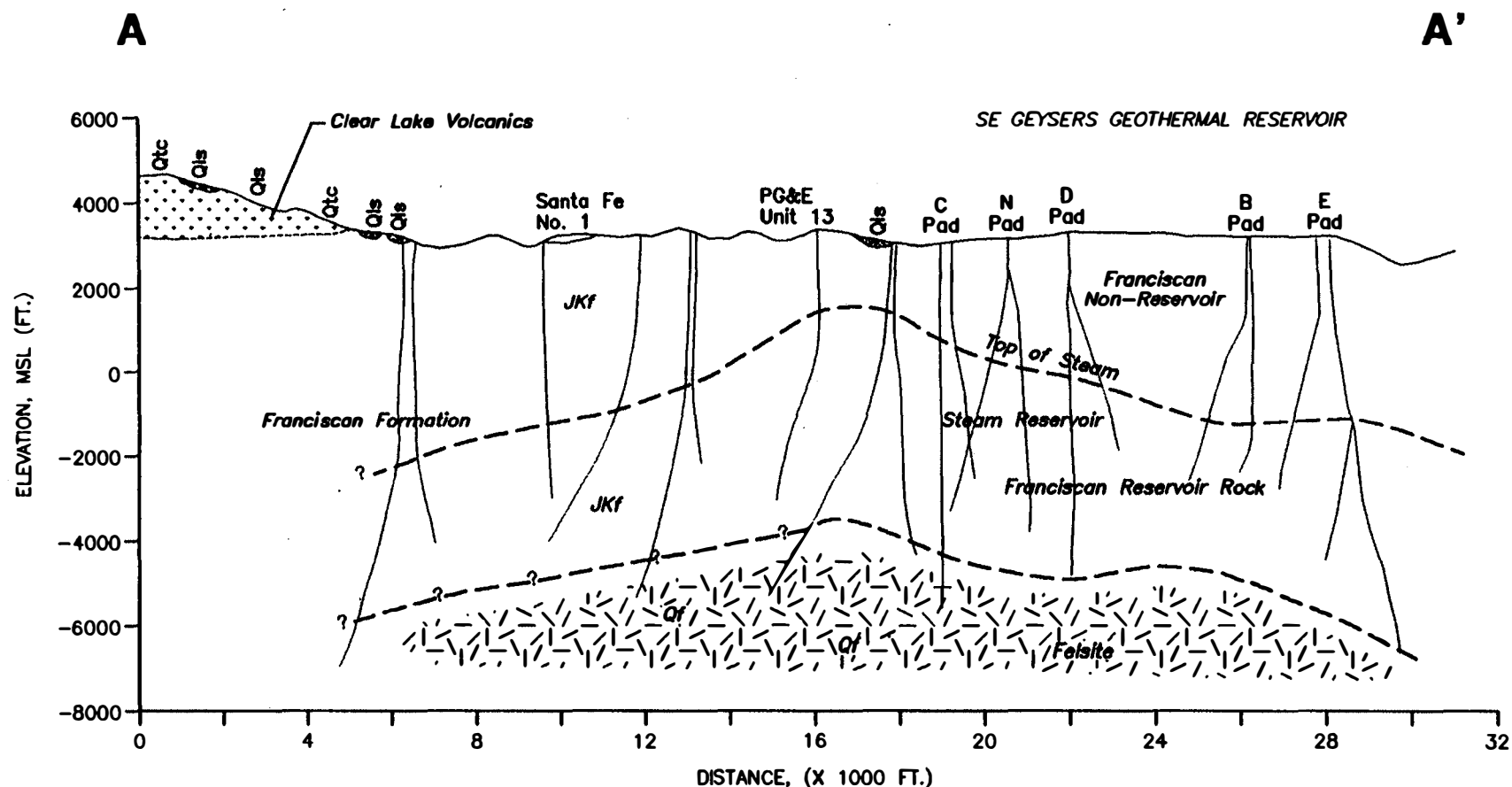
Jurassic to Cretaceous Franciscan Formation: Graywacke, chert, greenstone, serpentinite and melange. Non-reservoir rocks form a low permeability caprock to the steam field; may contain small volumes of poor to moderate quality groundwater in fractures. Fracture density and permeability is not sufficient to permit significant steam migration. Reservoir rocks host the steam field. Steam production is primarily from fractured zones; small irregular zones of saturation may be present, particularly near the margins of the field.

Source: McLaughlin, R. J., 1978, Preliminary geologic Map and Structural Section of the Central Mayacamas Mountains and The Geysers Steam Field, Sonoma, Lake, and Mendocino Counties, California: USGS Open file Map 78-389, Scale 1:2400.

Figure 4.4.3-A

S. E. GEYSERS EFFLUENT PIPELINE AND INJECTION PROJECT

ESA/SOUTHEAST GEYSERS/CA



Quaternary Landslide Deposits (Qls): Commonly contains small volumes of perched groundwater of moderate to good quality.



Quaternary Clear Lake Volcanics (Qtc): Commonly contains perched groundwater of good quality above contact with the Franciscan Formation.



Quaternary Felsite: Composite silicic batholith which underlies the Geysers Steam Field.



Jurassic to Cretaceous Franciscan Formation: Greywacke, chert, greenstone, serpentinite and melange. Non-reservoir rocks form a low permeability caprock to the steam field; may contain small volumes of poor to moderate quality groundwater in fractures. Fracture density and permeability is not sufficient to permit significant steam migration. Reservoir rocks host the steam field. Steam production is primarily from fractured zones; small irregular zones of saturation may be present, particularly near the margins of the field.

Well locations and Steam and Felsite contacts are approximate, modified from Eney, Grande and Smith (1990), with additional input from T. Box (personal communication, 1994).

Figure 4.4.3-B
**SCHEMATIC HYDROGEOLOGIC
CROSS-SECTION A-A'**
ESA/SOUTHEAST GEYSERS/CA

contact and is eventually discharged along the exposed contact as springs on the eastern, northern, and southern flanks of Cobb Mountain. The combined flows from springs along the flanks of Cobb Mountain supply dry-season flow for Alder, Gunning, Anderson, and Kelsey Creeks. Gunning and Anderson Creeks are part of the headwaters of Putah Creek which flows to the east. The communities of Cobb, Anderson Springs, Whispering Pines and Collayomi Valleys rely on the stream flows and on adjacent shallow wells for their domestic water supplies. The hydrogeologic setting at Pine Mountain is similar, although the volumes of water, and flow rates, are less. Groundwater derived from the volcanic rocks is generally of excellent quality. Such water is used as a water supply for small community systems and commercial water bottling companies in Whispering Pines and Cobb, California.

Landslide Deposits. Throughout the Geysers area, there are widespread landslide deposits composed primarily of brecciated, fractured or sheared Franciscan or ultramafic (serpentine) rocks, and/or hydrothermally clay altered rocks or fault breccia. The landslides have been formed through a variety of flow mechanisms, and vary in extent from a few meters to hundreds of meters in length, and are up to 46 meters thick. Landslides appear to cover roughly 25% of the Franciscan rocks in the area.

The hydrogeologic setting within the landslides is similar to that in the volcanics, in that landslide deposits retain both precipitation and runoff from upslope drainages, because of their unconsolidated nature. Groundwater recharge infiltrates into the deposits (often through cracks and scarps associated with movement of the landslide), accumulates above the less permeable Franciscan bedrock in perched water bodies, and commonly discharges in springs at the base (toes) of the landslides. In some cases, landslides also serve as a reservoir for groundwater derived from warm or hot water sources within the underlying rocks, or rarely, from condensing steam that reaches the near surface in fractures.

The storage capacity of landslide deposits is typically small, and the rate of discharge of springs that are fed by precipitation varies seasonally. A few springs do provide year round flow, although many are dry except after rainfall. The chemistry of waters derived from landslide deposits is a function of the temperature and water source: cool shallow groundwater derived from rainfall is of good quality, whereas groundwater that circulates more deeply, and is heated, may preferentially leach the bedrock, and therefore be of lower quality. Water that is heated through communication with the steam reservoir (e.g., condensing steam) is also of poor quality.

A number of landslides have been mapped (McLaughlin, 1978) within the injection area. The appropriate locations of these landslides are shown in Figure 4.4.3-1.

Stream Channel Deposits. In several locations near the proposed injection area, alluvial deposits in stream channels are a local source of good quality groundwater. The thickness of potential water bearing units (mostly sand and gravel lenses within silty or clay rich deposits) ranges from a few meters to a maximum of approximately 60 meters. Because of the limited extent of the aquifers, the volumes of groundwater found in stream channels are typically small, and groundwater production potential varies seasonally. During the dry summer season, water levels decrease and many wells cannot be used for irrigation or other purposes because of low flow rates and/or poor quality. There is no evidence that any of the groundwater found in stream channel deposits is derived from the geothermal reservoir, or from any source other than precipitation.

Franciscan Rocks. Franciscan rocks in the vicinity of the geothermal reservoir include greywacke, argillite, greenstone, chert, and serpentinite, and are divided into two major hydrogeologic units: reservoir rocks, and nonreservoir rocks.

Nonreservoir rocks (including metagreywacke, melange, greenstone, serpentinite and chert), which overlie and cap the steam reservoir, have relatively low permeability and porosity, and are at relatively low temperatures. According to the California Department of Water Resources (1962), they are considered essentially non-water bearing. Rare water bearing zones are sporadically distributed above and laterally adjacent to the steamfield, but no extensive aquifers are known. Because of their low intergranular permeability and the sparsity of fracture porosity, nonreservoir rocks have limited storage capacity, and generally do not yield significant quantities of groundwater, even in water bearing intervals. Cool meteoric water may percolate deeply through fractures in some areas, and may be the cause of some anomalously low thermal gradients in the region. The quality of water found in the nonreservoir rock ranges from good in cool, near-surface water to highly mineralized in water discharging from thermal springs which has been in contact with deeper, hotter rocks in which chemical leaching has occurred.

The reservoir rocks hosting the Geysers geothermal field consist mainly of fractured greywacke, underlain by a large Pliocene or younger intrusive body known as felsite. Section 5.3.1 describes the characteristics of the steam field, as well as the potential impacts of fluid injection. Natural circulation in the steam field is dominated by a "heat-pipe" mechanism, in which upward flowing

steam condenses, producing condensate that flows back down into the reservoir. Most of the fluid water in the reservoir rocks exists in pores and fractures that are hydraulically connected to larger steam dominated fractures. As the pressure declines during steam production, the fluid in the smaller fractures and pores also flashes to steam and migrates toward the lower pressure production zones. Although steam is predominant throughout the reservoir, it is close to saturation, and water producing zones have been encountered in several areas, particularly near the margins of the field. Well histories indicate that water production in steam wells has typically declined and ceased within a day or two.

As described in Truesdell et al. (1992), and Walters et al. (1992), isotopic and chemical evidence indicates that the steam in the southeast portion of the Geysers, near the proposed project reinjection area, was primarily derived from old meteoric water (precipitation that had percolated into the bedrock). In the northwestern portions of the Geysers, the isotopic data indicate an older and heavier fluid source which is believed to be a remnant of an earlier liquid dominated reservoir history, where fluid compositions are the result of connate waters (water that got into a rock formation by being trapped in the interstices of the rock material) modified by rock-water interactions in the presence of the heat provided by the felsite intrusion that underlies the Geysers system.

Local Hydrogeology

Figure 4.4.3-A shows the location of the proposed reinjection site area in the southeast corner of the Geysers Geothermal field. Figure 4.4.3 also shows the location of the proposed and existing pipelines, existing and proposed injection well locations and the landslide areas as mapped by McLaughlin (1978). As discussed in the previous section, no significant regional aquifers or potential drinking water sources are known in the immediate vicinity of the proposed project. Small volumes of unconfined, perched groundwater may be present in Quaternary landslide and stream channel deposits at the surface above the reservoir (within a few tens of meters of the surface). In addition, small discontinuous volumes of groundwater may exist within 50 to 1,000 feet from ground surface in fractures in nonreservoir rocks above or adjacent to the steam field, or in reservoir rocks near the margins of the field. The predominant source of both of these types of groundwater occurrence is infiltrating groundwater, which may discharge in springs at the surface or continue infiltrating along discontinuous fractures.

The largest local source of groundwater is the water contained in the volcanic rocks at Cobb Mountain to the north. The groundwater at Cobb Mountain is derived from precipitation, and is perched on the contact between the Franciscan and the volcanic rocks. Cobb Mountain groundwater discharges in springs at the base of the mountain, providing the majority of flow in Putah Creek. A small portion probably also infiltrates into the Franciscan rocks adjacent to the steam field (and may ultimately contribute to the recharge of the reservoir). Available evidence (chemical data) indicates that groundwater from the steam field has not mixed with Cobb Mountain groundwater. As noted above, the reservoir cap has effectively sealed the steam field for overlying groundwater. No future mixing is likely because there is no mechanism (e.g., there is insufficient energy) and there is no continuous fluid-filled pathways that would allow fluids to move from the underpressured steam reservoir.

The four wells proposed to be used for effluent injection by Unocal are located within or near the landslide areas identified by McLaughlin, 1978 (Figure 4.4.3-A) and Johnson and Treleaven (1990). Prior to construction of the existing drill pads and wells, Unocal performed detailed geotechnical investigations at each of the proposed locations (Chappell and Vantine, 1981; Vantine and Brock, 1983; Vantine and Brock, 1983a). Although several landslides were identified in the area, the drill pads for each of the existing wells were located at sites where no landslides exist, or where small, thin slides were excavated in the process of site development. The engineering geology reports concluded that there were no significant concerns regarding the stability of the injection well sites. In fact, the three existing injector wells have successfully operated for more than ten years with no stability problems.

In some of the landslide areas near the Unocal injection area, Johnson and Treleaven (1990), reported that hot springs discharged from landslides. One example was identified as the GDC 65-28 landslide near the Little Geysers Area. The water in the GDC 65-28 landslide appears to have been derived from meteoric groundwater conductively heated within the landslide and possibly also from steam condensate. Chemical analysis of water samples collected from Little Geyser Spring by Johnson and Treleaven indicated calcium concentration of 3 mg/l, magnesium concentration of 4 mg/l, sodium concentration of 3 mg/l, potassium concentration of 1 mg/l, carbonate and bicarbonate concentration of 0, sulphate concentration of 868 mg/l, and chlorine concentration of 0. Other elements measured which had concentrations greater than the recommended limits for domestic, freshwater aquatic, and agricultural use, were aluminum (5 mg/l), Iron (120 mg/l), and ammonium (192 mg/l).

The quantity of water stored in the landslide areas is estimated to be minimal. Springs issuing from smaller landslides after a heavy rainfall typically dry up within days. Specific studies of water stored within the landslides in the Little Geysers are not available. However, Unocal previously investigated the possibility of removing water from the Thermal and Happy Jack landslides (in the Big Geysers area) which are among the largest in the Geysers area, and injecting it into the underlying geothermal reservoir. Three water-extraction wells were drilled vertically into the Happy Jack landslide. After two or three weeks, the water in these wells was pumped down to such minimal levels that Unocal concluded that storage capacity and recharge were small, and that it was impractical to continue the process (Johnson and Treleaven, 1990).

Finally, as described in Section 5.3.3.2, shallow groundwater in the injection area is protected by the well completion practices implemented by the steam field operators as a result of the regulation of injection wells by the CDOG&GR and BLM. These practices include the use of two strings of casing in each injection or extraction well, pressure monitoring during injection, and periodic inspection and verification during operation.

4.4.4 SEWRTP FACILITIES PLAN COMPONENT

4.4.4.1 GROUNDWATER

Hydrology

In the area of the SERWTP the basement rocks, which are Cretaceous, are essentially non-water-bearing and yield, at most, a few gallons per minute to water wells. The nonmarine Cache Formation present in the project area is water-bearing and is considered one of the more important sources of groundwater. Water percolates into the Cache unit through surface infiltration. Where capped by permeable, vertically fractured volcanics, such as at Quackenbush Mountain, southeast of the SERWTP, a considerable amount of water travels through fractures in the overlying rock and infiltrates the Cache Formation.

The Burns Valley groundwater basin, which drains into Clear Lake, consists of a 2-square mile area which contains water-bearing younger alluvial deposits. The basin has an estimated storage capacity of 4,000 acre-feet of which 1,400 acre-feet are considered usable (Department of Water Resources, 1975). Well water is drawn from depths of 10-60 feet with yields averaging 200 gpm with maximum yields of 300 gpm. The Department of Water Resources has estimated a safe yield of about 600 acre-feet a year for domestic, irrigation and stock uses. The producing

aquifers in the area appear to be localized and have limited recharge capability. The basin has a limited development potential for additional domestic, irrigation, and stock uses, up to an estimated safe yield of about 600 acre-feet per year.

Well logs on groundwater levels at or near the SERWTP indicate that of the 9 borings north of the SERWTP with an average depth of 13 ft, 6 encountered no free groundwater, the other 3 encountered free groundwater at 3 1/2, 5 and 7 ft respectively. At the SERWTP, on 8/23/89 the water level was 32, 14 and 12 ft respectively. In well MW-2, a perched zone was encountered at 10-12 feet which was thought to "be seasonal (only when the Plant operates the spray fields in the spring and summer) and that the wells may go dry the rest of the year" (Herzog Associates, 1991).

Water Quality

In Burns Valley, minor boron and localized nitrate problems have been observed historically. Much of the groundwater is high in total dissolved solids, as well as iron and manganese. Treatment is required to remove the high concentrations of iron and manganese and softening is generally needed to reduce hardness in many supplies. Several wells also contain high concentrations of barium and arsenic which approach the maximum contaminant limitations established by the U.S. Environmental Protection Agency's (U.S. EPA) Interim Drinking Water Standards.

Treated wastewater effluent stored in the reservoir is being studied to determine if it is recharging the groundwater basin. Existing mineral analyses of the on-site well that supplies plant water indicate that there is no noticeable adverse impact on mineral quality and that quality is similar to or better than other potable supplies. Three new monitoring wells were bored on site at the SERWTP in March 1991 to establish the existing groundwater quality (Herzog Associates, 1991) and monitor for potential future effects. Results of tests performed on water from these monitoring wells are summarized in Table 4.4.4-1.

The measured lead level of 17 mg/l is below the California Drinking Water Standard of 50 mg/l and the EPA Maximum Contaminant Level (MCL) of 20 mg/l. Wells # 2 and 3 samples for 02/07/90 showed elevated 1,800 mg/l and 800 mg/l levels of Methyl-ethyl Ketone (MEK) but a follow-up test was below the detection level. These isolated elevated levels were attributed to PVC pipes and caps recently glued together with PVC cement (Dewante & Stowell, August 22, 1991).

TABLE 4.4.4.-1**SERWTP MONITORING WELLS CHEMICAL ANALYSES**

Date	Chemical (mg/l)	Well #2	Well #3	MDL
02/07/90	Chloride	98	24	1
	Nitrate	ND	1.5	1
	TDS	403	159	10
	COD	30	60	1
12/12/90	Chloride	88	27	0.5
	Nitrate	4.9	7.5	1
	TDS	395	164	10
	COD	16	10	1

Heavy Metals ($\mu\text{g/l}$)

Well #2	02/07/90	Lead	17	50
Well #2	12/12/90	Zinc	56	50

Notes: MDL = Minimum Detection Level

TDS = Total Dissolved Solids

COD = Chemical Oxygen Demand

ND = None Detected

Source: GODDARD & GODDARD ENGINEERING (1991) Derived from Dewante & Stowell (April 10, 1990); Alpha Analytical Laboratories (January 7, 1991)

TABLE 4.4.4-2**WATER SUPPLIERS IN THE SERWS SERVICE AREA**October 1989 ^(a)

Supplier	Raw Water Source	Area Served	Approx. No. of Accounts	Flow gallons per day
California Cities Water Company (Private)	Clear Lake	Clearlake Highlands, Clearlake Park north to Monitor Point	2,100	N/A
Highlands Water Company (Private)	Clear Lake	Clearlake Highlands, City of Clearlake	2,300	795,500
Konocti County Water District	Clear Lake	City of Clearlake, Area east of Hwy 53 south to Cache Creek	1,600	195,000
Lower Lake County Water District No. 1	Wells	Lower Lake Area	696	54,000

Note: Data from individual supplier.

SOURCE: Dewante & Stowell (1991) as reproduced by Goddard & Goddard Engineering

The soil is a very effective medium for removal of bacteria and viruses, and the distances that water must travel before being intercepted for use by Burns Valley residents is such that there should be no need for concern over the small amount of recharge that may now be occurring. Effluent runoff from the land disposal areas is intercepted via recapture facilities and pumped back to the reservoir, which minimizes the possibilities of surface contamination of local drainage ways.

4.4.4.2 WASTEWATER FLOWS

The SERWTP and irrigation disposal area has a recapture reservoir located on it which is used to collect irrigation runoff and pump it back to the storage reservoir (Figure 2.5.1-A). Overflows from the reservoir go into Burns Valley Creek and eventually Clear Lake, one mile away, as happened in early 1986 when reservoir capacity was exceeded and overflows from the reservoir occurred for a period of 57 days. The average overflow rate during this time was 2.66 mgd.

In the winter of 1985/86 flow measuring equipment was installed at the treatment plant. Measured influent flows, averaged on a monthly basis 1.02 mgd in 1990 and 1.16 in 1991 (5 months only). The 1988-1991 average monthly flow was 0.91 mgd.

Wastewater flow estimates and measurements were analyzed to generate accurate base data for determining current plant loadings and for use in making flow and load projections.

Wastewater flow rates are greatly affected by antecedent precipitation and the level of Clear Lake which is indicative of an infiltration and inflow (I/I) problem. Analysis of the relationship between lake level and I/I indicated that when the lake level is above 9.0 feet, I/I increases steadily with increased lake level, and that inflow is more important than infiltration (Dewante & Stowell, 1991). From this it was concluded that reduction of inflow offers the best opportunity for reducing I/I and that a 1.0 - 2.0 mgd reduction in influent flow could be attained by correction of major inflow sources subject to lake flooding. The current LACOSAN pipeline maintenance program is expected to achieve this but over several years, since problem areas can most easily be identified under high flow (wet weather) conditions.

Peak wastewater flows to the treatment plant are presently limited by the 4.5 mgd capacity of Pump Station No. 1.

4.4.4.3 SERWTP INFLUENT QUALITY

The water which comprises much of the influent to the SERWTP comes mainly from Clear Lake or from groundwater wells. All of the surface supplies are treated by sedimentation, coagulation, filtration and disinfection. Well supplies are treated only by disinfection. The water suppliers for the service area are listed in Table 4.4.4-2 and their locations shown in Figure 4.4.4-A. The quality of public water supplies in the service area was reviewed and none were found to have characteristics or constituents that would significantly affect the treatment and disposal of wastewater.

Monthly average SERWTP influent wastewater characteristics for 1990, 1991, and 1988-1991 are summarized in Table 4.4.4-3.

4.4.4.4 SERWTP EFFLUENT QUALITY

SERWTP wastewater is primarily of domestic or resort-related commercial origins. Effluent quality for the treatment plant is determined by an ongoing sampling and analysis program. In addition to measurement of these traditional parameters, LACOSAN has done sampling and analysis to determine the level of key trace contaminants for which there are drinking water standards. The results of this March 1989 analysis by Alpha Analytical Laboratories of Ukiah are summarized in Table 4.4.4-4.

4.4.4.5 SERWTP SLUDGE QUALITY

Sludge generated at the SERWTP is stored in concrete lined holding areas, drawn under vacuum into a sludge injector truck equipped with a 2,000 gallon stainless steel tank, and sprayed by gravity feed onto the pasture. The injector equipment is not used because of extreme wear from the sandy soils. Drainage from the land is collected in a recapture reservoir located at the south end of the SERWTP area and pumped back to the treated effluent reservoir.

Wastewater sludges from Publicly Owned Treatment Works (POTW's) are considered to be nonhazardous if they do not exceed DOHS criteria for hazardous wastes. One sample of SERWTP sludge was analyzed (May 19, 1986, LACOSAN) to determine sludge constituent total concentrations of various trace metals of regulatory and environmental concern, as summarized in Table 4.4.4-5. Results are compared to the pertinent hazardous waste levels.

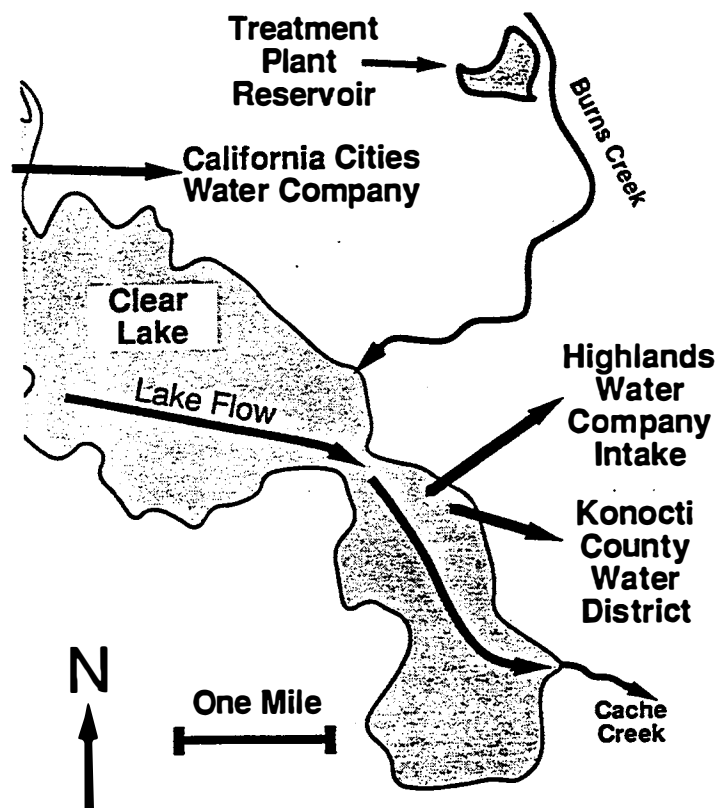


Figure 4.4.4.-A

Location of Water Suppliers in area of SERWS

SOURCE: Graphic as reproduced from
Goddard & Goddard Engineering.

TABLE 4.4.4-3

SERUTP INFLUENT WASTEWATER QUALITY

<u>Parameters</u>	1990 Monthly <u>Average</u>	1991* Monthly <u>Average</u>	1988-1991 Monthly <u>Average</u>
Flow, mgd	1.02	1.16	0.91
BOD ₅ mg/l	175	269	200
Suspended Solids, mg/l	264.3	255.4	199.2
Settleable Solids	18.3	13.0	9.3

SOURCE: Dewante & Stowell (1991) as reproduced by Goddard & Goddard Engineering .

TABLE 4.4.4-4**SERWTP EFFLUENT WASTEWATER QUALITY**

Parameter	Effluent Quality in Reservoir ⁽¹⁾
Total Hardness	172 mg/l
Calcium	32 mg/l
Magnesium	22 mg/l
Sodium	109 mg/l
Potassium	13 mg/l
Total Cations	8.49 meq/L
Total Alkalinity (as CaCO ₃)	187 mg/l
Bicarbonate (HCO ₃)	228 mg/l
Sulfate	101 mg/l
Chloride	64 mg/l
Nitrate	10 mg/l
Total Anions	7.80 meq/L
pH	8.1 units
Specific Conductance	696 umho/cm
Total Filterable Residue (TDS)	348 mg/l
Apparent Color	22 units
Odor Threshold @ 60°C	3.3 ton
Turbidity	4.0 NTU
MBAS	<0.05 mg/l
Arsenic	<10 µg/l
Barium	<100 µg/l
Cadmium	<1 µg/l
Chromium	<10 µg/l
Copper	<50 µg/l
Iron	150 µg/l
Lead	<5 µg/l
Manganese	100 µg/l
Mercury	<1 µg/l
Selenium	<5 µg/l
Silver	<10 µg/l
Zinc	<50 µg/l
Endrin	<0.02 µg/l
Lindane	<0.4 µg/l
Methoxychlor	<10 µg/l
Toxaphene	<0.5 µg/l
2,4-D	<10 µg/l
2,4,5-TP Silvex	<1 µg/l
BOD ₅	8 µg/l

SOURCE: (1) LACOSAN and Anlab Analytical Laboratories (1989) as reproduced by Goddard & Goddard Engineering

TABLE 4.4.4-5**SERWTP SLUDGE CHEMICAL CONCENTRATIONS COMPARED TO HAZARDOUS WASTE CRITERIA**

Parameter	TTL ⁽¹⁾ (mg/kg)	SERWTP Sludge Concentration (ppm)
Antimony	500	<.02
Arsenic	500	1.76
Barium	10,000	164
Beryllium	75	<0.02
Cadmium	100	0.52
Chromium VI	500	<20.0
Chromium III (or total)	2,500	6.0
Copper	2,500	84
Lead	1,000	9.6
Mercury	-	0.76
Nickel	2,000	0.5
Selenium	100	0.5
Silver	500	0.2
Thallium	700	2.47
Zinc	5,000	202

SOURCE: LACOSAN May 1986 Test Results as reproduced by
Goddard & Goddard Engineering

(1) TTL⁽¹⁾ = Total Threshold Limit Concentration (CCR Title 22 Section 66699)

Tests of wastewater sludges by members of the California Association of Sanitation Agencies using the Total and WET (Waste extraction Test) tests have shown sludges not to be hazardous under the proposed state criteria. Based on this mandatory testing using the WET test, testing will not be required unless it is suspected that a particular sludge has an excessive concentration of one of the regulated constituents. The State Water Resources Control Board (SWRCB) has proposed not to regulate any wastewater sludges from POTW's as hazardous wastes unless specifically requested by DOHS to do so.

Federal regulations pertaining to land application of sludge are contained in part 40 of the Code of Federal Regulations which is entitled "Criteria for Classification of Solid Waste Disposal Facilities and Practices." These regulations address land application, landfilling and sludge lagooning and specifically prohibit violation of the Clean Water Act from discharges to surface waters, contamination of groundwaters beyond the site boundary, creation of a risk of infection by enteric organisms, and obstruction of flood waters of a base flood (100-year flood) in a floodplain. These regulations are now being revised and national regulations were adopted as minimum standards by all of the states in 1993.

4.4.4.6 SERWTP GREASE QUALITY

Grease at the SERWTP is a mixture of pumpings from LACOSAN sanitary sewer pipeline cleaning operations and commercial grease traps, and is handled separately. A typical composition of "grease" wastewater is 1 cubic yard per month (cy/mth) of commercial pumpage from car wash sumps and restaurant grease traps together with 3 cy/mth of grease and sediments from LACOSAN's sewer line cleaning operations. The results of a characterization of the grease indicate that the liquid and solid fractions of the grease are neither hazardous nor designated wastes (Dewante & Stowell, letter, Nov. 16, 1990). Most of the chemicals analyzed for were not detected; those that were detected are listed in Table 4.4.4-6 below.

4.4.5 PROJECT DESIGN ALTERNATIVE

The affected hydrologic environment is approximately the same as that described in Sections 4.4.1 and 4.4.2. Points of note regarding the alternatives are as follows.

Lake Diversion Pumps and Pipeline on Pier

See description of Clear Lake, Section 4.4.1.1.

TABLE 4.4.4-6
CHEMICALS DETECTED IN SERWTP GREASE SAMPLES
(See Appendix E for full listing)

<u>Sample Description</u>	<u>Type</u>	<u>Measured Level</u>	<u>TTL⁽¹⁾</u>
Bottom of Grease Pit Grab		(mg/kg)	(mg/kg)
Total Metals	Barium	190	10,000
	Cadmium	0.6	100
	Chromium	29	2,500
	Cobalt	13	8,000
	Copper	47	2,500
	Lead	20	1,000
	Mercury	0.16	20
	Nickel	25	2,000
	Silver	0.8	500
	Vanadium	48	2,400
	Zinc	100	5,000
Liquid Fraction Grab		(mg/l)	<u>STLC²</u> (mg/l)
Total Metals	Arsenic (mg/l)	0.009	5.0
	Barium	0.67	100
	Chromium	0.04	560
	Cobalt	0.02	80
	Copper	0.37	25
	Lead	0.15	5.0
	Mercury	0.004	0.2
	Nickel	0.08	20
	Selenium	0.001	1.0
	Silver	0.02	5
	Vanadium	0.003	24
	Zinc	1.4	250
VOA Liquid Fraction Compound		(µg/l)	<u>Prop. 65⁽³⁾</u> (µg/l)
	Chlorobenzene	46	250
	1,4-Dichlorobenzene	33	1,120
	Toluene	1500	17,000
	Xylenes	2	

Notes: (1) TTL⁽¹⁾ = Total Threshold Limit Concentration (CCR Title 22 Section 66699)
(2) STLC = Soluble Threshold Limit Concentration (CCR Title 22 Section 66699)
(3) Proposition 65 Proposed Regulatory Level (no TTL⁽¹⁾ or STLC available for comparison)

Source: Goddard & Goddard Engineering (1991) summarized from data provided by Dewante & Stowell (November 16, 1990). Samples taken October 18, 1990, analyzed by Anlab Analytical Laboratory

Bear Canyon Single Pump Station

The site is part of the Putah Creek drainage. A small intermittent creek is located about 100 feet to the east of the site. The site is flat without clearly identifiable drainage features. Drainage is by overland flow.

One-Way Surge Tank in The Geysers

The site is located on an existing pad near a ridge line. There are no drainage features at the site. Drainage occurs by overland flow.

By-Pass Pipeline at the SERWTP

Hydrologic features and conditions are the same as those described for the SERWTP (see Section 4.4.4).

Alternate Route A-1 and A-2

Both sites are located in the drainage of Cache Creek (Clear Lake Outlet Channel). There are no specific drainage features on either alternate. The steep slopes drain directly southward by overland flow to Dam Road and then into the CLOC.

Alternate Route B

Drainage conditions are similar to those described for Clayton Creek at Station 39. The alternate site of the crossing of Clayton Creek is substantially the same as that at the proposed bridge crossing. The creek channel is similar in depth, but the width is perhaps 20 feet greater. The stream banks are eroded with fairly deep gullies. The western bank is the undercut slope of the channel in this area. The banks are steep on both sides of the channel.

Alternate Route C

The drainage features are similar to those described for the proposed route. Drainage from the adjacent slope on the west side of the highway discharges into a shallow swale between the slope and the berm of the highway.

Alternate Route D

The site lacks integrated drainage features. The existing road carries the drainage from the adjacent slope and is deeply gullied in places.

Alternate Route E

The route is located within the drainage of Harbin Creek. The route is on gently sloping land, with drainage by overland flow.

Alternate Route F

The lower part of the route crosses the same unnamed tributary of Bear Creek which the proposed connector road crosses at higher elevation. The crossing occurs in the upper part of an existing fill above the culverted creek. The actual crossing of the water course would occur in the road and fill which has been placed over the culverted creek. The route ascends the steep edge of the cut slope above the Bear Canyon Power Plant. This slope forms the ravine slope of the above creek, with steep slopes that drop directly to the channel. Beyond that point, most of the route follows the ridge. This is a brush-covered and wooded area. Most runoff occurs as overland flow on the ridge along the route.

Alternate Distribution Pipeline G

The route crosses an existing pad with overland drainage. At its northern end, it passes within 50 feet of an existing intermittent stream that drains from the north. On the northwest side of the C-Pad, a water course runs in the low area south of the Calpine/PG&E road. The route follows along a dirt road and is wooded on either side. The creek is a small intermittent stream draining the area to the north. When inspected in spring 1993, the water quality appeared to be good.

Alternate Site for Childers Peak Regulating Tank

The drainage conditions are the same as those for the proposed site.

4.5 BIOLOGICAL RESOURCES

4.5.1 OVERVIEW OF GENERAL CONDITIONS

4.5.1.1 CONDITIONS AFFECTING VEGETATION AND WILDLIFE HABITAT

The vegetation of the project area varies in relation to four primary controls: (1) topography, (2) climate, (3) soils, and (4) human alteration of the ecosystem. The project area is located in the inner North Coast Ranges of northwestern California. Topography ranges from flat lands to mountains. Much of the route is located in hills. Slope exposure has an important effect on natural vegetation. The region has a "Mediterranean" climate. Compared to the coast of California, this region has colder winters and hotter summers with rainfall typically concentrated during the winter and early spring months. Temperature decreases and rainfall increases as one climbs in altitude. Location is important also as rainfall is higher when the site is exposed to prevailing storms. The Helen Mine, located south of NCPA 1 and 2 on the south of the Mayacmas Range at about 2,700 feet mean sea level, has a yearly average rainfall of 2,192 mm (about 86 inches) and holds the U.S. record for monthly precipitation set in 1909 with 1,814 mm (71.4 inches). A weather station on Mount St. Helena averages 834 mm (32.8 inches) of annual rainfall and has a yearly average temperature of 14.6 degrees Celsius (58 degrees Fahrenheit).

A third important factor in the physical environment of the vegetation is the chemical nature of the soil or rock parent material. Lake County in general and The Geysers region of Lake and Sonoma Counties in particular have large exposures of serpentine rock. Where the slope has been shallow and sufficient time has elapsed, serpentine soil has developed. Serpentine typically has a low calcium to magnesium cation ratio when compared to other soils. It also has concentrations of metal cations (chromium, cobalt, and nickel) that are higher than other soils. As a result of largely unknown mechanisms, some species of plants are capable of growing on serpentine, some are prevented from growing on it and others can grow on or off of serpentine soil. Due to the fact that fewer species are able to tolerate serpentine soil chemistry, the plants that do grow on these soils have less problem with competition for available growing space and water.

The region has many rocks of volcanic origin. Both lava flows and ash deposits have formed impervious layers in localized areas and, where topography allows, vernal pools have formed. Vernal pools are small catchments of winter or spring rain which is prevented from percolating down into the soil and thus remains pooled on the surface until it evaporates. Numerous species

of plants have evolved adaptive strategies that allow them to live under the alternating conditions of drought and submergence, and, thus, vernal pools are small, isolated ecosystems, some of which support endangered rare or sensitive species of plants and animals.

Clear Lake is a very ancient lake, reported to be 2.9 million years old, perhaps the oldest on the North American Continent. It formed by a dropping fault-block valley which has been partially refilled by sedimentation. The streams tributary to Clear Lake contain sediment rich in phosphorus, and gravel mining in these streams has contributed nutrients and caused upstream and downstream destabilization. The upstream and downstream reaches of the streams have experienced changes in water-level in recent times since the construction of the dam on Cache Creek, the natural outlet of the lake.

The Geysers and Clear Lake were once abundant with large carnivores, such as mountain lion, grizzly bear, fisher and wolverine, as well as other large mammals, such as mountain beaver, and elk. European settlers decreased population numbers of these species through hunting, trapping and destruction of habitat. At present, mostly only the smaller mammals remain in the area. A few larger mammals, such as black bear, also are present in the area.

4.5.1.2 VEGETATION

Natural Communities (Wildlife Habitats)

The natural communities (Holland 1986) of plants and animals that make up the biological resources of the project area have been summarized as follows, using Wildlife Habitat Relationship (WHR) wildlife habitats (Mayer and Laudenslayer 1988) as the units into which the resources were grouped (Biosystems Analysis 1992).

Valley-Foothill Riparian. This habitat occurs along and adjacent to streams such as Rumsey, Cache, Clayton, Copsey, Big Canyon, Harbin, Putah, Sulphur and Bear Canyon Creeks. These are all perennial streams, flowing almost all year, with the exception of the upper tributaries of Sulphur and Bear Canyon Creeks, that appear to be intermittent in regime. Tree species found along these stream courses are red willow (*Salix laevigata*), valley oak (*Quercus lobata*), white alder (*Alnus rhombifolia*), California buckeye (*Aesculus californica*), and bigleaf maple (*Acer macrophyllum*). Characteristic shrubs include elderberry (*Sambucus mexicana*), mule fat (*Baccharis salicifolia*), California brickellbush (*Brickellia californica* var. *jepsonii*), brown dogwood (*Cornus glabrata*), snowberry (*Symphoricarpos* sp.) and Himalayan blackberry and

California blackberry (*Rubus discolor* and *R. ursinus*). Lianas of the California grape (*Vitis californica*) are evident in the trees of the riparian zone and also sometimes in the mixed hardwood and conifer communities nearby. The herbaceous species vary in density and species composition but often include chain fern (*Woodwardia fimbriata*), sword fern (*Polystichum imbricans* ssp. *imbricans*), California polypody (*Polypodium californicum*), common monkeyflower (*Mimulus guttatus*), mugwort (*Artemisia douglasii*), water cress (*Rorippa* sp.), sedges (*Carex leptopoda*, *C. nudata*, *C. serratodens*), small-fruited bulrush (*Scirpus microcarpus*) and common rush (*Juncus effusus* var. *pacificus*).

Areas of thermally altered soils with steam emissions are present in the canyon of upper Big Sulphur Creek. In one of these areas along a tributary to Big Sulphur Creek, Geysers panicum, a federal candidate and state endangered species of grass, occurs.

Annual Grassland. Non-native grasses of this grassland include introduced annual species such as ripgut brome (*Bromus diandrus*), soft chess (*Bromus [mollis] hordeaceus*), red brome (*Bromus rubens*), slender wild oat (*Avena barbata*) and wild oat (*Avena fatua*), hare barley (*Hordeum murinum* ssp. *leporinum*), Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*), Italian rye-grass (*Lolium multiflorum*), annual fescue (*Vulpia bromoides* and *V. megalura*), and herbaceous plants such as yellow starthistle (*Centaurea solstitialis*), fiddleneck or rancher's fireweed (*Amsinckia menziesii* var. *intermedia*), English plantain (*Plantago lanceolata*), bur-clover (*Medicago polymorpha*), filaree (*Erodium botrys*, *E. cicutarium*, and *E. moschatum*), and winter vetch (*Vicia villosa*). Native species are also common in the grassland, although they are less abundant than the introduced species. These native plants include many lupine and clover species including *Lupinus densiflorus*, *L. nanus* ssp. *latifolius*, *L. succulentus* and *Trifolium albopurpureum*, *T. bifidum*, *T. depauperatum*, *T. microcephalum*, *T. oliganthum* and *T. variegatum*. Other native species common in the grasslands are virgate tarweed (*Holocarpha virgata*), blow-wives (*Achrychaena mollis*), several microseris species (*Microseris* sp.), purple godetia (*Clarkia purpurea*), California poppy (*Eschscholzia californica*), and western buttercup (*Ranunculus occidentalis*). Scattered trees of valley oak (*Quercus lobata*), blue oak (*Quercus douglasii*) and foothill pine (*Pinus sabiniana*) occur locally in annual grassland habitats, especially in areas transitional between grassland and woodland habitats.

Wet Meadow. This type of grassland is noticeable in the early to mid spring when the rains are still producing new runoff from already saturated grasslands. Excess water moves by overland flow to lower areas in the landscape creating small, slow-moving streams in the swales or

drainages. Plant species more tolerant of inundation, such as the vernal pool species, flourish in these wet drainages. Typical species are meadow foam (*Limnanthes douglasii* ssp. *nivea*), button celery (*Eryngium* sp.), monkeyflower (*Mimulus guttatus*), popcorn flower (*Plagiobothrys* sp.) and goldfields (*Lasthenia* sp.). Wet meadow grassland occurs in the region of the SERWTP, at the end of Reid Road in Burns Valley.

Irrigated Pasture. The non-native grassland in the vicinity of the SERWTP is regularly irrigated and has been sown with a mixture of pasture grasses that includes Alta fescue (*Festuca arundinaceae*), Harding grass (*Phalaris aquatica*), Akaroa orchard grass (*Dactylis glomerata*), Ariki perennial rye (*Lolium perenne*), Oregon annual rye (*Lolium* sp.), Salinas strawberry clover (*Trifolium fragiferum*), and broadleaf trefoil (*Lotus* sp.) (Jones 1993). These grasses were growing along with weedy herbaceous plants such as common mallow (*Malva neglecta*), field mustard (*Brassica* sp.), wild radish (*Raphanus sativus*), and cocklebur (*Xanthium strumarium* var. *canadense*). All of these species were growing around the base of 10 large valley oak trees that seemed to have adapted very well to the irrigation regime that has occurred for approximately 21 years. No dead branches or diseased trees were observed.

Fresh Emergent Wetland. The freshwater emergent wetland grows in areas where groundwater is at or near the surface all year. This vegetation type includes freshwater marshes such as those of Anderson Marsh, at springs such as at Murphy's Springs Road and Highway 29, and at seeps. Plants typically found in freshwater wetlands include tule (*Scirpus acutus*), cattail (*Typha* sp.), tall cyperus (*Cyperus eragrostis*), tall spike-rush (*Eleocharis macrostachya*), baltic rush (*Juncus balticus*), Bolander's rush (*Juncus bolanderi*), common rush, and iris-leaved rush (*Juncus xiphioides*). Other species found in freshwater wetlands of Clear Lake and its environs are sticktight (*Bidens frondosa*) and red willow, rosilla (*Helenium puberulum*), willow-herb (*Epilobium ciliatum*), Braun's scouring-rush (*Equisetum laevigatum*) and common monkeyflower. Introduced, weedy species such as fuller's teasel (*Dipsacum fullorum*) and cocklebur are also common. Serpentine seeps and springs support species such as bifid sedge (*Carex serratodens*), Van Houtte's columbine (*Aquilegia eximia*), swamp larkspur (*Delphinium uliginosum*), serpentine sunflower (*Helianthus exilis*), bare monkeyflower (*Mimulus nudatus*) and serpentine collomia (*Collomia diversifolia*). The latter three species are special status species.

Valley Oak Woodlands. The valley oak woodland is an open woodland dominated visually by valley oak (*Quercus lobata*). The trees occur as large, well-spaced individuals or small groups

on level to gently rolling valley bottoms with deep, well-drained soil. The shrub layer consists of a few individuals of poison oak (*Toxicodendron diversilobum*), squaw bush (*Rhus trilobata* var. *quinata*), and common snowberry (*Symphoricarpos albus* var. *laevigatus*). The open areas between the trees are covered with non-native grassland species. Valley oak woodland habitats are scattered but found throughout the study area, except at higher elevations in The Geysers. Examples of valley oak woodlands are found at the SERWTP, along Clayton Creek, Copsey Creek, Big Canyon Creek, and Putah Creek at MWTPlant in Collayomi Valley.

Blue Oak Woodlands. This woodland is physically and visually dominated by blue oaks (*Quercus douglasii*) that grow on the moderate slopes of the lower hills throughout the study area but primarily in the Clearlake area. Blue oaks occur along the entire pipeline corridor, usually with foothill [=Grey] pine (*Pinus sabiniana*). Very few shrubs occur consistently in blue oak woodlands except poison oak; the understory is made up of mainly grass and herbaceous species, including hair grass (*Aira caryophyllea*), slender wild oat, wild oat, little rattlesnake grass (*Briza minor*), ripgut brome, soft chess, red brome, dog-tail grass (*Cynosurus echinatus*), Mediterranean and hare barley, Italian and perennial ryegrass, annual bluegrass, annual fescue and nitgrass (*Gastridium ventricosum*). The annual and perennial forbs include clovers (*Trifolium barbigerum*, *T. dubium*, *T. hirtum*, and *T. obtusiflorum*), bur clover, winter vetch, filaree, yellow starthistle, fiddleneck, prickly lettuce (*Lactuca serriola*) and virgate tarweed.

Blue Oak-Foothill Pine Woodlands. This habitat type is a woodland dominated by blue oak and foothill pine. The canopy cover is moderately dense with many small openings but also varies from very open to closed. Locally, interior live oak (*Quercus wislizenii*) or valley oak may largely replace blue oak as the dominant oak species. The shrub layer consists of widely scattered large shrubs, with common manzanita (*Arctostaphylos manzanita*) and California mountain-mahogany (*Cercocarpus montanus* var. *glaber*) the most common. The herb layer is well-developed and dense, consisting of a mixture of native and non-native species. Non-native species abundant in this habitat include all of the grasses found in the blue oak woodland plus hedge-parsley (*Torilis arvensis* ssp. *purpurea*), and wall bedstraw (*Galium murale*). Native species represented in this habitat are blue wildrye grass (*Elymus glaucus*), California brome-grass (*Bromus carinatus*), harvest brodiaea (*Brodiaea elegans*), purple godetia, Pacific sanicle (*Sanicula crassicaulis*) and purple sanicle (*S. bipinnatifida*), western buttercup, common yarrow (*Achillea millefolium* var. *Californica*) and few-flowered blue-eyed Mary (*Collinsia sparsiflora*). The pipeline from Highway 29, up Copsey Creek and Sweet Water Creek, over Childer's Peak and down to Putah Creek and Highway 175 has much of this woodland as cover.

Montane Hardwood. The tree species that make up this habitat type are predominantly black oak (*Quercus kelloggii*), madrone (*Arbutus menziesii*), canyon oak (*Quercus chrysolepis*), California bay (*Umbellularia californica*) and bigleaf maple with an understory of toyon (*Heteromeles arbutifolia*), western redbud (*Cercis occidentalis*) and poison oak. The ground is covered by blue wildrye grass, California fescue (*Festuca californica*), mountain sweet-cicily (*Osmorhiza chilensis*), California bedstraw (*Galium californicum*), common Pacific pea (*Lathyrus vestitus*), red fescue (*Festuca rubens*) and iris (*Iris macrosiphon*). The only two locations of montane hardwood habitat along the pipeline route occur at the lower end of Sweet Water Creek Canyon and near the Bear Canyon Power Plant.

Montane Hardwood-Conifer. This habitat contains the same hardwood shrub, and herbaceous species as the montane hardwood habitat with the addition of Douglas fir (*Pseudotsuga menziesii*), foothill pine, ponderosa pine (*Pinus ponderosa*), and an occasional sugarpine (*Pinus lambertiana*). This is a common habitat in the Mayacamas Mountains especially in the canyon above the Bear Canyon Power Plant including the route of the proposed road. A common understory herb of the montane hardwood-conifer community is butterfly flower or milkwort (*Polygala californica*).

Closed-cone Pine-Cypress. This is a woodland of exposed serpentine barren ridges and is dominated by one or the other of two serpentine tolerant conifers. McNab cypress (*Cupressus macnabiana*) exhibits grayish branches of scale-like leaves and forms dense stands of small, shrub-sized trees averaging from 3 to 10 meters (10 to 30+ feet) that look like "pygmy" forests. Knobcone pine (*Pinus attenuata*) may intergrade with the cypress but usually forms separate stands of much taller trees. The two species form a mosaic with the mixed chaparral and serpentine barren on the crest and sides of the Mayacmas Mountains in The Geysers region of the pipeline and also near Childer's Peak. The habitat type is variable in the proportion of the two dominant species, with some stands overwhelmingly dominated by knobcone pine and other stands by McNab cypress. The species diversity of the shrub layer is low, and shrub density is variable. White-leaved manzanita (*Arctostaphylos viscida*) is the dominant shrub in areas of McNab cypress and white-leaved manzanita and Eastwood's manzanita (*Arctostaphylos glandulosa*) predominate in areas of knobcone pine. Other common shrubs are Stanford's manzanita (*Arctostaphylos stanfordiana*) and leather oak (*Quercus durata*). In the Big Sulphur Creek Canyon of Sonoma County on serpentine soils both McNab and Sargent cypress (*Cupressus sargentii*) are reported (Neilson and McQuaid 1981) but along the pipeline the serpentine soils were covered primarily with knobcone pine and an understory of hoary

manzanita (*Arctostaphylos canescens*), big manzanita (*A. manzanita*) and Stanford's manzanita (*A. stanfordiana*) with occasional plants of wavy-leafed ceanothus (*Ceanothus foliosus*). The herbaceous layer is extremely sparse and there is much barren ground especially in areas dominated by MacNab cypress. Short-stemmed sedge (*Carex brevicaulis*) and Indian warrior (*Pedicularis densiflora*), a green root-parasite, are the only abundant herbs in these areas. In areas dominated by knobcone pine, Indian's dream (*Aspidotis densa*) is common.

Serpentine Barrens. These open, scree (loose rock) covered habitats are found in areas of serpentine outcrops where little or no soil development has occurred. The poorly weathered serpentine is broken up into scree but has not progressed to the point of having any organic material incorporated. Barrens are located primarily east of the NCPA main entrance gate along the main road and roads to the NCPA Q-Pad and P-Pad. The barrens support only scattered representatives of vascular plant species- Snow Mountain buckwheat (*Eriogonum nervulosum*), Socrates Mine jewelflower (*Streptanthus brachiatus*) and Morrison's jewelflower (*Streptanthus morrisonii*). All three of these species are special status species. The two species of jewelflower are not reported from the same barren within the survey route (Biosystems 1992). Serpentine barrens also occur along the survey corridor in the vicinity of the Childer's Peak Regulating Tank, where a larger species diversity is observed including an onion with sickle-shaped leaves (*Allium falcifolium*), and the scarlet fritillary (*Fritillaria recurva*). At the base of Childer's Peak near the head of Sweet Springs Creek is a small population of an unidentified jewelflower, likely (*Streptanthus glandulosus glandulosus*).

Serpentine Seeps and Springs. At Childer's Peak Regulating Tank Site there are several drainages that seep water and support a small number of species adapted to this environment including a thread-leaved miner's lettuce (*Claytonia exigua*), marsh monkeyflower (*Mimulus guttatus*), Serpentine collomia (*Collomia diversifolia*) and bare monkeyflower (*Mimulus nudatus*). The latter two species are of special status.

Mixed Chaparral. Mixed chaparral is a habitat dominated by tall shrubs. It is a community of woody, sclerophyllous plants growing on steep, exposed slopes, and slopes that receive little precipitation and are covered with fast draining, mineral soils with low fertility. The plants on average have hard, waxy or resinous leaves and are of a height that they create conditions that support very hot, fast moving fires. Many of the species of the chaparral are adapted to fire and can sprout from large underground burls at the root crown and others are fire-dependent, requiring the action of fire to break their seed dormancy. The species composition of the mixed

chaparral is somewhat different on non-serpentine and on serpentine substrates. Characteristic shrubs on both substrates include chamise (*Adenostoma fasciculatum*), California yerba santa (*Eriodictyon californicum*), coffeeberry (*Rhamnus californica* ssp. *tomentella*), toyon, California mountain-mahogany, and silk-tassel bush (*Garrya flavvescens* ssp. *congdonii*, *G. fremontii*). On non-serpentine substrates, common manzanita, common buck brush (*Ceanothus cuneatus*), California scrub oak (*Quercus dumosa*), and locally the shrub form of interior live oak (*Quercus wislezenii* var. *frutescens*) are important shrub species. They are largely replaced by white-leaved manzanita, Jepson's ceanothus (*Ceanothus jepsonii* var. *albiflorus*), and leather oak on serpentine soils. The herbaceous cover is very sparse under dense chaparral, but in openings in the scrub there is dense cover of grasses and forbs, including Malpais bluegrass (*Poa secunda*), squirreltail grass (*Elymus elymoides*), annual fescue (*Vulpia microstachys*), phlox-leaved bedstraw (*Galium andrewsii*), woolly Indian paintbrush (*Castilleja foliolosa*), cryptantha (*Cryptantha flaccida*, *C. hispidula*, *C. muricata* var. *jonesii*), Austin's skullcap (*Scutellaria austinae*), turpentine weed (*Trichostema laxum*), and Indian warrior. A few herb species found in the chaparral such as bearded streptanthus (*Streptanthus barbiger*), Sierra morning-glory (*Calystegia collina* ssp. *tridactylosa*), two-carpellate dwarf flax (*Hesperolinon bicarpellatum*), and serpentine reed grass (*Calamagrostis ophiditis*), occur only or primarily on serpentine soil. The latter two species are of special status.

Residential / Cultivated. This community is varied depending on the location. In the rural area near the SERWTP there are walnut orchards (*Juglans regia*), stone fruit trees (*Prunus* sp.), apple trees (*Malus* sp.), vegetable crops grown for home consumption and ornamental shrubs and trees surrounding the homes that are sparsely located along the largely dirt roads.

Bare / Paved. This habitat unit includes roadways and bare dirt areas that are not serpentine barrens.

4.5.1.3 DEFINITION OF WETLANDS

The term "wetland" is defined by the Corps of Engineers (*Federal Register* 1982) and by the EPA (*Federal Register* 1980) as "The areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

To determine whether areas that appear to be wetlands are subject to Corps' jurisdiction (i.e., are "jurisdictional" wetlands), a wetlands delineation must be performed. Three criteria are applied in this determination: (1) evidence of inundation or saturation by surface or groundwater for at least two weeks during an average rainfall year (hydrology), (2) a prevalence of wetland vegetation (hydrophytes) if the site is undisturbed, and (3) typical wetland (hydric) soils, that is, soils formed under saturated, anaerobic conditions. Since streams, including those with riparian habitat, rarely meet all three criteria for delineation as a wetland, those portions of a stream or river that lie below the line of "ordinary high water", or "bankful stage", are generally regarded by the Corps as falling within their jurisdiction as either navigable waters, tributaries to navigable waters, or "other waters" of the United States.

In 1987 the Corps published a manual which standardized the manner in which waters, including wetlands, were to be delineated nationwide. Local Districts of the COE have been directed to use this manual until a study can be completed regarding several other newer editions of the manual.

The project corridor crosses several natural communities that may contain jurisdictional wetlands including valley and foothill Riparian, wet meadow and several serpentine seeps. The corridor parallels a freshwater emergent marsh at Murphy Springs. None of these areas have been delineated to determine the extent of jurisdictional wetlands but the extent of wetlands to receive impact is believed to be minimal. Wet meadow is present on the alignment in the area that the Clear Lake Diversion Pipeline crosses and possibly (but less likely) in the grassland in Sweet Springs Creek Canyon.

4.5.1.4 WILDLIFE

Because wildlife communities are very complex and because impacts are most typically related to alterations of the wildlife environment, this EIR/EIS will describe wildlife habitats. Wildlife habitats consist of areas or places where an organism lives, such as foraging areas, nesting areas, and shelter from predators. Some wildlife species have a very narrow range of tolerance for one or more aspects of their physical or biological environment. When the environment exceeds the genetically inherited tolerance for temperature, humidity, length of day, or chemical attributes, the individual animal dies. The individual members of the species that do survive and breed occupy what is known as the species geographic range. This range may vary depending on the phase of the animal's life cycle.

A natural community (Holland 1986) or wildlife habitat (Mayer and Laudenslayer, 1988) are both conceptual categorizations designed to aid in the discussion and understanding of the natural world. Natural communities (*sensu* Holland) are based on the plant species of the vegetation and wildlife habitats are based on the vegetation types utilized by wildlife species. Natural communities may be defined as the areas formed by the overlapping of geographic ranges of plant species. The wildlife habitats tend to be broader categories than the natural communities because plants are more often limited by soils than are animals. Wildlife habitats are based on the vegetation in a structural way. A raptor preying on small mammals is less affected by whether the mammal lives in a serpentine grassland, a Valley bunchgrass grassland or a non-native grassland than are the species making up the grassland. Table 4.5.1-1 describes the correspondence between vegetation communities and wildlife habitats. Species lists for plants and wildlife are presented in Appendices A and B of BioSystems Lake & Sonoma Counties Geysers Sustainability Plan, Vol. 4: S.E. Geysers Effluent Pipeline Biological Survey, June 1992 available as a file report at the Lake County Planning Department

Plants produce high energy compounds that they and animals depend upon in order to survive and reproduce. Herbivorous animals are more likely to occur in a habitat comprised by their species' food plants. A few of large mammal species and some bird species have behavioral flexibility that allows them to survive by modifying behavior and adapting to the changes that humans make in their habitats. Mule deer browse on grape vines in vineyards and fox and raccoons eat garbage. Most species do not have this mobility or flexibility. If they did, they would likely find that the adjacent habitat identical habitat was already at carrying capacity with individuals of their same species and the neighboring dissimilar habitat was already occupied by other species.

Valley and Foothill Riparian Forest

The riparian habitat attracts bird species that hover while catching insects, such as warbling vireo (*Vireo gilvus*), and black phoebe (*Sayornis nigricans*). Other species such as mallards (*Anas platyrhynchos*) and snowy egrets (*Egretta thula*) use the shallow quiet waters of rivers and streams to forage for vegetation and small fish. The American crow (*Corvus brachyrhynchos*) is found in this habitat, as well as others, feeding on insects, fruits, carrion, amphibians, and reptiles. Predators, such as sharp-shinned hawks (*Accipiter striatus*) and red-shouldered hawks (*Buteo lineatus*), nest in the high canopy and feed on the smaller birds and amphibians. Omnivores, such as raccoon (*Procyon lotor*) and striped skunk (*Mephitis mephitis*) forage on

TABLE 4.5.1-1: CROSS REFERENCE OF WILDLIFE HABITATS TO VEGETATION COMMUNITIES

Wildlife Habitats	Vegetation Communities
Valley-foothill riparian	Freshwater swamp, north coast riparian forest, central coast riparian forest, riparian scrub, and Great Valley riparian scrub.
Annual grasslands	Valley foothill grassland, and vernal pools.
Fresh emergent wetlands	Coastal and valley freshwater marsh.
Valley oak woodland	Valley oak woodland.
Montane hardwood-conifer	Mixed evergreen forest, bay forest, and coast range mixed conifer forest.
Montane hardwood	Black oak woodland, interior live oak woodland and forest, and coast live oak woodland and forest.
Serpentine barrens	Serpentine grasslands and serpentine chaparral.
Mixed chaparral	Serpentine chaparral, scrub oak chaparral, interior live oak chaparral, poison oak chaparral, and alluvial fan chaparral vegetation communities.
Chamise-redshank chaparral	Chamise chaparral and red shank chaparral.
Douglas fir forest	Douglas fir forest, western hemlock forest, and Tanoak forest.
Blue oak woodland	Blue oak woodland, interior live oak forest and woodland.
Closed-cone pine-cypress	Closed cone coniferous forest.
Disturbed areas	Non-native grasslands found in pastures, orchards and vineyards, croplands, residential parks.

SOURCE: Mayer and Laudenslayer, 1988, ESA 1993.

invertebrate species, plant parts, amphibians and fruits. Special status species potentially found in this habitat along the pipeline route are yellow breasted chat (*Icteria virens*), purple martin (*Progne subis*), northwestern pond turtle (*Clemmys marmorata marmorata*), red-legged frog (*Rana aurora draytonii*), foothill yellow-legged frog (*Rana boylei*), and Valley elderberry longhorn beetle (*Demoscerus californicus dimorphus*). The Special Status Species are described later.

Annual Grassland Habitat

Grassland habitat, such as non-native grasslands, attracts seed eaters as well as insect eaters. California quail (*Callipepla californica*), mourning dove (*Zenaida macroura*), and meadowlarks (*Sturnella neglecta*) are but a few seed eaters that nest in grasslands. Insect eaters, such as scrub jays (*Aphelocoma coerulescens*), barn swallows (*Hirundo rustica*), and mockingbirds (*Mimus polyglottos*), use the habitat for foraging only. Mammals, such as the California vole (*Microtus californicus*), deer mouse (*Peromyscus maniculatus*), broad-footed mole (*Scapanus latimanus*), and black-tailed jackrabbit (*Lepus californicus*), forage and nest within the grassland. Mule deer (*Odocoileus hemionus*) will use grassland for grazing and, if the grass is tall enough, for nesting at night. Small rodents attract raptors (birds of prey), such as red-tailed hawks (*Buteo jamaicensis*), and red-shouldered hawks, if the grasslands are adjacent to riparian habitat. Southern alligator lizard (*Gerrhonotus multicarinatus*), western fence lizard (*Sceloporus occidentalis*), and Pacific slender salamander (*Batrachoseps pacificus*) use the grassland for foraging for invertebrates found within and underneath fallen logs. Two special status species, California horned lark (*Eremophila alpestris*) and logger-head shrike (*Lanius ludovicianus*), use this habitat for nesting and foraging.

Fresh Emergent Wetlands

Fresh Emergent Wetlands offer an abundance of food and shelter for wildlife and waterfowl. Species such as great blue herons (*Ardea herodias*), American bittern (*Botaurus lentiginosus*), cattle egret (*Bubulcus ibis*), and snowy egret feed on fish invertebrates in the mud and vegetation. Waterfowl, such as cinnamon teal (*Anas cyanoptera*) and ruddy ducks (*Oxyura jamaicensis*), use these areas during the spring and summer for foraging and for nesting. Avocets (*Recurvirostra americana*) and blacknecked stilt (*Himantopus mexicanus*) use this habitat year-round for foraging and nesting. Mammals from the nearby grassland habitat use the wetlands for drinking and for foraging. Raptors are attracted to the area by the small mammals using the resources, and Northern harriers (*Circus cyaneus*), kestrels (*Falco sparverius*) and red-tailed hawks will hunt in the nearby grasslands, with Northern harrier nesting in the wetland vegetation.

Valley Oak Woodlands

This habitat supports many edge species, that is, species that use two habitats adjacent to each other for different purposes. Often these species will nest or hide in one habitat and forage in

another. Mammals, such as fox squirrel (*Sciurus niger*) and deer, feed off acorns and new leaf shoots, while others, such as gray fox (*Urocyon cinereoargenteus*), bobcat (*Lynx rufus*) and weasels (*Mustela* sp.) feed off small mammals and ground dwelling birds. Amphibians and reptiles occurring underneath leaf litter and fallen logs include California slender salamander and ringneck snake (*Diadophis punctatus*), common kingsnake (*Lampropeltis getulus*) and gopher snake (*Pituophis melanoleucus*).

Montane Hardwood Conifer

Avian species in this habitat feed primarily on pine nuts during the winter months and have beaks adapted to forage upon them, such as evening grosbeak (*Hesperiphona vespertina*). Others, such as Clark's nutcracker (*Lucifraga columbiana*), hoard seeds away during the summer for feed in the winter. Grey squirrels (*Sciurus carolinensis*) also hoard seeds for the winter months. There are various guilds of avian insect eaters, such as northern flicker (*Colaptes auratus*), that glean insects from the bark, and others, such as yellow rumped warbler (*Dendroica dominica*) and ruby crowned kinglet (*Regulus calendula*), which feed on insects while hovering. Woodpeckers (*Picoides* sp.) are some of the few birds that excavate into the bark to obtain insects. Steller's jay (*Cyanocitta stelleri*) and Bewick's wren (*Thryomanes bewickii*) glean on the ground. Mammals in this habitat include Douglas' squirrel (*Tamiasciurus douglasii*), and weasel (*Mustela* sp.), both occurring in the upper branches of conifers, hunting for nuts and birds eggs, respectively. Ground dwellers include mule deer, which move through a variety of habitats, feeding on twigs and needles during the winter. Striped skunk and spotted skunk (*Spilogale gracilis*) also occur in this and other habitats, feeding on insect larvae and competing with black bear (*Ursus americanus*) for berries and other fruits. Special Status Species for in this habitat include California spotted owl (*Strix occidentalis occidentalis*), Coopers hawk (*Accipiter cooperi*), and sharp-shinned hawk.

Montane Hardwood

Coast live oak woodlands and forest and interior live oak woodlands and forests attract bark gleaner species such as black-capped chickadee (*Parus atricapillus*), bushtit (*Psaltirparus minimus*), scrub jay, Stellar's jay, acorn woodpecker (*Melanerpes formicivorus*), and plain titmouse (*Parus inornatus*). California quail, and brown towhee (*Pipilo fuscus*) are the foliage gleaners in this habitat. Red-shouldered hawks forage on small mammals in the grassland from the protection of the coast live oak forest. Cooper's hawks and sharp-shinned hawks (see section --for special status species), are often associated with this habitat, hunting small birds.

Mammals such as mule deer utilize the understory of this community, i.e. poison oak, and black berry bushes, for shelter and food. The gray fox (*Urocyon cinereoargenteus*) also utilizes the poison oak and black berry bushes for food and shelter, foraging on small birds and mammals, insects, fungi and berries. The Pacific slender salamander occurs in this habitat underneath the cover of fallen leaf litter and bark.

Serpentine Barrens

Serpentine grasslands do not offer abundant cover or food for wildlife, except for those species, specifically invertebrates, that are food plant specific. Often these plant species can only grow on serpentine soils. Small mammals, such as voles and mice, use this habitat for burrows while foraging in other more abundant grasslands. Other grassland species, such as loggerhead shrike, black-shouldered kite (*Elanus caeruleus*), ferruginous hawk (*Buteo regalis*), prairie falcon (*Falco mexicanus*), and horned lark (*Eremophila alpestris*), might use these sparsely covered grasslands for foraging.

Mixed Chaparral Habitat

Chaparral habitat contains animal species that are attracted to edges of communities, such as grassland or oak forest adjacent to chaparral, for foraging and nesting. These types of species include mountain quail (*Oreortyx pictus*), in the higher elevations, California quail, California thrasher (*Toxostoma redivivum*), mourning dove, and rufous-sided towhee (*Pipilo erythrophthalmus*), that forage among the leaf litter for invertebrates. Avian species that use the canopy of the chaparral for catching insects include phainopepla (*Phainopepla nitens*), ash-throated flycatcher (*Myiarchus cinerascens*), and wrentit (*Chamaea fasciata*). Besides insects, flowers of the manzanita and ceonothus attract nectar drinkers such as Anna's hummingbird. If cliffs are nearby, prairie falcons will use chaparral for foraging grounds, as well as sharp-shinned hawks will use chaparral, if water is nearby. Mammals use this habitat for protection and foraging grounds, feeding off new shoots of plants. These species include brush rabbits (*Sylvilagus bachmani*), gophers (*Thomomys* sp.), and deer mice. Small mammals attract predators such as weasel, grey fox, red fox and bobcat. Western rattlesnake (*Crotalus viridis*) and western fence lizards inhabit the warm, dry chaparral community.

Chamise-Redshank Chaparral

Avian species occurring in this habitat include California quail, brown towhee, and Oregon junco, species that nest and forage in this habitat. Chamise-Redshank Chaparral does not offer much foraging or cover habitat for the larger mammals. However, smaller mammals, such as brush rabbits and meadow voles, usually use this habitat for cover and foraging. Reptiles would be attracted to this habitat and species, such as western fence lizard, alligator lizard, western skink (*Eumeces skiltonianus*), and western rattlesnake.

Blue Oak Forest

Species occurring in this habitat are similar to the species occurring in montane hardwood habitat.

Closed Cone Pine Cypress Forest

These forests offer perching and roosting sites for a variety of avian species, with raptors nesting in the cypress. The lack of understory growth does not provide much habitat for insects and, therefore, reptiles that prey upon them, nor for mammals, except for cover and resting areas.

Disturbed Lands

Agricultural lands generally do not provide as much habitat values for mammals, reptiles, and amphibians as they do for birds. The requirements of large herbivorous mammals for food and cover from predators and the elements in their territory, as well as those for suitable courting and pairing habitats are generally not met by agricultural uses. Agricultural fields, which generally consist of monocrops of a uniform height, do not provide the diversity of structural components needed for large herbivores. Food diversity is also not available for larger mammals, such as deer, which eat bark, and a variety of foliage, and berries. Herbivores are likely to use agricultural fields along their travel corridors from one natural community to another, although supportive studies are lacking.

Orchards offer the least overall habitat value of all agricultural crops, mostly because of farming practices. Row crops do provide limited food (in the form of insects) and cover for birds and mammals, but typically do not provide adequate foraging grounds for predators, such as raptors. Small mammals, such as rabbits and rodents, forage on the leaves and grasses of orchards and, in

turn, may attract small predators, such as hawks or feral cats. Other mammalian species known to use agricultural areas include coyote, raccoon, skunks, and opossum.

Pasture lands provide habitat for species historically found in grasslands of the region, but which are now adapted to croplands. Bird species using these areas include granivores, foliavores (leaf-eaters), and insectivores, which consume plant seeds, plant material, and insects, respectively. Small mammals, such as harvest and house mice, are attracted to these areas and provide not only food for other species but also enhance the habitat. For example, California ground squirrels, attracted to the short grasses for safety reasons, provide habitat for various species, such as burrowing owls and tiger salamanders, that are able to modify burrows made by ground squirrels. Resident birds of prey, such as red-tailed hawk and black-shouldered kite, use these areas for hunting small mammals. Other raptors, such as merlins and Swainson's hawk, use these types of fields for hunting during the winter migration along the Pacific Flyway. Species typically found in these agricultural areas include pheasant, dove, red-tailed hawk, northern flicker, crow, and western meadowlark. Wildlife species typically include red fox, skunk, raccoon, opossum, jackrabbit, cottontail, California ground squirrel, California vole, western harvest mouse, western fence lizard, and gopher snake.

Residential areas parks and disturbed areas provide little habitat for wildlife except for those species adapted to human habitation, such as starlings, golden crowned sparrows, and rock pigeons. These areas do not provide habitat for the larger mammalian species nor for predators, except as possible movement corridors.

4.5.1.5 REGULATORY FRAMEWORK

Wetlands

Wetlands and other "waters of the U.S" are under the jurisdiction of the U.S. Army Corps of Engineers (COE) through its delegated authority to enforce Section 404 of the Federal Clean Water Act. Section 404 regulates discharge of fill material into "waters of the United States," which include wetlands. If the wetlands are adjacent to a "water of the U.S.", such as Clear Lake, the COE is responsible for issuance of an individual permit for any project which proposes filling any amount of that wetland. As of August 1993, this also includes actions such as mechanical land clearing of trees in which the sediment of the wetland is disturbed and "re-deposited" on the wetland. A fill in this type of wetland requires that a water-dependent project have no environmentally less damaging alternative. If, however, the wetland lies "above the

headwaters" (above the point at which the stream has a yearly average flow of 5 cubic feet per second more than 50 percent of the time) of a stream or is an "isolated water" the regulation may be enforced by a "Nationwide Permit". Discharge of fill into one to ten acres would automatically be permitted under a Nationwide Permit, provided certain conditions were met. Fills of less than one acre of wetlands require no formal notification of the COE. The Environmental Protection Agency (EPA) has an oversight role, and (through an involved process) can override a decision by the COE to issue a permit.

Executive Order 11990 requires federal agencies to prepare wetland assessments for proposals located within or affecting wetlands. Agencies must avoid undertaking new construction in wetlands unless no practicable alternative is available and the proposed action includes all practicable measures to minimize harm to wetlands.

Streambed Alteration Agreement. In addition to COE regulatory authority over "Waters of the United States," the California Department of Fish and Game (CDFG) has authority to oversee work in streams pursuant to Fish and Game Code Sections 1601 to 1603. A landowner or agency proposing to substantially divert the natural flow of a stream, substantially alter its bed or bank, or use any material from the streambed, must first enter into a "Streambed Alteration Agreement" with CDFG. The CDFG, while being able to impose reasonable conditions on the agreement, may not decline to enter into an agreement.

Special Status Species

Plant species listed by the U.S. Fish and Wildlife Service as endangered, threatened, or proposed as endangered are protected by the Federal Endangered Species Act (FESA, Section 9(a)(2)) from "take" if the plants are under Federal jurisdiction; or from removal, damage or destruction in knowing violation of any law or regulation of any state or in the course of any violation of a state criminal trespass law. While species that are candidates for listing are not strictly protected, if they are likely to become listed during the time of construction of the project, they may be subject to protection under FESA. On lands under the jurisdiction of the Bureau of Land Management (BLM) all candidate species are considered Sensitive Species and fully protected under Bureau policy. A permit may be issued for incidental take of the species during the course of project construction.

Under the California Endangered Species Act (CESA) plant species (together with animal species) determined to be endangered, threatened or candidate for listing by the California Fish and Game Commission are protected from take or possession. Under the California Environmental Quality Act (CEQA), additional species of plants maybe protected. By virtue of CEQA's including not only species officially listed by federal and state resource agencies, protected species also may include those that can be shown to meet the criteria of rare or endangered under CEQA Section 15380 (b). This provision of CEQA allows many jurisdictions to include as protected the species on lists of the California Native Plant Society (CNPS). However, CNPS listed species do not have legal protection under FESA or CESA.

Special status animal species include those listed by the Federal or State governments as endangered, threatened, rare, or candidate for listing. These species have varying degrees of legal protection under both FESA and CESA, and recognition under CEQA. The United States Fish and Wildlife Service (USFWS) and the California Department of Fish and Game (CDFG) share responsibility for management and protection of biological resources in the proposed project area. Under separate State and Federal legislation, each agency conducts a detailed review of any project that could affect a special status plant or animal species. If a listed species may be affected, the lead agency must initiate a formal consultation with the USFWS and/or CDFG, as applicable under Federal or State law.

Fully protected species include those that are protected under Sections 3511, 4150, 4700, 5050, and 5515 of the California Fish and Game Code. "Species of special concern" are animal species with breeding populations within California that may face extinction in the near future and are protected under CDFG Code 4150.

Federally, the Migratory Bird Treaty Act of 1919, 1972, and 1976 prohibits the harming of any species listed in the act (see Code of Federal Regulations, 50 CFR 10.12.) Locally, Section 3503 of the California Department of Fish and Game Code states that it is "unlawful to take, possess, or needlessly destroy the nest or eggs of any bird" and section 3503.5 states "it is unlawful to take, possess or destroy any birds in the Order of Strigiformes (owls) or Falconiformes (birds of prey) or to take, possess, or destroy the nest or eggs of any such bird."

Special Status Plant Species

In April, May and June, 1992, BioSystems Analysis, Inc., working for Lake County, conducted rare plant surveys along a 28-mile-long pipeline corridor. They also mapped wildlife habitats and surveyed for frog adults and tadpoles in 18 streams and ponds. A total of 20 special status species of plants were identified along the corridor from a potential list of 38 species. Table 4.5.1-2 summarizes these species. Only two plant species are listed and fully protected under the FESA: both are a species of goldfields (*Lasthenia*). Seven species are federal candidate species. The list includes an additional species of jewelflower, Freed's jewelflower (*Streptanthus brachiatus* ssp. *hoffmanii*), that was subsequently identified by ESA on the access road to NCPA Q-Pad, growing under the existing pipeline along the road in gravel placed as ground-cover under the pipe. Burke's goldfields (*Lasthenia burkei*) was added to the list because the make-up water pipeline crosses areas of moist grasslands and swales that were observed to support a species of *Lasthenia*. While located outside of the pipeline corridor when the final alignment is decided upon it should once again be checked for *Lasthenia* because populations may vary from one year to the next. The third species added to the list is one that was surveyed for in 1992 and not found, but it still has a potential to occur on locations of impact within The Geysers area. This species, Geysers panicum (*Panicum acuminatum* ssp. *acuminatum*) is a grass growing on thermally altered soils.

Special Status Animal Species

The list of special status animal species potentially occurring along the Geysers Effluent Pipeline Corridor is presented in Table 4.5.1-3. Please refer to Table 4.5.1-3 for alphabetical listing of species under each category.

Special Status Species Potentially Affected by the Pipeline Route

Several species of birds, one species of reptile and two species of amphibian could be potentially affected by the construction of the pipeline. Surveys for special status amphibian species were conducted by Biosystems Analysis in 1993, but surveys for other species were not conducted.

Federal and State Listed Species

Bald eagle (*Haliaeetus leucocephalus*), Federal and State listed as an endangered species, like other raptors and birds in general, falls under California Code 3503 and 3503.5, which prohibits

TABLE 4.5.1-2: SPECIAL STATUS PLANT SPECIES POTENTIALLY OCCURRING WITHIN THE PROPOSED GEYSERS EFFLUENT PIPELINE CORRIDOR

<i>Scientific Name</i> Common Name	Status Fed./State/ CNPS	General Habitat	Specific Location and 1000 Foot Marker
FEDERALLY LISTED SPECIES			
<i>Lasthenia burkei</i> Burke's goldfields	FPE/SE/List 1B	Vernal pools, swales, and wet meadows	Neither species observed in survey corridor but possible between M1-2, M4-6 (ESA)
<i>Lasthenia conjugens</i> Contra Costa Goldfields	FPE/-/List 1B	Vernal pools, swales, and wet meadows	
FEDERAL CANDIDATE SPECIES			
<i>Hesperolinon didymocarpum</i> Lake County dwarf flax	FC1/SE/List 1B	Serpentine grassland, chaparral, woodland	Big Canyon Road at 89 (BioSystems)
<i>Streptanthus brachiatus</i> ssp. <i>brachiatus</i> Socrates Mine jewelflower	FC1/-/List 1B	Serpentine barrens	NCPA Road at 130-133(BioSystems)
<i>Streptanthus brachiatus</i> ssp. <i>hoffmanii</i> Frees jewelflower	FC1/-/List 1B	Serpentine barrens	Access road to Q-Pad (ESA)
<i>Streptanthus morrisonii</i> Morrison's jewelflower	FC2/-/List 1B	Serpentine barrens	Southeast of E-Pad (BioSystems)
<i>Dichanthelium lanuginosum</i> var. <i>thermale</i> Geysers panicum	FC2/SE/List 1B	Thermally altered soil	Not found by BioSystems, but potential , some taxonomic question
<i>Eriogonum nervulosum</i> Snow Mountain buckwheat	FC2/-/List 1B	Serpentine outcrops	Near N-Pad at 137 and southeast of E-Pad (BioSystems)
<i>Hesperolinon bicarpellatum</i> Two-carpellate dwarf flax	FC2/-/List 1B	Serpentine chaparral	On Childer's Peak saddle at 66.5 to 67, 68.2,, 72.4, and at 75.7 along original route toward Big Canyon Creek; between Harbin Springs Rd. and Putah, 10 occurrences Creek at 99, and 102.6 (BioSystems)
CALIFORNIA NATIVE PLANT SOCIETY (CNPS) LISTS			
<i>Astragalus rattanii</i> var. <i>jepsonianus</i> Jepson's milk vetch	-/-/List 1B	Grassland, open gravelly areas	Big Canyon Road at 88.4 (BioSystems)
<i>Pogogyne douglasii</i> ssp. <i>parviflora</i> Douglas' pogogyne	FC3/-/List 3	Serpentine grassland	Between Harbin Springs Road and Putah Creek at 101.4 (BioSystems)

(Continued)

TABLE 4.5.1-2: SPECIAL STATUS PLANT SPECIES POTENTIALLY OCCURRING WITHIN THE PROPOSED GEYSERS EFFLUENT PIPELINE CORRIDOR (Continued)

<i>Scientific Name</i> Common Name	Status Fed./State/ CNPS	General Habitat	Specific Location and 1000 Foot Marker
<i>Astragalus brewerii</i> Brewer's milk vetch	-/-List 4	Grassland, chaparral, woodland, often serpentine	Sweet Springs Creek Canyon at 64.1 (BioSystems)
<i>Astragalus clevelandii</i> Cleveland's milk vetch	-/-List 4	Moist serpentine	South of Childer's Peak at 68.2 to 70.6 (BioSystems)
<i>Calamagrostis ophitidis</i> Serpentine reed grass	-/-List 4	Serpentine soils	Between tributary of Putah and Big Canyon Creeks at 72.6-73.6 (BioSystems)
<i>Calyptridium quadripetalum</i> Four-petaled pussypaws	-/-List 4	Sandy or gravelly area, usually serpentine	Near tributary of Putah Creek at 72.6 (BioSystems)
<i>Collomia diversifolia</i> Serpentine collomia	-/-List 4	Serpentine areas, rocky or gravelly	On Childer's Peak saddle at 67.2 and at 73.2 along original route toward Big Canyon Creek (BioSystems)
<i>Cordylanthus tenuis</i> ssp. <i>burnneus</i> Serpentine bird'sbeak	-/-List 4	Serpentine, Closed-cone pine-cypress woodland, chaparral and barrens	Near B-Pad at 130.6 (BioSystems)
<i>Delphinium uliginosum</i> Swamp larkspur	-/-List 4	Streamside, seeps on serpentine	Along Big Canyon Road at 91.4 and north side of pipeline route at 100.9 (BioSystems)
<i>Fritillaria purdyi</i> Purdy's fritillary	-/-List 4	Serpentine, dry ridges	Between Harbin Springs Road and Putah Creek at 100.7 (BioSystems)
<i>Helianthus [exilis] bolanderi</i> Serpentine sunflower	-/-List 4	Serpentine seeps	Four occurrences between Harbin Springs Road and Putah Creek at 99,100.4, 100.6, and 102.6 (BioSystems)
<i>Lepidium latipes</i> Dwarf pepper-grass	Deleted, too common	Alkaline flats, meadows	Field south of Harbin Springs Road at 98.7 (BioSystems)
<i>Lomatium repostum</i> Napa lomatium	-/-List 4	Montane hardwood- coniferous woodland	Bear Canyon Road at 110.5 (BioSystems)
<i>Mimulus nudatus</i> Bare monkeyflower	-/-List 4	Serpentine seeps	Two locations between Highway 29 and Big Canyon Road at 67. and at 72.8 (BioSystems)

(Continued)

TABLE 4.5.1-2: SPECIAL STATUS PLANT SPECIES POTENTIALLY OCCURRING WITHIN THE PROPOSED GEYSERS EFFLUENT PIPELINE CORRIDOR (Continued)

<i>Scientific Name</i> Common Name	Status Fed./State/ CNPS	General Habitat	Specific Location and 1000 Foot Marker
<i>Navaretia jepsonii</i> Jepson's navaretia	-/List 4	Serpentine grassland	Four locations at 75.7 (south of Childer's Peak), 87.8 (Big Canyon Road), 101 and 101.3 (between Harbin Spring Road and Putah Creek) (BioSystems)

STATUS CODES:

FEDERAL:

FE=Listed as Endangered by the Federal Government

FT=Listed as Threatened by the Federal Government

FPE = Proposed for listing by the Federal Government

FC1=Category 1 Candidate for Federal listing (taxa for which the U.S. Fish and Wildlife Service has sufficient biological information to support a proposal to list as Endangered or Threatened)

FC2=Category 2 Candidate for Federal listing (taxa for which existing information indicates may warrant listing, but for which substantial biological information to support a proposed rule is lacking).

FC3= No longer a candidate

STATE

SE= Listed as Endangered by the State of California

ST= Listed as Threatened by the State of California

CNPS

LIST 1A=Species presumed extinct in California

LIST 1B= Species rare , threatened or endangered in California and elsewhere

LIST 2= Species rare, threatened or endangered in California, more common elsewhere

LIST 3=Species about which more information is needed- a review list

LIST 4=Species of limited distribution-a watch list.

SOURCE: BioSystems Analysis Inc., 1992; CNPS, 1993; Environmental Science Associates, Inc., 1993

the taking or destroying of nest or eggs of any bird and prohibits the taking or destroying of any bird or nest in the order of Falconiformes (falcons, kites, and hawks) and Strigiformes (owls). This species utilizes most of California's lakes, reservoirs, river systems, and coastal wetlands. They will forage on large bodies of water (a minimum of 8 hectares [Peterson, 1986]), or free flowing rivers with abundant fish. Although fish are the primary food source, bald eagles will also opportunistically hunt sick or wounded ducks across water, and will feed on carrion. Within the project area this species winters along the shores of Clear Lake using dead snags for roosting areas.

TABLE 4.5.1-3: SPECIAL STATUS ANIMAL SPECIES POTENTIALLY OCCURRING WITHIN THE PROPOSED GEYSERS EFFLUENT PIPELINE CORRIDOR

Scientific Name Common Name	Status Federal/State	General Habitat	Habitat Threat
FEDERALLY LISTED SPECIES:			
Birds			
<i>Haliaeetus leucocephalus</i> Bald eagle	FE/SE	Nests in large trees over lakes and rivers perching on large snags	Agriculture and human disturbance
<i>Strix occidentalis caurina</i> Northern spotted owl	FT/-	Dense old growth forests of mixed conifer, redwood and Douglas fir habitats	Loss and degradation of habitat
<i>Falco peregrinus anatum</i> Peregrine falcon	FE/SE	Nests in cliffs foraging on birds	Pesticides and human disturbance
FEDERAL CANDIDATE SPECIES:			
Mammals			
<i>Eumops perotis californicus</i> Greater western mastif bat	FC2/-	Open and arid habitats, and conifer and deciduous woodlands	Human disturbance
<i>Plecotus townsendii townsendii</i> Pacific western big-eared bat	FC2/-	Occurs in all habitats with most abundance in mesic habitats	Human disturbance
Birds			
<i>Aquila chrysaetos</i> Golden eagle	FFP/CSC	Nests on cliffs or tall trees	Agriculture and human disturbance
<i>Eremophila alpestris actia</i> California horned lark	FC2/-	Breeds in open grasslands and irrigated pasture	Agricultural operations destroy nests
<i>Lanius ludovicianus</i> Loggerhead shrike	FC2/-	Nests in open fields and woodlands	Agriculture
Reptiles			
<i>Clemmys marmorata marmorata</i> Northwestern pond turtle	FC2/CSC	Thoroughly aquatic species that frequents rocky or muddy bottom streams	Irrigation and channelization
Amphibians			
<i>Ambystoma trigrum californiense</i> California tiger salamander	FC1/-	Seasonal water sources adjacent to grasslands with underground refuges	Agriculture and urbanization
<i>Rana aurora draytonii</i> California red-legged frog	FPE/CSC	Ponds and streams running until June with emergent vegetation	Loss and degradation of habitat
<i>Rana boylei</i> Foothill yellow-legged frog	FC2/CSC	Streams with rocks and boulders and no emergent vegetation	Loss and degradation of habitat
Fish			
<i>Archoplites interruptus</i> Sacramento perch	FC2/CSC	Streams and lakes with rocky bottom	Loss of riparian habitat

Continued

TABLE 4.5.1-3: SPECIAL STATUS ANIMAL SPECIES POTENTIALLY OCCURRING WITHIN THE PROPOSED GEYSERS EFFLUENT PIPELINE CORRIDOR (Continued)

Scientific Name Common Name	Status Federal/State	General Habitat	Habitat Threat
Insects			
<i>Dubiraphia brunnescens</i> Brownish dubiraphnian riffle beetle	FC2/-		Loss and degradation of habitat
<i>Lindieriella occidentalis</i> California lindieriella	FC2/-	Freshwater vernal pools, grass bottomed swales underlain by hardpan or sandstone	Habitat destruction
CALIFORNIA SPECIAL SPECIES:			
Mammals			
<i>Bassariscus astutus</i> Ringtail	-/CFP	Riparian, forest and shrubs habitats near water	Habitat destruction
Birds			
<i>Elanus caeruleus</i> Black-shouldered kite	-/CFP	Nests in dense topped trees in the vicinity of open grasslands, meadows, or marshes	Loss of wetlands agriculture
<i>Accipiter cooperii</i> Cooper's hawk	-/CSC	Nests in riparian growths of deciduous trees and live oaks	Loss of riparian habitat
<i>Accipiter striatus</i> Sharp-shinned hawk	-/CSC	Nests in riparian growths of deciduous trees and live oaks	Loss of riparian habitat
<i>Asio flammeus</i> Short-eared owl	-/CSC	Winters in Central and Sacramento Valley in open grasslands, wetlands, and pastures	Loss and degradation of habitat
<i>Circus cyaneus</i> Northern harrier	-/*	Nests in scrubby vegetation at the edge of marshes	Loss of wetlands and grazing
<i>Falco mexicanus</i> Prairie falcon	-/CSC	Nests on cliffs; forages from dry open terrain to marshlands	Loss of feeding habitat and pesticides
<i>Coccyzus americanus occidentalis</i> Western yellow-billed cuckoo	-/CE	Nests dense riparian forests	Flood control and urbanization
<i>Icteria virens</i> Yellow breasted chat	-/CSC	Nests in dense shrubs along stream or river	Loss and degradation of habitat
<i>Progne subis</i> Purple martin	-/CSC	Summer resident in riparian, valley foothill, and montane hardwood-conifer	Loss and degradation of habitat
Amphibians			
<i>Scaphiopus hammondi</i> Western spadefoot toad	-/CSC	Inhabits washes, floodplains, and alkali flats	Agriculture
Fish			
<i>Lavinia exilicavda chi</i> Clear Lake hitch	-/CSC	Inhabits quiet and shallow waters	Introduced species

Continued

TABLE 4.5.1-3: SPECIAL STATUS ANIMAL SPECIES POTENTIALLY OCCURRING WITHIN
THE PROPOSED GEYSERS EFFLUENT PIPELINE CORRIDOR (Continued)

STATUS CODES:

FEDERAL

FE=Listed as Endangered by the Federal Government

FT=Listed as Threatened by the Federal Government

FPE=Proposed for listing by the Federal Government

FC1=Category 1 Candidate for Federal listing (taxa for which the U.S. Fish and Wildlife Service has sufficient biological information to support a proposal to list as Endangered or Threatened)

FC2=Category 2 Candidate for Federal listing (taxa for which existing information indicates may warrant listing, but for which substantial biological information to support a proposed rule is lacking).

STATE

CFP= Listed as Fully Protected by the State of California

CE= Listed as Endangered by the State of California

CT= Listed as Threatened by the State of California

CSC= Listed as Species of Concern by the State of California

* = breeding areas protected

NOTE: This list is preliminary in nature and does not reflect U.S. Fish and Wildlife Service data specific to this project.

SOURCE: Biosystems Analysis Inc., 1992; Environmental Science Associates, Inc., 1992

Federal Candidate Species

Birds. California horned lark (*Eremophila alpestris actia*), a federal Category 2 species proposed for being listed as threatened or endangered, is a year long resident in most of California. It is usually found in open habitat, such as grassland and agricultural areas, where trees and shrubs are absent. This species has been observed from sea level to above treeline in various habitats, such as grasslands, deserts and alpine dwarf-shrub habitat.

Loggerhead shrike (*Lanius ludovicianus*), a federal-Category 2 species proposed for being listed as threatened or endangered, is common throughout California in the lowlands and the foothills. This species occurs in open habitats, such as grasslands or, occasionally, agricultural fields, using shrubs, trees, posts, fences, and utility lines for perching surfaces. Habitats with little to no human disturbance are preferred, such as open canopied valley, valley foothill hardwood, valley foothill hardwood conifer, and valley foothill riparian. Edges of denser habitats are sometimes used.

Reptiles. Western Pond Turtle (*Clemmys marmorata*), a federal Category 2 species, proposed for listing as threatened or endangered, and a California species of concern, is an aquatic turtle, found in permanent ponds, rivers, streams, and irrigation ditches that typically have rocky or muddy bottoms and are overgrown with vegetation. Basking areas are required by this species and include partially submerged logs, rocks, mats of vegetation or open mud banks. Eggs are laid in April -August. Habitat destruction and degradation are the primary threats to this species.

Amphibians. Red-legged frog (*Rana aurora*), a federal Category 1 species proposed for Federal listing as endangered or threatened, is usually found near permanent sources of water, inhabiting ponds and streams with emergent vegetation, such as cattails, and shoreline cover.

Foothill yellow-legged frog (*Rana boylei*) is a federal Category 2 species proposed for Federal listing as endangered or threatened, and is a California species of concern. It occurs in rocky stream habitat, usually in woodland, chaparral or forest with little to no pooling or bank vegetation cover.

Sacramento perch (*Archoplites interruptus*), a federal Category 2 candidate for listing as threatened or endangered, occurs in sluggish waters with beds of rooted and emergent aquatic plants, feeding on small crustaceans and small fish (Moyle; 1976). This species breeds in areas of rocks and algae approximately 20 - 50 cm deep. Spawning occurs from the end of March to the beginning of August, with peaks in May and June. Water temperatures are between 21 and 29 degrees Celcius. The fry congregate in shallow waters and aquatic plants.

State Listed Species

Fully Protected Mammals. Ringtail cat (*Bassariscus astutus*), a California fully protected species, is found throughout California, except in the Central Valley and northeast mountains (CDFG 1986). This species occurs in various riparian, forest and chaparral habitats, usually not more than 0.6 miles from water. The primary habitat requirements for this species seem to be den sites among boulders or in hollows of trees, with rodents and small mammals in abundance. Urbanization and riparian degradation are the main factors in the extirpation of this species.

Fully Protected Birds. Black-shouldered kite (*Elanus caeruleus*), a California fully protected species, is a resident of California, but shifts about locally per season in accordance with food supplies. Prior to 1895, this species was common to widespread in valley and lower foothill

areas, but is now rare in many sections of the state (Grinnell 1944). This species forages in wetlands and open brushlands, usually near water and streams. Oak woodlands, valley oak or live oak, or trees along marsh edges are used for nesting sites. A combination of habitats is essential, including open grasslands, meadows or marshes for foraging and isolated dense topped trees for perching and nesting. The destruction of wetlands is the primary threat to this species.

Bird Species of Concern. Cooper's hawk (*Accipiter cooperii*), a California species of concern, is a hunter of small birds, hunting on the edges of forests, in broken forest, and grassland habitats where passerines forage for seeds and insects. This species nests in heavily forested areas near a water source. Some research sites on nesting Cooper's hawks rarely show the nests more than a quarter of a mile away from water, whether it is a cattle tank, stream or seep (Snyder, 1975). Typical trees used by Cooper's hawks are cottonwoods, coast live oaks and black oaks (Call 1978). This species also nests in second growth conifer stands or deciduous riparian areas.

Sharp-shinned hawk (*Accipiter striatus*) is listed as a California species of concern whose breeding population may face extinction in the near future. Although the breeding populations are declining in California there are other populations country-wide that do not warrant a federal listing. This species, like other raptors and birds in general, falls under California Code 3503 and 3503.5, which prohibits the taking or destroying of nest or eggs of any bird and prohibits the taking or destroying of any bird or nest in the order of Falconiformes (falcons, kites, and hawks) and Strigiformes (owls). This species migrates down to lower elevations from September to April when breeding in the northern part of the state (Grinnell 1944). Sharp-shinned hawks are hunters of small birds, using forested areas and forest edges along grassland areas for hunting. In the higher elevations this species prefers to nest in large conifer trees. If nesting in a canyon or valley, a preference of nesting sites 50-100 yards upslope from the valley floor has been observed (Call 1978). North facing slopes, with perches available for plucking their prey, is another critical habitat requirement for sharp-shinned hawks (Polite 1982). Along the coastal ranges sharp-shins nest in coastal scrub and riparian areas.

Fish Species of Special Concern. Clear lake hitch (*Lavinia exilicauda chi*), a California species of concern, occurs in sluggish waters in slow moving rivers, ponds or reservoirs. Inhabiting sandy bottomed pools with moderate growth of aquatic vegetation, this species feeds on planktonic crustaceans and flying insects (Moyle 1976). Spawning takes place in March through July in fine to medium size gravel bottoms at water temperatures of 14 to 18 degrees Celcius.

Once the fry have hatched in the tributaries to Clear Lake, they quickly move to the littoral areas of the lake to avoid the drying up of the tributary (Moyle 1976).

4.5.2 THE EFFLUENT PIPELINE PROJECT COMPONENT

4.5.2.1 CLEAR LAKE MAKE-UP WATER PIPELINE

The make-up water pipeline is proposed to go from the southwest corner of the SERWTP reservoir approximately 1500 feet across irrigated pasture and then through 200 feet of annual grassland to Pond Lane at M1.7. The pipeline crosses under Pond and follows Robin Lane, at M3 it makes a right-angle turn to the west and continues through agricultural land for 250 feet; at M3.3 the pipeline crosses an annual grassland with several large valley oak trees and passes through a blue oak woodland from M3.7 to M4.1. The pipeline next crosses the bottom of a large annual grassland with a small stream or swale crossing it at about M4.2. The moist meadow community of this swale includes meadow foam and button celery, two species also found in vernal pools and the grassland contains many native species. At M5.0 the pipeline makes a 90 degree turn to the south and follows Smith Lane for approximately 1300 feet until another right-angle turn to the west. Part way down Smith Lane which is flanked by houses and walnut orchards, at M5.8, the road and pipeline crosses a culverted stream course or small swale that supports a rich diversity of moist meadow species including some goldfields (*Lasthenia* sp.). At M6.3 the pipeline corridor proceeds west along the alignment of Reid Road, going between rows of a walnut orchard until M7.0 where the pipeline enters annual grassland which it will continue in for 500 feet until entering the Reid Roadbed. From this point (M7.6) until reaching Clear Lake the pipeline is in streets of the City of Clear Lake. At M9 Reid joins Burns Valley Road which the pipeline follows until M10.2 when it continues west on Arrowhead Road, Huntington, Manatee Avenue and finally Lakeshore.

The preferred intake site would be on a vacant lot at 13409 Lakeshore Drive. The lot supports only annual grassland, two large red willow trees and a dozen or so small willows.

Clear Lake supports a number of fish species (Table 4.5.2-1). Two of these fish species, Sacramento Perch and Hitch, are special status species.

TABLE 4.5.2-1: CLEAR LAKE FISH SPECIES LIST

<u>Common Name</u>	<u>Scientific Name</u>
Pacific lamprey ^a	<i>Lampetra tridentata</i>
Rainbow trout ^a	<i>Oncorhynchus mykiss</i>
Goldfish	<i>Carassius auratus</i>
Common carp	<i>Cyprinus carpio</i>
Thicktail chub ^a	<i>Gila crassicauda</i>
Clear Lake Hitch ^{a,b}	<i>Lavinia exilicauda</i>
Golden shiner	<i>Notemigonus crysoleucas</i>
Sacramento blackfish ^a	<i>Orthodon microlepidotus</i>
Clear Lake splittail ^a	<i>Pogonichthys ciscoideus</i>
Sacramento squawfish ^a	<i>Ptychocheilus grandis</i>
Sacramento sucker ^a	<i>Catostomus occidentalis</i>
White catfish	<i>Ictalurus catus</i>
Brown bullhead	<i>Ictalurus nebulosus</i>
Channel catfish	<i>Ictalurus punctatus</i>
Mosquitofish	<i>Gambusia affinis</i>
Inland silverside	<i>Menidia beryllina</i>
Threespine stickleback ^a	<i>Gasterosteus aculeatus</i>
Sacramento perch ^{a,b,c}	<i>Archoplites interruptus</i>
Green sunfish	<i>Lepomis cyanellus</i>
Bluegill	<i>Lepomis macrochirus</i>
Redear sunfish	<i>Lepomis microlophus</i>
Largemouth bass	<i>Micropterus salmoides</i>
White crappie	<i>Pomoxis annularis</i>
Black crappie	<i>Pomoxis nigromaculatus</i>
Tule perch ^a	<i>Hysterocarpus traski</i>
Prickly sculpin ^a	<i>Cottus asper</i>

^a Native species.

^b State listed species of concern.

^c Federal Category 2 Candidate for listing.

SOURCE: Week (DFG), 1982

4.5.2.2 SECONDARY PIPELINES TO WELLS

NCPA proposes to inject effluent through lines that are within or follow existing pipeline routes to the following wells: A-1, C-11, F-1, J-6, Q-2, and Y-5 (see Table 4.5.2-2). These pipelines are already disturbed corridors that have been subjected to varying amounts of revegetation and natural colonization of the local plant community. Along the Q-2 route, at least 50 individual plants of a jewelflower species (cf. *Streptanthus brachiatus* ssp. *hoffmanii*) were observed in the disturbed corridor at the edge of the road and under the existing pipelines. It is unknown whether these plants are part of an earlier mitigation planting. The two new injection wells would be conversions of existing steam wells and the pipes would follow already disturbed corridors.

The Geysers Effluent Pipeline continues on the NCPA road to the leasehold boundary and then continues on the Calpine road where Calpine proposes to supply four existing and three new injection wells. The four new secondary lines proposed to supply these are as follows: a line in or adjacent to the existing road down to Barrows 1; a line from Barrows 1 to CA 958-5 down an existing pipe corridor; a line from CA-958-5 to McKinley 3 following the existing road; and a line from the main Calpine road to CA 956-2 following an existing road. These roads and existing lines run through closed-cone pine-cypress, montane hardwood-conifer, montane hardwood, and mixed chaparral natural communities.

No special status species of plants were observed along the NCPA road between the C and H Pads. Very few native species persist under the existing pipeline. From the H Pad, the pipe would follow an existing jeep road that traverses approximately one-half mile (2363 feet) of montane hardwood-conifer and closed-cone Pine habitats. The jeep road and pipeline would pass through woodlands composed of approximately 80 percent closed-cone pine habitat with 50- to 60-foot-tall knobcone pines (dbh 8 to 10 inches) on the exposed south and west facing slopes and 20 percent montane hardwood-conifer with a mixture of Douglas fir, madrone, black oak, canyon oak and California bay in the narrow canyon in which an intermittent creek flows. The creek is an unnamed tributary of Big Sulphur Creek. The understory species of the closed-cone pine habitat are Stanford's, hoary, and big manzanita with wavy-leaf ceanothus and leather oak. These species also comprise the vegetation cover in openings or clearings in the pine overstory. The understory of the montane hardwood-conifer habitat is California coffeeberry and toyon with native grasses including California fescue, and creeping wild-rye grass. Sword fern and California polypody ferns occur in the moist, shaded areas. The proposed location of the

TABLE 4.5.2-2: HABITAT TYPES AND POTENTIAL SPECIAL STATUS SPECIES
OCCURRENCE ALONG SOUTHEAST GEYSERS PIPELINE PROJECT

Station (1,000 foot Section)	Habitat	Location	Potential Species
Project			
1 to 5	Urban/ Agricultural (50%) and Bare	SERWTP to Highway 53	
8 to 25	Annual Grassland (11%), Blue Oak Woodland (20%), Urban/Agricultural (1%) and Bare	Highway 53 to Cache Creek	
25 to 25.3	Valley and Foothill Riparian	Cache Creek	
25.6 to 33	Annual Grassland, Blue Oak-Foothill Pine and Valley Oak Woodland (13% each), Blue Oak Woodland and Valley and Foothill Riparian (3% each), Urban/Agri. (26%) and Bare (28%)	Lower Lake	
33 to 40	Blue Oak Woodland, Valley Oak Woodland, and Annual Grassland (20% each), Valley and Foothill Riparian (9%), Blue Oak-Foothill Pine (7%), and Bare (24%)	Morgan Valley to Clayton Creek Road mainly off established roads	Cooper's hawk Sharp-shinned hawk
40 to 46	Annual Grassland (33%), Urban/Agriculture (15%), Valley and Foothill Riparian and Valley Oak Woodland (5% and 6%) and the rest Bare	Clayton Creek Road to Highway 29	Cooper's hawk Sharp-shinned hawk Horned lark
46 to 54	Annual Grassland (13%), Valley Oak Woodland (3%), Blue Oak Woodland (5%), Urban/Agricultural (30%) and the remainder Bare	Highway 29	Horned lark
54 to 58	Annual Grassland (48%), Valley Oak and Blue Oak Woodlands (15% each), Valley and Foothill Riparian (10%) and Blue Oak-Foothill Pine Woodland (7%)	Copsey Creek in El Roble Grande Ranch, off established road	Western pond turtle Red-legged frog Yellow-legged frog Horned lark Cooper's hawk Sharp-shinned hawk
58 to 60	Blue Oak-Foothill Pine Woodland (25%), Annual Grassland (30%), Valley and Foothill Riparian (15%) and Bare (30%)	Copsey Creek in Canyon pipe in dirt road	Red-legged frog Yellow-legged frog Cooper's hawk Sharp-shinned hawk

(Continued)

TABLE 4.5.2-2: HABITAT TYPES AND POTENTIAL SPECIAL STATUS SPECIES OCCURRENCE ALONG SOUTHEAST GEYSERS PIPELINE PROJECT (Continued)

Station (1,000 foot Section)	Habitat	Location	Potential Species
Project			
60 to 63	Blue Oak-Foothill Pine Woodland (33%), Annual Grassland and Montane Hardwood-Conifer (10% each) and Mixed Chaparral (6%)	Lower Sweet Springs Creek in dirt road	Red-legged frog Yellow-legged frog Loggerhead shrike
63 to 66	Annual Grassland (50%), Mixed Chaparral (35%), Valley and Foothill Riparian (6%) and Blue Oak-Foothill Pine Woodland (9%)	Upper Sweet Springs Canyon on grassland	Red-legged frog Yellow-legged frog Loggerhead shrike Brewer's milk vetch
66 to 69	Mixed Chaparral (36%), Annual Grassland (20%), Blue Oak-Foothill Pine (33%) and Serpentine Barrens and Seeps (11%)	Childers Peak	Horned lark Cooper's hawk Sharp-shinned hawk Loggerhead shrike unknown jewelflower Serpentine Collomia Bare monkeyflower Two-carpellate dwarf flax
69 to 73	Blue Oak-Foothill Pine Woodland (40%), Mixed Chaparral (30%) and Annual Grassland (30%)	Oak Woodland, pipe follows old dirt road	Loggerhead shrike Horned lark Cleveland's milk vetch
72.5	Blue Oak-Foothill Pine Woodland (50%), Valley Oak Woodland (20%) Valley and Foothill Riparian (10%) and Annual Grassland (20%)	Unnamed Creek (Trib. to Putah Creek)	Four-petaled pussypaws
73 to 76	Mixed Chaparral (60%), Serpentine Barrens and Seeps (10%), Blue Oak-Foothill Pine Woodland (6%) and Bare (24%)	Chaparral, pipe follows old dirt road	Loggerhead shrike Horned lark Two-carpellate dwarf flax Serpentine reed grass Mimulus nudatus Serpentine Collomia Jepson's navaretia
76.5	Valley and Foothill Riparian and Valley Oak Woodlands (20% each), Blue Oak-Foothill Pine Woodland (10%) and 50% Bare (water and rocks)	Big Canyon Creek, pipeline in roadbed	Cooper's hawk Sharp-shinned hawk
77 to 86	Annual Grassland (29%), Valley Oak and Blue Oak-Foothill Pine Woodlands (20% each), Valley and Foothill Riparian (5%) and Bare (25%)	Big Canyon Road near Big Canyon and Putah Creeks, pipeline in roadbed	Cooper's hawk Sharp-shinned hawk

(Continued)

TABLE 4.5.2-2: HABITAT TYPES AND POTENTIAL SPECIAL STATUS SPECIES
OCCURRENCE ALONG SOUTHEAST GEYSERS PIPELINE PROJECT
(Continued)

Station (1,000 foot Section)	Habitat	Location	Potential Species
Project			
86 to 95	Annual Grassland (40%), Blue Oak Woodland (14%), Blue Oak-Foothill Pine Woodlands and Serpentine Barrens (2.5 % each)	Big Canyon Road to Harbin Creek, pipeline in roadbed	Cooper's hawk Sharp-shinned hawk Lake County dwarf flax Jepson's navaretia Jepson's milk vetch Swamp larkspur
95 to 99	Annual Grassland and Valley Oak Woodland (25% each), Blue Oak-Foothill Pine Woodland (15%), Valley and Foothill Riparian (10%) and Mixed Chaparral (5%)	Harbin Creek to Harbin Springs Road, pipeline in road except across field	Cooper's hawk Sharp-shinned hawk
99 to 102	Mixed Chaparral (40%), Annual Grassland 30%, Blue Oak-Foothill Pine (7.5%), Wet Meadow (5%), Blue Oak-Foothill Pine (8%), and Serpentine Barrens (2.5%)	Unnamed Ridge from northern toe to above Putah Creek	Two-carpellate dwarf flax Serpentine sunflower Serpentine collomia Serpentine reed grass Douglas' few-flowered pogogyne Jepson's navaretia Purdy's fritillary
102 to 102.8	Valley Oak Woodland (50%) and Valley and Foothill Riparian Woodland (20%) and Bare (30)	Putah Creek and north bank	Cooper's hawk Sharp-shinned hawk
102.9 to 110	Irrigated Pasture (44%), Valley Oak Woodland and Bare (12% each), Valley and Foothill Riparian Woodland and Blue Oak-Foothill Pine Woodland (5% each)	Putah Creek to Calpine Road through MWTP	Cooper's hawk Sharp-shinned hawk
110 to 121	Montane Hardwood-Conifer Woodlands (65%), Mixed Chaparral and Montane Hardwood Woodland (10 %)	Calpine Road, entirely in roadway, with several exceptions	
121 to 124	Montane Hardwood-Conifer Woodlands (57%), Montane Hardwood (37%), Mixed Chaparral (10%) and Valley and Foothill Riparian (5%)	Bear Canyon Connector Road, off road	Red-legged frog Yellow-legged frog Napa Lomatium
124 to 140	Closed Cone-Pine Woodland (33%), Bare (45%), Mixed Chaparral (9%), Serpentine Barrens (8%) and Montane Hardwood-Conifer (6%)	NCPA Road, pipeline in roadway	Morrison's and Socrates Mine jewelflowers Snow Mountain buckwheat Geyser's panicum

(Continued)

TABLE 4.5.2-2: HABITAT TYPES AND POTENTIAL SPECIAL STATUS SPECIES OCCURRENCE ALONG SOUTHEAST GEYSERS PIPELINE PROJECT (Continued)

Station (1,000 foot Section)	Habitat	Location	Potential Species
Project Alternatives			
23.5 TO 24.8 (A)	Mixed Chaparral (90%) and Bare (10%)	Pipeline goes down-slope from end of Boyles through brush instead of down driveway	
23.5 to 24.8 (B)	Mixed Chaparral (40%) and Bare (60%)	Pipeline turns east at end of Boyles and goes down-slope along a fire road	

SOURCE: ESA 1993 and BioSystems 1992.

3-point turnaround is the location of a large ponderosa pine (dbh 38 inches) and several black oaks. The stream was flowing in April 1994, and it supported moss and algae species. The unnamed stream measured 8 feet from bank top to bank top; the wetted area was 5 feet wide and 3 inches in depth. Approximately 700 feet from the point at which the pipeline connects to the Unocal existing pipeline is a wildlife guzzler.

4.5.2.3 POWER SUPPLY TO BEAR CANYON PUMP STATIONS

The four pump stations will be supplied with power via a 21kv power supply line that will be routed by PG&E from the switch yard servicing PG&E's Unit 16 by road to near Bear Creek. From Bear Creek to Bear Canyon Power Station the line will be on poles under the high voltage lines. The poles will be trucked in on access roads and placed and the wire will be pulled by helicopter across the mosaic of montane hardwood and montane hardwood-conifer woodlands with small patches of mixed chaparral on exposed, west facing slopes.

4.5.3 THE GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT

Injection operations would not disturb biological resources.

4.5.4 SERWTP FACILITIES PLAN COMPONENT

The General project area includes a variety of habitats a variety of habitats including grassland, chaparral, riparian oak woodland/grassland, pasture and orchards. Aquatic habitats include streams, Clear Lake, and the wastewater storage reservoir. A list of wildlife species known to inhabit these types of habitats is presented in Table 4.5.4-1. Common names for wildlife species known to inhabit grassland (the predominant habitat in the project area) are pocket gopher, jackrabbit, coyote, American kestrel, meadowlark and gopher snake. The larger mammals are blacktail deer and domestic cattle.

The treatment plant site is highly modified and differs significantly from the surrounding oak-grassland habitat in that it is irrigated and used for pasture. The reservoir site serves as habitat to waterfowl and as a source of drinking water for various terrestrial wildlife species (Goddard & Goddard, 1991).

The pasture, or non-native grassland, in the vicinity of the SERWTP is regularly irrigated and has been sown with a mixture of pasture grasses that includes Alta fescue (*Festuca arundinaceae*), Harding grass (*Phalaris aquatica*), Akaroa orchard grass (*Dactylis glomerata*), Ariki perennial rye (*Lolium perenne*), Oregon annual rye (*Lolium* sp.), Salina strawberry clover (*Trifolium fragiferum*), and broadleaf trefoil (*Lotus* sp.) (Jones, 1993). These grasses were growing along with weedy herbaceous plants such as common mallow (*Malva neglecta*), field mustard (*Brassica* sp.), wild radish (*Raphanus sativus*), and cocklebur (*Xanthium strumarium* var. *canadense*). All of these species were growing around the base of 10 large valley oak trees that seemed to have adapted very well to the irrigation regime that they have been on for approximately 21 years. No dead branches or diseased trees were observed by ESA biologists in spring 1993.

4.5.5 PROJECT DESIGN ALTERNATIVES

Lake Diversion Pumps and Pipeline on Pier

The site is the same as that proposed for the intake pipe location. The lot supports only annual grassland, two large red willow trees and a dozen or so small willows. Freshwater emergent marsh plants grow in a narrow band (25 feet wide at most) in the offshore water. Fishes are the same as those listed in Table 4.5.2-1.

TABLE 4.5.4-1

WILDLIFE SPECIES IN THE PROJECT AREA

Scientific Name	Common Name
Grassland	
<u>Thomomys bottae</u>	Pocket gopher
<u>Lepus californicus</u>	Black-tailed jackrabbit
<u>Canis latrans</u>	Mountain coyote
<u>Falco sparverius</u>	Sparrow hawk
<u>Sturnella neglecta</u>	Western Meadowlark
<u>Pituophis catenifer</u>	Gopher snake
Chaparral	
<u>Odocoileus hemionus columbianus</u>	Black-tailed deer
<u>Sylvilagus bechmani</u>	Brush rabbit
<u>Neotoma fuscipes</u>	Dusky-footed wood rat
<u>Urocyon cinereocargenteus</u>	Grey fox
<u>Aphelocoma coerulescens</u>	Scrub jay
<u>Toxostoma redivivum</u>	California thrasher
<u>Lophortyx californicus</u>	California quail
<u>Gerrhonotus multicarinatus</u>	Alligator lizard
Riparian	
<u>Procyon lotor</u>	Raccoon
<u>Mephitis mephitis</u>	Striped skunk
<u>Icteria virens</u>	Yellow-breasted chat
<u>Aix sponsa</u>	Wood duck
<u>Thamnophis couchi</u>	Garter snake
<u>Anas platyrhynchos</u>	
<u>Anas crecca</u>	
Mallard	
Green-winged teal	
Oak-Grassland	
<u>Melanerpes formicivorus</u>	California woodpecker
<u>Buteo jamaicensis</u>	Red-tailed hawk
<u>Citellus beecheyi</u>	California ground squirrel
<u>Crotalus viridis</u>	Western rattlesnake

SOURCE: Lindstrom (1991) as reproduced by Goddard & Goddard Engineering

Bear Canyon Single Pump Station

This site is partly a parking lot that shows evidence of having originally been a grassland and/or valley oak woodland at the edge of a montane hardwood woodland. The remaining native trees are valley oak and ponderosa pine with English walnut (*Juglans regia*), black walnut (*J. nigra or hindsiana*), and Italian cypress (*Cupressus* sp.)

One-Way Surge Tank in The Geysers

There are no plant communities on the proposed surge tank site. The pad has been cleared of vegetation.

By-pass Pipeline at the SERWTP

See Section 4.5.4.

Alternate Route A-1 and A-2

The slope from the end of Boyles to Dam Road (21 to 24) faces south and is covered with a dense stand of mixed chaparral. Alternative A-1 is estimated to be 90 percent chaparral and 10 percent bare soil and Alternative A-2 is estimated to be evenly divided. Several pines are located adjacent to the cleared trail or fire-break. The pipeline is projected to be completely within the narrow fire-road of A-2.

Alternate Route B

Between Clayton Creek Road and Highway 29 (41 to 46) the vegetation is 35 percent annual grassland, 12 percent valley oak woodland, 6 percent blue oak woodland, 5 percent valley and foothill riparian and about 15 percent urban/agriculture and the remainder bare or paved. The alternate route proposes to cross the valley oak /foothill and valley riparian community along the Creek.

Alternate Route C

Alternate Route C passes along the Highway 29 right-of-way avoiding a row of large cultivated trees on the east side of the highway. The route is entirely non-native grassland.

Alternate Route D

In the serpentine grassland and chaparral of the Alternate Route D, Biosystems reported finding the two carpellate dwarf flax, a C2 candidate species that is List 1B: the following "List 4" plants were also reported: Jepson's navaretia, serpentine reedgrass, and serpentine collomia. Only the reedgrass was evident at the time of ESA's survey.

Alternate Route E

Harbin Springs Road is bordered with valley oak trees and an annual grassland and valley oak woodland. The alternative route takes the Geysers Effluent Pipeline in the roadway and avoids the grassland and woodland completely.

Alternate Route F

Alternate Route F would be in a narrow corridor that goes directly up a ridge covered with mixed chaparral and montane hardwood woodland. At the lower end of the route, BioSystems staff found a CNPS List 4 species, Napa lomatium.

Alternate Route G

Alternate Route G, crosses a pad that is cleared of vegetation, then takes an old road through a stand of McNab cypress and white-leaved and Eastwood manzanita.

Alternate Site for Childers Peak Regulating Tank

At the summit of the road in the general location of the Childer's Peak Regulating Tank was a serpentine barren and areas of moisture from seeps or drainage features. In the moist areas plants of serpentine seeps were observed such as bare monkeyflower, serpentine collomia, sickle-leaved onion, and thread-leaved miner's lettuce. The alternative site also had serpentine barrens and a drainage with scarlet fritillary and thread-leaved miner's lettuce together with serpentine mixed chaparral and blue oak-foothill pine community.

4.6 AIR QUALITY

4.6.1 OVERVIEW OF GENERAL CONDITIONS

The primary factors that determine air quality are the locations of air pollutant sources and the amounts of pollutants emitted. Atmospheric conditions such as wind speed, wind direction, and air temperature gradients interact with the physical features of the landscape to determine the movement and dispersal of air pollutants.

4.6.1.1 CLIMATE AND METEOROLOGY

The project is located primarily within Lake County Air Basin, which lies entirely within the Coast Range mountains. The meteorological conditions in Lake County Air Basin are dominated by the semi-stationary Pacific high pressure system which is almost always present off the west coast of North America. This broad region of descending air is normally warm, dry and stable. In winter, the Pacific high pressure system shifts southward, allowing a series of frontal systems to sweep across the area bringing rain for two to five days followed by one to two weeks of dry weather. Annual rainfall totals about 30 inches in Clear Lake basin while more than double that amount occurs at the mountain ridges in The Geysers.

While the regional weather patterns have significant effects on the Lake County Air Basin wind, there are long periods when regional systems are weak and locally-generated, mountain-lake, wind systems predominate. Local wind patterns are determined by terrain characteristics, such as steep mountains and valleys that channel wind. Anderson Springs, a sheltered location, experiences calm conditions (about 75 percent of the time), while more open locations, such as Middletown, experience calm conditions less frequently (about 18 percent of the time) (Lake County, 1989). The predominant regional northwest winds tend to flush out air pollutants from Lake County Air Basin. When local winds dominate, air pollutants tend to become entrained within the lake-mountain-valley circulations resulting in reduced air quality (Lake County, 1989).

The project also extends into northern Sonoma County which lies within the North Coast Air Basin. Some of the same regional influences that affect the Lake County Air Basin also affect meteorological conditions in the North Coast Air Basin. In the Geysers portion of the North Coast Air Basin, the mountains of the Mayacmas Range affect both surface-wind direction and speed. Up-valley (during the day) and down-valley (during the night) wind drainage patterns are

typical in this area. Wind speeds typically increase with elevation; average annual wind speeds measured in the project vicinity (in Sonoma County) are approximately 12 miles per hour (California Air Resources Board, 1984).

4.6.1.2 AIR QUALITY PLANS, POLICIES, AND REGULATIONS

Regulation of air quality is achieved through both federal and state ambient air quality standards and emissions limits for individual sources of air pollutants. The federal Clean Air Act required the U.S. Environmental Protection Agency (EPA) to identify National Ambient Air Quality Standards (NAAQS) to protect public health and welfare. NAAQS have been established for the six "criteria" air pollutants: ozone (O₃), carbon monoxide (CO), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), suspended particulate matter (PM₁₀), and lead (Pb). California has adopted its own, more stringent ambient air quality standards for these same pollutants and has adopted ambient air quality standards for some pollutants, like hydrogen sulfide (H₂S), for which there are no corresponding federal standards.

In addition to the "criteria" pollutants, state and federal law also addresses emissions of air toxics. Air toxics are air pollutants that are believed to have carcinogenic or adverse non-carcinogenic effects but that do not have a corresponding ambient air quality standard. The federal Clean Air Act Amendments of 1990 identify specific compounds as toxic and direct EPA to determine what control technology should be applied to particular toxics and particular industries. This technology is referred to Maximum Achievable Control Technology (MACT), and the requirements will be implemented through the permit process contained in Title V of the Act. State law, the Air Toxics "Hot Spots" Information and Assessment Act of 1987, Assembly Bill 2588 (AB 2588), provides for the regulation of over 200 air toxics. Under AB 2588, specified facilities must submit to the local air pollution control agency a comprehensive emissions inventory of these regulated substances.

Lake County's *General Plan* recognizes good air quality as one of Lake County's most valuable resources and also recognizes the potential for degraded air quality in the Basin given that the topography of Lake County Air Basin makes dispersion of pollutants difficult under inversion conditions (Lake County, 1981). To protect and preserve Lake County's air quality, the *General Plan* calls for the County to encourage the use of the best available air pollution control technologies to maintain healthful air quality and high visibility standards.

Sonoma County's *General Plan* also recognizes the importance of maintaining the good air quality that exists in the County (Sonoma County, 1989). Sonoma County identifies geothermal power plants in the Geysers as the largest stationary air pollutant source in the County and encourages adoption of standards, development of new technology, and retrofitting to reduce the air pollution resulting from geothermal development (Sonoma County, 1989).

Air quality regulation in California is the responsibility of the EPA, California Air Resources Board (ARB), and the local/regional air districts. The ARB regulates mobile emissions sources and oversees the activities of local and regional air districts. The ARB regulates local air quality indirectly by having established state ambient air quality standards and vehicle emission standards, by conducting research activities, and through planning and coordinating activities.

The local air district in Lake County is the Lake County Air Quality Management District (LCAQMD). LCAQMD has the principal responsibility for regulating stationary sources of air pollutants in Lake County. The LCAQMD exercises permit authority over most types of stationary emission sources. LCAQMD requires that Best Available Control Technology (BACT) be applied to new or modified stationary source if (without BACT) emissions from that source would exceed 20 lb/hour or 150 lb/day of any criteria pollutant (except CO for which BACT is triggered at 150 lb/hour or 1,500 lb/day and Pb for which BACT is triggered at 27 lb/day) (LCAQMD, 1992). Any changes to the operating conditions at The Geysers power plants would be evaluated against the LCAQMD's general permit requirements, including BACT.

LCAQMD would probably issue a permit for the proposed pipeline or modify existing permits for the SERWTP and affected steam fields under their authority to control stationary sources with the potential for toxic or odorous emissions (Reynolds, 1993). The effluent injection component of the project would be covered under the existing air quality permits for the steamfield and power plant operators, which means that the existing emissions limits on the steamfield operators would not be modified with the project.

Pipeline construction projects can involve specific activities that fall under the purview of various LCAQMD *Rules and Regulations*. For example, LCAQMD has the authority to remedy public nuisances that involve excessive emissions of any kind. In addition, all construction projects located on a serpentine outcrop or alluvial material from an outcrop which contains greater than one percent asbestos must submit an asbestos-dust-hazard mitigation plan to

LCAQMD for approval (LCAQMD, 1992). Also, burning of collected brush during clearing of a right-of-way is only allowed during certain hours on certain days when meteorological conditions are favorable for dispersing the pollutants.

The local air district in northern Sonoma County is the Northern Sonoma County Air Pollution Control District (NSCAPCD). (The southern half of Sonoma County lies within the jurisdiction of the Bay Area Air Quality Management District.) NSCAPCD regulates geothermal development in the Geysers through its permit authority over stationary sources. Like LCAQMD, NSCAPCD reviews an application for a new or modified stationary source to determine whether BACT would be required and what control measures constitute BACT. NSCAPCD does not normally exercise permit authority over pipeline construction projects, unless they would result in substantial emissions once built (such as from associated compressors, pumps, or fugitive sources) (Laird, 1994). NSCAPCD does not have specific requirements regarding construction activity in areas with serpentine rock or serpentine-rich alluvial material (Laird, 1994). However, the NSCAPCD does have a general rule (Regulation 1, Rule 430) that addresses fugitive dust emissions from construction activities (Connolly, 1994).

4.6.1.3 EXISTING AIR QUALITY

Lake County is designated "attainment" for all state and federal ambient air quality standards and for state visibility standards (California Air Resources Board, 1993a). Lake County is alone among California counties with this designation. The good air quality of the County is documented in Table 4.6.1-1 which shows the last five years' of monitoring data taken in Lakeport, on the west side of Clear Lake. Pollutant concentrations are likely to be similar on the east side of the Lake. In Table 4.6.1-1, air pollutant concentrations are compared with the applicable state ambient air quality standards, which are more stringent than the corresponding national standards.

The Sonoma County portion of the North Coast Air Basin is "attainment" or "unclassified" for all state and federal ambient air quality standards except for the state standards for PM₁₀ for which it has been designated "nonattainment" (California Air Resources Board, 1993a). General air quality conditions for northern Sonoma County are shown in Table 4.6.1-2. The two station sites listed in Table 4.6.1-2 are approximately 10 to 15 miles from the project site.

TABLE 4.6.1-1: LAKE COUNTY AIR POLLUTANT SUMMARY, 1988-1992

<u>Pollutant</u>	<u>Std./c/</u>	<u>Monitoring Data by Year/a/</u>				
		<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>
<u>Ozone (O₃)</u>						
Highest 1-hr. average, ppm/b/	0.09	0.07	0.06	0.09	0.08	0.08
Number of violations		0	0	0	0	0
<u>Carbon Monoxide (CO)</u>						
Highest 1-hr. average, ppm	20.0	NA	3.0	6.0	7.0	NA
Number of violations			0	0	0	
Highest 8-hr. average, ppm	9.0	NA	2.2	2.6	3.1	NA
Number of violations			0	0	0	
<u>Particulate Matter (PM₁₀)</u>						
Highest 24-hr. average ug/m ³ /b/	50	28	29	30	31	22
Number of violations		0	0	0	0	0
Annual geometric mean, ug/m ³	30	11	12	10	11	11

/a/ All data are from the Lakeport monitoring station.

/b/ ppm = parts per million; ug/m³ = micrograms per cubic meter.

/c/ State standard, not to be exceeded.

NA = Not Available.

SOURCE: California Air Resources Board, *Air Quality Data Summary*, 1988, 1989, 1990, 1991, 1992.

4.6.1.4 SENSITIVE RECEPTORS

Some land uses are considered more sensitive to air pollution than others, due to the types of population groups or activities involved. Sensitive population groups include the young, the elderly and the ill, especially those with cardio-respiratory diseases. Land uses such as schools, hospitals, and convalescent homes are considered to be relatively more sensitive to poor air quality because the young, the old, and the infirm are more susceptible to respiratory infections and other air-quality-related health problems than the general public. Residential areas are also considered to be sensitive to air pollution because residents (including children and the elderly)

TABLE 4.6.1-2: NORTHERN SONOMA COUNTY AIR POLLUTANT SUMMARY,
1988-1992

Pollutant	Std./c/	Monitoring Data by Year/a/				
		1988	1989	1990	1991	1992
<u>Ozone (O₃) - Healdsburg</u>						
Highest 1-hr. average, ppm/b/	0.09	NA	NA	NA	NA	0.09
Number of violations						0
<u>Particulate Matter (PM₁₀) - Healdsburg</u>						
Highest 24-hr. average ug/m ³ /b/	50	<u>62</u>	NA	<u>57</u>	<u>72</u>	42
Number of violations/d/		3		2	3	0
Annual geometric mean, ug/m ³	30	21.9	NA	16.9	19.1	16.9
<u>Particulate Matter (PM₁₀) - Cloverdale</u>						
Highest 24-hr. average ug/m ³ /b/	50	<u>86</u>	<u>71</u>	<u>266</u>	<u>78</u>	<u>58</u>
Number of violations/d/		8	3	5	10	1
Annual geometric mean, ug/m ³	30	23.3	24.6	19.3	22.2	17.8

/a/ O₃ data is from Healdsburg while PM₁₀ is from both Healdsburg and Cloverdale as shown. Underlined values represent violations of the applicable standard.

/b/ ppm = parts per million; ug/m³ = micrograms per cubic meter.

/c/ State standard, not to be exceeded.

/d/ Typically measured once every six days.

NA = Not Available.

SOURCE: California Air Resources Board, *Air Quality Data Summary*, 1988, 1989, 1990, 1991, 1992.

tend to be at home for extended periods of time, resulting in sustained exposure to any pollutants present. Agricultural crops, especially broad-leaved produce crops and cultivated flowers, are also sensitive to air pollutants such as O₃, NO_x, and SO₂.

4.6.2 THE GEYSERS EFFLUENT PIPELINE PROJECT COMPONENT

4.6.2.1 EXISTING AIR QUALITY

Most of the pipeline routes (the water diversion and the effluent pipelines) passes through portions of the Air Basin that are largely unaffected by emissions from geothermal operations in The Geysers. In these areas, worst-case pollutant concentrations are similar to those shown in Table 4.6.1-1. Pollutant concentrations are low and general air quality is very good. The major sources of CO and O₃ precursor emissions, hydrocarbons (HC) and nitrogen oxides (NO_x), in Lake County are on- and off-road vehicles (California Air Resources Board, 1993b). On- and off-road vehicles account for 60% of total CO, 66% of County-wide HC, and 73% of NO_x.

Entrained dust from vehicle travel on paved and unpaved roads accounts for 70% of County-wide PM₁₀.

4.6.2.2 SENSITIVE RECEPTORS

Much of the lake water-diversion pipeline route between Clear Lake and SERWTP would pass through residential areas. From SERWTP to The Geysers, the Geysers Effluent Pipeline would pass through residential areas north of Morgan Valley Road (SM33). Lower Lake Elementary and High Schools are located along the effluent pipeline route at SM29. Most of the remainder of the route, from Morgan Valley Road to Bear Canyon Road (SM110), passes through undeveloped areas where residences are widely scattered.

4.6.3 THE GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT

4.6.3.1 EXISTING AIR QUALITY

Geothermal air pollutants are generally emitted from steam wells, steam transmission lines and steam stacking, and non-condensable gas treatment facilities at power plants. Well bleeds and well maintenance steam releases are currently the largest steam field emissions sources. Power plant emissions are generally confined to the cooling towers which strip air pollutants from the circulating water and also vent non-condensable gas. Geothermal air pollutants of concern consist mainly of hydrogen sulfide, ammonia, arsenic, boron, mercury, radon-222, silicon, sulfur dioxide, sulfates and particulate matter (Lake County, 1989). The steam field and power plant operators run their facilities under permits issued by the LCAQMD. These permits specify certain conditions that must be met including emissions limits for certain pollutants.

The Geysers Air Quality Monitoring Program (GAMP) was established in 1983 to monitor air quality and meteorological data in order to track power plant emissions in the area. The program currently operates three monitoring stations, within Lake County, that monitor H₂S, PM₁₀, metals, radon and meteorological parameters (Kauper, 1993). H₂S data from the GAMP station closest to the project area is shown in Table 4.6.3-1. These data show that H₂S concentrations in Anderson Springs do not exceed the state ambient air quality standard for H₂S. All the GAMP stations are located on the west (Lake County) side of the Mayacmas main ridgeline in The Southeast Geysers (Connolly, 1994).

TABLE 4.6.3-1: H₂S CONCENTRATIONS IN ANDERSON SPRINGS, 1988-1992

<u>Hydrogen Sulfide</u>	<u>Standard/a/</u>	<u>Monitoring Data by Year</u>				
		<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>
Highest 1-hr. average	0.03 ppm	0.01	0.01	0.01	0.01	0.01
Number of violations		0	0	0	0	0

/a/ State H₂S standard, not to be equaled or exceeded.

SOURCE: California Air Resources Board, *Air Quality Data Summary*, 1988, 1989, 1990, 1991, 1992.

4.6.3.2 SENSITIVE RECEPTORS

The closest residences to the proposed injection area are the McKinley Ranch located in the Calpine leasehold and the Anderson Springs area, about one-half mile from the closest injection wells. The threshold of odor for H₂S is considerably below the state ambient air quality standard, and thus, while the state standard has not been exceeded in Anderson Springs in the past five years, occasional odor complaints have been filed with LCAQMD by those living in the Anderson Creek and Bear Canyon Creek drainages.

On the Sonoma County side of the Geysers, there are no residences within several miles of the proposed effluent pipeline segment that would be within the Unocal leasehold. Odor complaints related to geothermal operations are relatively rare (Laird, 1994).

4.6.4 SERWTP FACILITIES PLAN COMPONENT

Air quality conditions in the vicinity of SERWTP are similar to those for the rest of Lake County except for odorous emissions in the immediate vicinity of certain process elements at the plant. SERWTP operates under permit conditions set by LCAQMD. Sensitive receptors include the residential dwellings widely scattered south of the plant.

4.6.5 PROJECT DESIGN ALTERNATIVE

Same as Affected Environment described in Sections 4.6.1, 4.6.2, and 4.6.3.

4.7 NOISE

4.7.1 OVERVIEW OF GENERAL CONDITIONS

4.7.1.1 INTRODUCTION TO ENVIRONMENTAL NOISE DESCRIPTORS

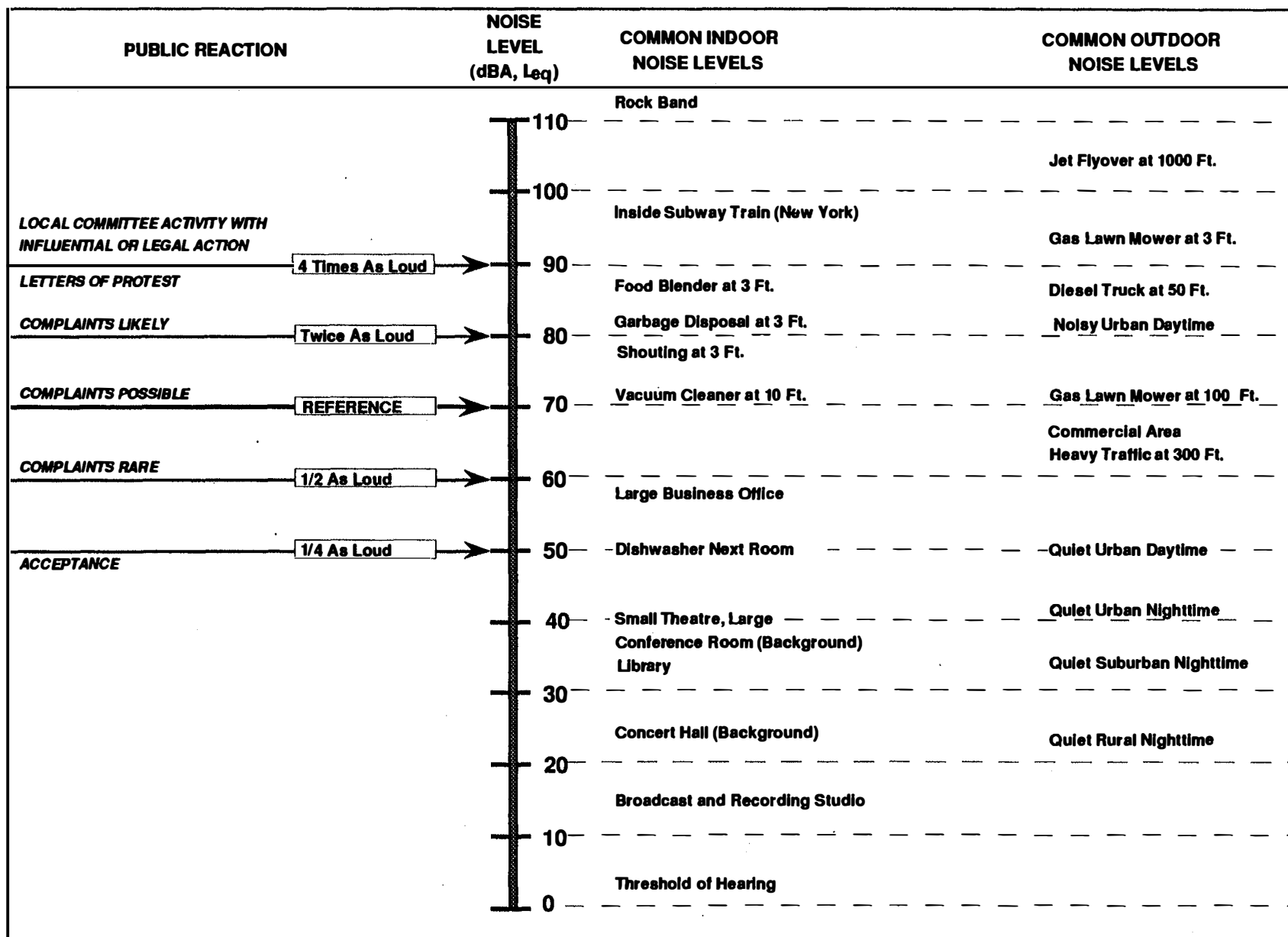
Sound waves travel outward from a source and exert a sound pressure (commonly called "sound level") measured in decibels. A decibel (dB) is a logarithmic unit of sound energy intensity. Environmental noise is usually measured in A-weighted decibels (dBA). A dBA is a decibel corrected for the variation in frequency response of the human ear at commonly encountered noise levels. Some representative noise sources, their associated noise levels, and corresponding effects are shown in Figure 4.7.1-A. In general, people can perceive a three-dBA difference in noise level; a difference of 10 dBA is perceived as a doubling of loudness.

Environmental noise levels typically fluctuate over time, and different types of noise descriptors are used to account for this variability. L_{eq} is the equivalent steady-state sound level which, in a stated period, would contain the same acoustic energy as the actual time-varying sound level during the same period. L_{dn} , the day-night average noise level, is based on human reaction to cumulative noise exposure over 24 hours. To calculate the L_{dn} , noise between 10:00 p.m. and 7:00 a.m. is weighted by adding 10 dBA to take into account the greater annoyance of nighttime noise.

4.7.1.2 REGULATORY BACKGROUND

Noise is regulated on the local level through implementation of *General Plan* policies and Noise Ordinances. Lake County *General Plan* identifies 55 dBA, L_{dn} , as the maximum noise level normally acceptable for residential areas (Lake County, 1981). However, Lake County now recognizes that a 55 dBA, L_{dn} standard is largely insufficient to ensure noise/land use compatibility given the very low background noise levels over much of the County. The performance standard commonly applied to new geothermal projects in Lake County is 50 dBA, L_{dn} at the nearest sensitive receptor (Lake County Air Quality Management District, 1991). In recognition of the particularly annoying qualities of noise with a pure tone, Lake County implements the 50 dBA, L_{dn} standard with the added provision that tonal noise is to be removed to the greatest degree possible.

Noise standards in the Lake County Zoning Ordinance set specific noise standards by octave-band frequency ranges (Lake County Air Quality Management District, 1991). For heavy



SOURCE: Caltrans Transportation Laboratory Noise Manual, 1982; and
Modification by Environmental Science Associates, Inc.

Figure 4.7.1-A
Effects of Noise on People

industrial activities, these octave-band standards correspond to a fence-line standard of approximately 70 dBA, Lake County Noise Ordinance standards do not apply to temporary construction work. Lake County Air Quality Management District (LCAQMD) serves as the technical and enforcement arm of the Lake County Planning Department for noise control.

The Sonoma County *Noise Element* contains noise level performance standards for new development (Sonoma County, 1989). These standards were developed to be more stringent as the duration of the noise event increases and as the noise extends into more sensitive nighttime hours. Geothermal power plants are identified by Sonoma County as significant noise sources, and the County has established a noise limit of 65 dBA at the boundaries of leaseholds (Sonoma County, 1989).

4.7.1.3 EXISTING NOISE ENVIRONMENT

Background noise levels in portions of Lake County are as low as can be found in any outdoor setting (Lake County, 1981). The *General Plan* recognizes that a quiet environment is a valuable characteristic of Lake County but also acknowledges that such an environment is highly susceptible to noise intrusion. Daytime levels of between 20 and 30 dBA in the hills are common (Lake County, 1981). Noise levels are higher in the towns largely due to motor vehicle use. Some of the higher steady-state noise levels in the County occur along Highway 29. Geothermal development in the southern portion of the County includes a wide variety of intrusive noise sources, some relatively constant and others intermittent.

Background noise levels in the Mayacmas Range portion of northern Sonoma County are also very low, except in the vicinity of geothermal development and activities.

4.7.1.4 SENSITIVE RECEPTORS

Some land uses are considered more sensitive to ambient noise levels than others, due to the amount of noise exposure (in terms of both time and insulation from noise) and the types of activities typically involved. Residences, motels and hotels, schools, libraries, churches, hospitals, nursing homes, auditoriums, parks and outdoor recreation areas are generally more sensitive to noise than are commercial and industrial land uses. For this project, sensitive receptors include residences and schools along the proposed pipeline routes and in the vicinity of the southern portion of Geysers KGRA.

4.7.2 THE EFFLUENT PIPELINE PROJECT COMPONENT

4.7.2.1 EXISTING NOISE SOURCES AND LEVELS

The ambient noise environment in the vicinity of Clear Lake is relatively quiet. The largest source of noise is motor vehicle traffic. Daytime noise levels in undeveloped areas away from roadways is less than 40 dBA. In developed areas, daytime noise levels are 40 to 60 dBA depending upon the distance to the nearest roadway, the characteristics of that roadway (traffic volume, speed, and truck percentage), and the shielding effects of terrain and vegetation. Daytime noise levels at Lower Lake High School are about 53 dBA, Leq daytime (Lake County, 1981).

4.7.2.2 SENSITIVE RECEPTORS

Much of the water-diversion pipeline route between Clear Lake and SERWTP passes through residential areas, although the residences in the vicinity of SERWTP are widely scattered. The effluent pipeline route passes through residential areas north of Morgan Valley Road (SM33). Lower Lake Elementary and High Schools are located along the effluent pipeline route at SM29. Most of the remainder of the route, from Morgan Valley Road to Bear Canyon Road (SM110), passes through undeveloped areas where few residences are located.

4.7.3 THE GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT

4.7.3.1 EXISTING NOISE SOURCES AND LEVELS

In the Geysers KGRA, the noise environment is affected by geothermal resource operations. Some of the noise sources associated with geothermal operations are relatively steady (e.g. cooling towers) while others are intermittent but very intrusive (e.g. blowdowns). Table 4.7.3-1 shows noise levels related to geothermal development processes. LCAQMD and the geothermal resource developers have worked together to develop noise abatement technology and procedures for the geothermal industry with the result that, while residential complaints still occur, complaints are much less frequent than in the mid-1980's (Lake County Air Quality Management District, 1991).

The major sources of noise at the power plants are cooling towers, turbine generators, steam jet ejectors, and pumping gear. The movement of steam through the steam lines and venting of

TABLE 4.7.3-1: NOISE LEVELS FROM GEOTHERMAL RESOURCE DEVELOPMENT OPERATIONS

<u>Plant Operation</u>	<u>Duration</u>	<u>Noise Level (dBA)</u>	<u>Distance (feet)</u>
Steam line vent (muffled)	Intermittent	90	100
Jet gas ejector	Continuous		
unattenuated		117	5-10
with acoustical insulation		84	5-10
Steam line separator	Continuous	80	25
Steam line breaks	Brief, infrequent	100	50
Cooling tower	Continuous	80-90	5-10
Turbine-generator building	Continuous	70	outside

SOURCE: U.S. Environmental Protection Agency, *Western Energy Resources and the Environment: Geothermal Energy*, 1977.

steam lines also generates considerable noise. Noise associated with bleed line discharges is about 85 dBA but can be lowered to about 65 dBA by venting the line into a rock-filled concrete structure (muffler). Occasionally, wells are allowed to vent at full pressure for several hours to prevent the buildup of condensate. Because this operation is not usually muffled, noise levels of about 118 dBA can be produced. Well blowouts, generally caused by equipment strength being insufficient to withstand the steam pressure, can also cause noise levels of this magnitude.

4.7.3.2 SENSITIVE RECEPTORS

Several residents are located in the Calpine injection area. Anderson Springs, the nearest community area, is located about one-half mile from the closest proposed injection wells.

On the west side of the Mayacmas ridgeline, there are no residences within several miles of the proposed secondary distribution pipeline segments within the Unocal leasehold.

4.7.4 SERWTP FACILITIES PLAN COMPONENT

The major source of noise within the project area is the traffic on State Highway 53. The Lake County General Plan Figure IV-17 shows that the 55 Ldn level is 400 ft from the edge of the highway. The Highway 53 noise would be heard as 46.2 Ldn at the SERWTP site and as 50 Ldn at the closest neighbors.

The major sources of noise at the SERWTP are the trucks carrying septage and chemicals which come to the site and the aerators and other equipment used on-site to treat the wastewater and sludge. Noise levels at the site have not been measured but they are estimated to be 85 dBA during trucking periods and to average 60 dBA Leq. No noise complaints have been documented concerning the operations of the SERWTP.

4.7.5 PROJECT DESIGN ALTERNATIVE

The affected noise environment is the same as that described in Sections 4.7.1, 4.7.2, and 4.7.3.

4.8 CULTURAL RESOURCES

4.8.1 OVERVIEW OF GENERAL CONDITIONS

Information in this section is derived from cultural resources investigations carried out by the Cultural Resources Facility, Anthropological Studies Center of Sonoma State University, Rohnert Park, California. This section provides a summary of findings by the Cultural Resources Facility. Because of the sensitivity of the resources, details about their specific nature and locations are not provided here. Consultation with the State Historic Preservation Officer has not yet been undertaken. This is a required consultation that will occur prior to approval of the project by the LACOSAN Board of Directors and the BLM.

4.8.1.1 ARCHAEOLOGICAL RESOURCES

Archaeological resources in Lake County, and in the project area, are extensive in occurrence and general richness. As early as 10,000 to 12,000 years ago, people occupied the area to take advantage of the abundant animal and plant resources. They exploited the local obsidian (volcanic glass) for tool material. Because of its unique cleavage, obsidian was highly valued for making sharp projectile points. The native peoples used obsidian as an important commodity for exchange with other aboriginal groups in California.

The archaeological record is contained in material culture, burials, occupation sites and other evidence of past human activity that reveal the long period of human occupation in the region. Archaeological resources are found at depths up to several meters in the soil profile in some areas. Local sites excavated and dated using radiocarbon dates, obsidian hydration (weathering) readings and artifact assemblages, reveal some of the earliest temporal sequences in northern California pre-history. They also reveal a wide diversity of peoples and cultural manifestations within the region, that is, multiple cultural sequences are recognized. The relationships of the cultures that lived in the region were diverse and cannot be simply ordered by an earliest to latest sequence of occupation. Additionally, the same cultural sequence cannot be overlain without reservation on every nearby area.

One model used to categorize the progression of cultures is that proposed by Frederickson. The model, simply listed here divides the pre-historic occupation of the Clear Lake region as follows:

Paleoindian Period (10,000 to 6,000 B.C.); culture with a focus on hunting and fishing; use of wide-stem obsidian points.

Lower Archaic Period (6,000 to 3,000 B.C.) and Middle Archaic Period (3,000 to 500 B.C.); culture with a focus on hunting, fishing, collecting and processing of hard seeds; complex culture history.

Upper Archaic Period (500 B.C. to A.D. 500); hunting and fishing culture with acorn collection and processing; use of bedrock mortars, chert and obsidian wide-stem points; evidence of influence of other cultures in the Sacramento Valley and San Francisco Bay Region.

Emergent Period (500 B.C. to A.D. 1,800); hunting and fishing culture with acorn collection and process; use of bone tools, beads and ornaments, flexed burials with artificials, leaf-shaped and pentagonal points, rock alignments and petroglyphs.

The Geysers region also is divided into five archaeological cultures including: (1) Post Pattern; (2) Bald Mountain Aspect; (3) Mendocino Pattern; (4) Houx Aspect; and (5) Clear Lake Aspect.

The archaeologic record in the Clear Lake and the Geysers region is represented by a great variety of evidence. The typical evidence includes obsidian chert projectile points and chips, burials, bone tools, beads and ornaments, bedrock mortars and milling equipment, midden, housepits, stone alignments, petroglyphs, fire-affected rock, faunal remains and other indicators of human use. The evidence is used to identify occupation sites of various sizes, probable importance and frequency of use. There are abundant locations of possible large occupation sites as well as many sites of encampments, stone-working and milling.

4.8.1.2 ETHNOGRAPHY

Native American populations present at the time when European peoples entered the area included three linguistically unrelated ethnographic groups. The Southeastern Pomo held lands including the eastern Clear Lake margin to Cache Creek. The Lake Miwok lived in the area between Cache Creek south the Wappo boundary east of Dry Creek and south of Cobb Mountain. The Wappo occupied the southern part of the area including The Southeast Geysers. These were the latest of the ethnographic groups that came after thousands of years of continuous use and shifting cultural configurations. Several Native American villages in the project area continued to be occupied into the 19th and early 20th centuries.

4.8.1.3 HISTORIC RESOURCES

Until the 1840s, the region remained fairly isolated from all but a few Spanish and American explorers. Spanish intrusion in the area occurred prior to 1816. American trappers entered the

area in 1832. In 1842, Salvador Vallejo led soldiers in an attack on the lake Indians. During the next several years, three tracts of land in the Clear Lake region were granted to Mexican citizens. By the mid-1840s, settlers began to come into the region; cabins and houses appeared as early as 1848. In 1853, W.L. Anderson settled his family and was among the first to raise cattle in the valley near the current MWTP site. Anderson moved to the Lower Lake area by 1856. Settlement increased to include a number of communities in the 1860s, in the Lower Lake and Burns Valley areas, and the Middletown area. Agriculture became firmly established in the 1860s through 1880s. Resorts throughout the Geysers and Lake regions were well established by the 1860s. Mining was initiated in the mid-1800s. This included mercury which was mined for use in amalgam processing of gold and silver. Until the 1900s, mercury mining was Lake County's primary mineral output.

4.8.2 THE GEYSERS EFFLUENT PIPELINE PROJECT COMPONENT

There are 29 identified prehistoric sites along the proposed project pipeline alignments and facilities sites. Of these, 23 are prehistoric sites, five have both pre-historic and historic components and one has displaced materials. With one exception, the sites contain obsidian flaking debris, eight had midden, two had possible housepits, one has human remains and 12 have other evidences, such as midden and faunal remains. The sites vary in size and complexity. As surveys of this EIR/EIS consisted solely of "walk-over" Phase 1 reconnaissance, the true extent, significance and complexity of the sites are largely unknown. The site identification process also uncovered a number of isolates in the project corridor and facility sites. Table 4.8.1-1 presents a list of the identified pre-historic sites.

Ethnographic Sites

There are eight ethnographic village location within or near the Geysers Effluent Pipeline and Lake Diversion Pipeline. These include two Southeastern Pomo village sites, five Lake Miwok village sites and one Wappo village site.

Historic Sites

There are 14 historic settlement sites within the survey corridor that includes the Geysers Effluent Pipeline and related facilities sites and their immediate vicinity, as well as the southeast Geysers injection pipelines routes.. Two of these were historic village sites of Native Americans. The others include ranches, residences, and historic structure sites. There are

TABLE 4.8.1-1: TABLE OF PREHISTORIC AND HISTORIC ARCHAEOLOGIC SITES

CA-LAK-671:	obsidian flakes, midden-like
CA-LAK-753:	obsidian flakes and scrapes, chipping station
CA-LAK-659/H:	obsidian source and workshop; historic foundation remains and refuse
CA-LAK-871/H:	obsidian workshop; historic cistern and refuse
CA-LAK-510:	obsidian tools and flakes, human burials, midden; recently excavated
CA-LAK-72/H:	flaked form tools, midden, house pit; historic features
CA-LAK-509:	flaked formed tools, obsidian and basalt flakes, fire affected rock, midden
CA-LAK-881:	obsidian tool and flakes, midden, bedrock mortars
CA-LAK-984:	obsidian and basalt flakes, midden
CA-LAK-544:	obsidian flakes
CA-LAK-269:	varied materials and round alignments
CA-LAK-261:	points, obsidian tool fragments and flakes, fire affected rock, midden human remains
CA-LAK-262:	flaked formed tool
CA-LAK-601:	obsidian tools and flakes, chert tools and flakes
CA-LAK-598:	obsidian and basalt flakes, rock features
CA-LAK-597:	obsidian flakes, rock feature
CA-LAK-593:	obsidian and chert flakes
CA-LAK-592:	obsidian and flaked formed tools
CA-LAK-1487/H:	obsidian flakes, midden; historic debris
CA-LAK-191:	midden, possible house pits, fire affected rock, groundstone, obsidian flakes
CA-LAK-1414:	lithic scatter
CA-LAK-1413:	flaked formed tool, flaking debris, groundstone scatter
CA-LAK-428:	house pits
CA-LAK-616:	obsidian flakes
CA-LAK-1785/H:	historic mortared rockwall, bricks, refuse concrete cistern
CA-LAK-1786/H:	obsidian flakes, biface fragment; historic foundation remnants and refuse
CA-LAK-1787:	obsidian flakes, possibly displaced materials
CA-LAK-1788/H:	obsidian flakes and core, biface; historic refuse
CA-LAK-1789:	obsidian and chert flakes, faunal remains
CA-LAK-1792:	lithic scatter, possible rock ring, midden-like material
CA-LAK-1793H:	historic foundation remains, bricks, old road
CA-LAK-1970H:	historic foundation, pipes, refuse, well cover
CA-LAK-1791H:	historic residence, refuse

SOURCE: Cultural Resource Facility, Anthropological Studies Center, Sonoma State University, 1993.

13 sites of historic industry and transportation within this same survey area. These include a quarry, five mines, a sawmill site, flour mill site, winery site, springs (including hot springs) and three historic roads.

No historic or prehistoric cultural remains were found within the Unocal project area.

4.8.3 GEYSERS EFFLUENT INJECTION PROGRAM COMPONENT

Cultural resources for this component are included in those identified in Section 4.8.2.

4.8.4 SERWTP FACILITIES PLAN COMPONENT

Lake County has a significant native American heritage and cultural artifacts of significance which are found at selected sites throughout the County, particularly in the sheltered valleys where there is water and along the shoreline of Clear Lake. Twelve identified Indian groups inhabited the area at the time of the first White contact including the Pomo, Miwok, Wappo and Patwin. Spanish ranchers lived on land grants in the area in the period beginning in 1844. Settlers began inhabiting the area in the mid-1800s, but settlement was sparse until the recreational aspects of Clear Lake became attractive and transportation was improved.

An extensive archaeological records search and field survey of the SERWTP site was completed prior to its construction. A major excavation was conducted after finding a significant Native American camp site, the resources present were thoroughly documented (Peak and Associates, 1978) and mitigations were implemented.

The ethnographic literature, archaeological base maps, site records and prior survey reports on file at the Northwest Information Center of the California Archaeological Inventory (housed at Sonoma State University) were reviewed to determine whether recorded archaeological or ethnographic sites were situated within the project area. No ethnographic sites were recorded within or immediately adjacent to the project area.

The record search also showed nine archaeological surveys that had been conducted within the project boundaries or immediately adjacent to them, including S-431, S-487, S-4984, S-5838, S-6829, S-6867, S-6899, S-8729 and S-8829 (full citation given in the Cultural Resources references).

The Native American Heritage Commission was contacted for review of its Sacred Lands File.

4.8.5 PROJECT DESIGN ALTERNATIVES

Cultural resources for this component are included in those identified in Section 4.8.2.

Lake Diversion Pumps and Pipeline on Pier

The cultural resources are the same as those of the proposed site.

Bear Canyon Single Pump Station

The site has no cultural resources of note.

One-Way Surge Tank in The Geysers

The site has no cultural resources of note.

Bypass Pipeline at the SERWTP

The cultural resources are the same as those reported for the SERWTP.

Alternate Route A-1 and A-2

Cultural resources are similar to those of the proposed route.

Alternate Route B

Cultural resources are similar to those of the proposed route.

Alternate Route C

The site has no cultural resources of note.

Alternate Route D

The site has no cultural resources of note.

Alternate Route E

Cultural resources are similar to those of the proposed route.

Alternate Route F

The site has no cultural resources of note.

Alternate Distribution Pipeline G

The site has no cultural resources of note.

Alternate Site for Childers Peak Regulating Tank

Cultural resources are similar to those of the proposed route.

4.9 VISUAL/AESTHETIC RESOURCES

4.9.1 OVERVIEW OF GENERAL CONDITIONS

The great variety of topography, water bodies, forested and agricultural landscapes and other physical and cultural features combine to provide Lake County in general, and most of the project area specifically, with visual amenities and aesthetic characteristics that are exceptional in California. The visual/aesthetic qualities contribute significantly to the County's attraction as a tourist and recreation area. Natural scenic beauty is identified in the General Plan as one of the primary factors attracting residents and visitors to the area. As a result, both local and state agencies have policies directed to ensuring the development will be compatible with visual/aesthetic resource qualities.

While similar visual amenities likewise are present in Sonoma County, the project area is located in a seldom seen portion of the county. There is no public access to the project area.

4.9.1.1 SCENIC HIGHWAYS

Both Caltrans and Lake County have identified transportation corridors that merit designation as scenic highways. Within the project study area this includes Highway 29, Highway 53, Big Canyon Road and Highway 175. While these corridors are identified as eligible for formal designation as "scenic highways" by Caltrans, the County Board of Supervisors has not formally requested the studies and plans by Caltrans to obtain the official designation. Nonetheless, the County recognizes the scenic quality of the routes, through objectives and policies in the General Plan and has established a "Scenic Corridor Combining District." This overlay designation provides regulations for permitted uses, property development standards, alteration of natural land contours, utility siting standards and other requirements.

4.9.1.2 SCENIC AREAS

The project area includes one area within the County that is part of a special designation partly related to aesthetic and visual quality. The area along the lakeshore in Clear Lake is identified as subject to the Clear Lake Conservation and Development Policy. The policies in the General Plan (Section V, pp. V-58 - 62) include a range of objectives and policies to maintain and enhance aesthetic and natural characteristic of the lakeshore, ensure access for recreation, and promote improvements which, in combination, will provide sustained enjoyment the lakeshore's amenities.

4.9.1.3 OTHER SCENIC/AESTHETIC RESOURCE POLICIES

The City of Clearlake General Plan identifies specific objectives to "improve the appearance of the community by encouraging good design, landscaping and maintenance of property" and to "protect the community's archaeological, historic and architectural resources." No specific designations accompany these policies, with the exception that Highway 53 is designated as a City Scenic Corridor. However, there are no specific policies related to Highway 53's visual qualities. City policy also promotes preservation of native trees, groves and orchards, where possible. The City also requires that new development comply with design standards for size and type of trees and shrubs to be used in landscaping.

The Southeast Geysers is included in BLM Visual Resource Management (VRM) policies. Under the VRM, the Geysers is considered to be an area of Class III Objective, which means that the landscape is managed to partially retain the existing character of the landscape. The designation reflects the substantial alteration of the natural landscape that has resulted from geothermal development as well as the lack of public access to most of the steamfield, and therefore limited view opportunity.

The Sonoma County General Plan identifies objectives to provide "important visual relief from urban densities" and to "retain the largely open, scenic character of important scenic landscape units." There are no specific policies related to the Geysers area or the Mayacmas Mountains.

There are no designated or candidate Wild and Scenic Rivers in the project area under either federal or state programs for such designation and protection.

4.9.2 THE GEYSERS EFFLUENT PIPELINE PROJECT COMPONENT

4.9.2.1 VIEWSHEDS

As a broad method of characterization, the project area is composed of six viewsheds including (1) Clearlake-Lower Lake, (2) Excelsior Valley, (3) Sweet Springs Valley-Childers Peak, (4) Big Canyon-Lower Harbin Creek Valley, (5) Collayomi Valley, (6) Mayacmas Mountains of the Southeast Geysers. These viewsheds each have common visual characteristics which define their visual/aesthetic character. The visual characteristics include similar physiography, similar visual landscape (patterns, textures, color variety), relative degree of man-made modification, relative amount of use, and general opportunity for close-in versus distant views. These are briefly summarized below.

Clearlake-Lower Lake Viewshed

The viewshed includes all of the route of the Lake Diversion pipeline and the Geysers Effluent Pipeline from Station 0 to 35. The viewshed is dominated by man-made modifications of the landscape including buildings, streets, lighting, signage, orchards and non-native landscaping. The topography is hilly and there are abundant long-distance views of Clear Lake, Mt. Konocti and surrounding hills. The area is well populated. There are numerous residents with close-in views of the project route and proposed facilities sites.

Excelsior Valley

The viewshed extends from approximately Station 35 to 58. The predominant characteristics are rural including agricultural alteration of the landscape in orchards and pastures. Scattered residences and four buildings are located along a small number of roads. Highway 29 provides the primary view opportunity in the viewshed including close-in views of the route in some areas. The topography is hilly to flat. The hills are wooded; the flatlands are dominated by orchards and pastures. As Highway 29 is the primary north-south travel corridor in this region, it obtains high levels of use by both residents and visitors. The proposed pipeline route leaves the highway and the viewshed at station 58, where the highway makes a large bend in the mountains.

Sweet Springs Valley-Childers Peak

The viewshed extends between stations 58 and 77. The predominant characteristics are wooded mountains retaining a natural character. There are no residences with views of the route. The route is seldom seen, as the area is entirely private lands with few roads. Steep hillsides with forests of oak and pine dominate the landscape. As the route follows the valley floor there are few distant views from the route. Most of the route, including the Childers Peak Regulating Tank site, is not visible from any public roads.

Big Canyon-Lower Harbin Creek Valley

The viewshed between stations 77 and 101.5. The viewshed has a predominantly rural character with few residences. The landscape is dominated by close-in views of open pasture land interspersed with woodlands. Big Canyon Creek and Harbin Creek are the features of dominant visual interest. The background views are of mountains and woodlands. Big Canyon Road and

Harbin Springs Road are the primary routes of travel by residents and visitors. The proposed route is located mostly in the road or in the shoulder.

Collayomi Valley

The viewshed extends between stations 101.5 and 110. The landscape is rural and dominated by open pasture land and fields with scattered large oak trees. The background views are of low wooded hills to the north and steep, forested mountains to the south. Background distant views of the Southeast Geysers are also part of the viewshed. There are no residences with close-in views of the route. Highway 175 provides the only route of travel for residents and visitors. There is high use of the highway and abundant view opportunities are present for both close-in and distant of the proposed route.

Mayacmas Mountains and the Southeast Geysers

The viewshed extends between station 110 and the terminus and includes the area of the secondary distribution lines. The predominant visual characteristics include rugged mountains with dense forest cover. Between stations 110 and 126, the heavy forest cover provides few view opportunities of the route from observation points on Highway 175 or residential areas in Anderson Springs. The visual landscape in The Geysers is dominated by the power plants, steam collection lines, roads, cut and fill slopes and other features of human altered landscape. The vegetation includes shrubs and scattered trees. The entire viewshed is either private land or areas with controlled access. Therefore, few close-in view opportunities are available to the public.

The injection area is located on both sides of the main ridge of the Mayacmas Mountains. The eastern side (predominantly Lake County) affords some views of the project area. There are private residences in the viewshed, some with close-in views of proposed project facilities. Most view opportunities for the public (residents and visitors) are afforded from Highway 175. These are distant views of the project area. The western side (Sonoma County) is seldom seen, as public access is limited. The mountainous topography and lack of through roads preclude all but distant views of the project site.

Table 4.9.2-1 provides a breakout by station post of the visual characteristics of the proposed pipeline route and related facilities sites. Both viewer use and viewing distance are qualitative in application. High viewer use refers to areas which are viewed frequently either by residents near the site or travellers on public roads with substantial traffic. Low viewer use refers to areas

TABLE 4.9.2-1: VISUAL CHARACTERISTICS OF THE GEYSERS EFFLUENT PIPELINE
PROJECT COMPONENT ALIGNMENT AND FACILITIES SITES

Station	Physiography	Man-Made Modifications	Viewer Use	Viewing Distance	Special Considerations
Lake Diversion					
M0.0 - 1.5	gentle slopes grasslands	SERWTP facilities and sprayfields	seldom seen	mostly middleground	--
M1.5 - 3.5	flat	orchards, scattered residences	low	close-in	--
M3.5 - 5.0	flat meadows and scattered oaks	minor	low	close-in	--
M5.0 - 6.5	flat	orchards, scattered residences	low	close-in	--
M6.5 - 7.5	flat	orchards	seldom seen	background	--
M7.5 - 9.0	flat, gentle slopes	orchards and pastures	low	close-in	alignment in road
M9.0 - 15	flat, gentle slopes	urban residential	high	close-in	alignment in roads
Pump Station	lakeshore	urban residential	high	close-in	private land visible from Lakeshore Drive
SERWTP Pump Stations	gentle slopes	SERWTP facilities	seldom seen	close-in	--
0 - 1.5	gentle slopes grasslands	SERWTP facilities and sprayfields	seldom seen	mostly distant	--
1.5 - 7.0	flat, gentle slopes	urban residential and orchards	moderate	close-in	alignment in roads
7.0 - 8.0	steep, oak woodlands	road and scattered residences, water tank	low	close-in	alignment in road
8.0 - 8.5	gentle hills	road and scattered residences	high	close-in	Highway 53 is designated Scenic Corridor in Clearlake
8.5 - 22	hills	urban development	high	close-in	alignment in roads
22 - 24.5	hills, chaparral brush and scattered oak/ pines	scattered residences	low	close-in	--

(Continued)

TABLE 4.9.2-1: VISUAL CHARACTERISTICS OF THE GEYSERS EFFLUENT PIPELINE
PROJECT COMPONENT ALIGNMENT AND FACILITIES SITES (Continued)

Station	Physiography	Man-Made Modifications	Viewer Use	Viewing Distance	Special Considerations
24.5 - 32.3	gentle slopes and hills, Seigler Creek	scattered residences, urban development (Lower Lake)	high	close-in	alignment in roads
32.3 - 34.0	hills, open fields	urban development (Lower Lake)	high	close-in	alignment in Morgan Valley Road
34.0 - 39	hills, woodlands pasture lands	one residence	seldom seen	close-in	partly aligned in roads
39 - 41.5	flat to hilly pasture land	scattered and residences and commercial at Spruce Grove Road	moderate	close-in	alignment in road
41.5 - 43.2	flat, open fields	Highway 29	high	close-in	Highway 29 is County Scenic Corridor Combining District
43.2 - 45.0	hills, wooded	scattered residences	low	close-in	alignment in road
45.0 - 54.5	hills, wooded	Highway 29	high	close-in	Highway 29 is County Scenic Corridor Combining District
54.5 - 57.2	hills and flatlands	Ranch (El Roble Grande Ranch)	high	middleground view from Highway 29; close-in seldom seen	--
57.2 - 58.0	hills, watercourse	Highway 29	high	close-in	Highway 29 is County Scenic Corridor Combining District
58.0 - 77.0	mountainous, wooded valleys and watercourses	dirt roads no residences	seldom seen	close-in	--
77.0 - 86.5	mountains, heavily wooded, rivers (Big Canyon Creek and Putah Creek)	Big Canyon Road, some open fields, no residents	moderate	close-in	Big Canyon Road is County Scenic Corridor Combining District

(Continued)

TABLE 4.9.2-1: VISUAL CHARACTERISTICS OF THE GEYSERS EFFLUENT PIPELINE
PROJECT COMPONENT ALIGNMENT AND FACILITIES SITES (Continued)

Station	Physiography	Man-Made Modifications	Viewer Use	Viewing Distance	Special Considerations
86.5 - 94.0	gentle slopes open fields with scattered oaks	Big Canyon Road, pasture no residences	moderate	close-in	Big Canyon Road is County Scenic Corridor Combining District
94.0 - 97.0	hilly, heavily wooded, Harbin Creek	Big Canyon Road, no residences	moderate	close-in	Big Canyon Road is County Scenic Corridor Combining District
97.0 - 98.0	hilly, open pasture and oak woodland	pasture land no residences	moderate	middleground	views from Big Canyon and Harbin Springs Road
98.0 - 99.0	gently sloping to hilly	pasture land	moderate	middleground	views from Harbin Springs Road
99.0 - 101.5	hilly, grasslands and scattered oaks	grazing land	seldom seen	close-in	--
101.5 - 102.5	steep hills, chaparral	--	seldom seen close-in high-distant	background	distant view from Highway 175, a County Scenic Corridor Combining District
102.5 - 106.0	flat, grasslands and large oaks	some roads, MWTP	seldom seen	close-in	--
106.0 - 110.0	flat grasslands	MWTP sprayfields	high	close-in	views from Highway 175, a County Scenic Corridor Combining District
110.0 - 121.0	mountains, heavy forest cover	road (Bear Canyon Access Road)	seldom seen	close-in	alignment in road
121.0 - 122.0	mountains forest cover	none (site of new road)	seldom seen close-in high-distant	background only	views at distance from Highway 175, a County Scenic Corridor Combining District

(Continued)

TABLE 4.9.2-1: VISUAL CHARACTERISTICS OF THE GEYSERS EFFLUENT PIPELINE
PROJECT COMPONENT ALIGNMENT AND FACILITIES SITES (Continued)

Station	Physiography	Man-Made Modifications	Viewer Use	Viewing Distance	Special Considerations
122.0 - 124.0	mountains heavy forest cover	none (site of new road)	seldom seen	background only	--
124.0 - 131.0	mountains scattered trees	road	moderate	background only	distant views from Highway 175, a County Scenic Corridor Combining District
131.0 - 138.5	mountains, ridgeline, grasslands and scattered trees	geothermal power plants, steam collection lines, roads and other structures	moderate	background only	distant views from Highway 175, a County Scenic Corridor Combining District, and scattered residences
NCPA and Calpine injection area	mountains, ridgeline, grasslands and scattered trees	geothermal power plants, steam collection lines, roads and other structures	moderate	mostly background	distant views from Highway 175, a County Scenic Corridor Combining District, and scattered residences
Unocal injection area	mountains, ridgeline, grasslands and scattered trees	geothermal power plants, steam collection lines, roads and other structures	seldom seen	background only	distant views from Highway 175, a County Scenic Corridor Combining District, and scattered residences

SOURCE: Environmental Science Associates, 1993.

which are viewed only from scattered residences or from roads with low road traffic. Moderate viewer use represents a combination of residential viewpoints and/or roads with moderate vehicle traffic. Seldom seen refers to areas lacking public access and/or remote from residences and public roads. Viewing distance is a qualitative assessment related to the position of viewers in residences or travellers on public roads. Close-in views refers to viewer position within a few hundred yards of the alignment site. Middleground views refer to viewer position between a few hundred yards and up to about a mile, although topographic relief may affect visibility.

Background viewer distance refers to distances of about 1 to 5 miles, or for areas with high topographic relief even more distant.

4.9.3 GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT

The visual resources of this component are similar to those described in Section 4.9.2 for The Geysers for stations 122 to 138.5. Substantial alteration of the visual landscape has occurred related to the geothermal industry. There are several residences located in the Calpine leasehold that would have close-in views of some of the proposed injection lines. All other views for the public would be long-distance views of the area from the eastern side of the Mayacmas Mountains. The Unocal injection area is located in mountainous topography lacking public access. There are no close-in views for the public. All views would be at long distance, essentially background views or not visible to the public because of intervening topography.

4.9.4 SERWTP FACILITIES PLAN COMPONENT

The project area consists of unincorporated residential, commercial and undeveloped land adjacent to and east of Clear Lake and is largely composed of grassland and oak-grassland that has previously been used for grazing. The treatment plant site is situated in a valley that was once rolling oak-grassland terrain and now is grassland. The SERWTP site is noticeable from the distance in summer due to the large circular areas of green created by the sprinkler irrigation in an area that is otherwise dry grasslands and rolling hills. However, being relatively remote and set in a valley, it is barely visible when driving by on Highway 53 and from the surrounding residential areas.

Visual resources are similar to those of the proposed route at the lakeshore. The site is entirely open lake surface. It is visible from numerous dwellings along the lakeshore.

4.9.5 PROJECT DESIGN ALTERNATIVES

Lake Diversion Pumps and Pipeline on Pier

Visual resources are similar to those of the proposed facilities at the lakeshore. The site is entirely open lake surface. It is visible from numerous dwellings along the lakeshore.

Bear Canyon Single Pump Station

Visual resources are similar to those of the proposed route at Station 110. It is in the foreground views of travelers on SR175.

One Way Surge Tank in The Geysers

The site is located on an existing pad on the ridgeline. The site is visible in distant views from SR 175 as a small background feature.

SERWTP Bypass Pipeline

Visual resources are the same as those for the SERWTP.

Alternate Route A-1 and A-2

The route is similar to that of the proposed route at Station 22 - 24.5.

Alternate Route B

The route is similar to that of the proposed route at Station 34 to 39.

Alternate Route C

The route is similar to that of the proposed route at Station 45 to 54.5. Some large trees along the east side of the highway would be avoided by this alternate route.

Alternate Route D

The route is similar to that of the proposed route at Station 58 to 77. The route follows an existing dirt road cut into the steep, brush-covered hillside in this area. It is seldom seen.

Alternate Route E

The route is similar to that of the proposed route at Station 97 to 98. The route is along existing roads (Big Canyon Road and Harbin Springs Road) with close-in views. The site receives moderate use (road traffic) and is in the foreground views of travelers.

Alternate Route F

The route is located in mountains with heavy brush and forest cover. The route is visible in background views from southbound travelers on SR 175 and residents located on the south-facing slopes above Anderson Springs.

Alternate Distribution Pipeline G

The route is located in hilly terrain in a seldom seen area. The site is not visible from public roads.

Alternate Site for Childers Peak Regulating Tank

The site is similar to that of the proposed Childers Peak site. It is seldom seen.

4.10 LAND USE

4.10.1 OVERVIEW OF GENERAL CONDITIONS

Most of the project is located within Lake County. The injection area in the Geysers is located in both Lake and Sonoma counties.

The majority of Lake County's 857,330 acres remain undeveloped, the predominant land uses being agriculture, rangeland, forestry, wildland and watershed open space (Lake County, 1981). Wildland and watershed open spaces particularly dominate the Known Geothermal Resource Area. Agricultural crop and rangeland occur in valleys and on foothills, particularly Big Valley, and Collayomi and Excelsior-Little High Valleys. Commercial timberland is concentrated in the vicinity of Cobb Valley and south of Cobb Mountain (Lake County, 1989). Approximately half of the County's land is in public ownership. Federal lands account for 43.2 percent of the total acreage, or 370,367 acres. The County owns 2,760 acres. LACOSAN owns and operates two regional wastewater treatment plant sites. The SERWTP site includes approximately 485 acres. The Northwest Treatment Plant site includes approximately 1,450 acres. The County owns and operates the Eastlake Landfill. The proposed pipeline route would pass through the incorporated City of Clearlake and the community of Lower Lake.

The Lake County General Plan clearly supports activities that are beneficial to the geothermal industry and its associated secondary industries (Lake County, 1988). For example, Land Use Policy 4 of the General Plan as amended (Lake County, 1988, p. IV-27) states that it is the objective of the County, "To establish urban and rural areas suitable for the development of industrial activities, to provide guidelines for their development, and to protect lands with industrial potential."

The specific policies of this objective are as follows:

- 4.1 The county should actively promote the development of a sound and diversified economic base by continuing to promote agriculture, recreation services, and commerce, and by expanding its efforts to encourage industrial development including the development of geothermal service industries, and other resource related and 'clean' industrial applications.
- 4.2 Industrial and agricultural applications which could directly use geothermal resources as a heat source instead of fossil fuels should be encouraged if properly planned and compatible with surrounding land uses.

- 4.3 Industrial development activities should be encouraged to promote economic development, employment opportunities and provide a sound tax base.

Transportation Policy 7 of the General Plan as amended (Lake County, 1988, p. IV-51) states that it is the policy of the County, "To insure that the location, distribution, and size of transmission lines and pipelines are consistent with the land use development pattern and are sited to reduce environmental impacts." In particular, the following policy is relevant to the proposed project:

- 7.2 Extension of services, such as sewer, water, power lines, and roads should avoid traversing agricultural lands. Where such extensions must cross agricultural lands, they should be located in the public right-of-way or along lot lines whenever possible. If appropriate, these service lines must be consistent with the development intensity reflected on the Land Use Plan.

The project area includes parts of the three planning areas: City of Clearlake, Lower Lake and Middletown (see General Plan, Figure 8A, p. IV-39A). The unincorporated Clearlake Area includes 1,150 acres of Suburban Reserve adjacent to the city limits of the City of Clearlake. This designation allows a density of one dwelling unit per acre minimum and serves as a transitional designation between Suburban and Rural Residential areas (the latter allow 1-5 dwelling units per gross acre and 1 dwelling unit per 5-20 gross acres, respectively). The reserve areas promote a population of 576 persons. The intent of the suburban reserve designation is to discourage intensive development until the City of Clearlake is capable of providing services, which it currently cannot provide for wastewater because of the existing CVRWQCB Cease and Desist Order.

The Lower Lake Plan area contains the community of Lower Lake and a fairly large land area suitable for development. Lower Lake currently is restricted in growth by the moratorium that is part of the CVRWQCB Cease and Desist Order, as well as water supply. The remainder of the Lower Lake plan area has limited suitability for development because of limited water supplies, poor drainage, steep slopes and other limitations. The land use map promotes a population of 2,550 persons and about 700 acres are designated for Suburban Reserve. The Middletown Planning area contains the community of Middletown as the chief population center. The pipeline alignment in this plan area is located in Rural Lands and Agriculture designated areas.

A review of the City of Clearlake General Plan indicates that the proposed pipeline would not be in conflict with Plan policies and objectives.

There are 21 parcels under Williamson Act contract within the vicinity of the pipeline, but the proposed route does not traverse any of these properties. In accordance with the directive provided in Lake County's General Plan, the pipeline route has been situated within public rights-of-way to the maximum extent possible.

Part of the proposed injection area of the NCPA and Calpine leaseholds and all of the Unocal facilities for the project are located within Sonoma County. These areas are located within an area of Sonoma County designated as the Geysers Geothermal Area. Land use designation in this area is rural lands and resource conservation, as indicated in Table 4.10.2-1.

The Sonoma County General Plan recognizes that "tax revenues and jobs generated by geothermal development significantly benefit the county's economy" (Sonoma County, 1989). Goal 10 of the Resource Conservation Element of the Sonoma County General Plan states that a goal for the County is to "manage geothermal resources for various beneficial uses, including electricity, space heating, aquaculture and agriculture." Specific objectives under this goal are to "plan production to maximize long-term use of the geothermal resource and to mitigate adverse environmental impacts," and to "encourage exploration of the extent and potential use of hot water geothermal resources" (Sonoma County, 1989). Unocal operates the Unit 18 and 20 leaseholds under a use permit from Sonoma County.

The upper watershed of Big Sulphur Creek, including the project area, has no permanent occupation and no public access. The existing uses include geothermal energy development and watershed lands (open space).

4.10.2 THE EFFLUENT PIPELINE PROJECT COMPONENT

Land uses along the pipeline route were identified through a flyover of the route and field reconnaissance. The following discussion identifies generalized land uses and locates them by using station post numbers. That is, the predominant land uses are described for any given segment, as shown in Table 4.10.2-1, but a parcel-by-parcel description is not provided for the proposed route, except where there is a concentration of commercial land uses. Table 4.10.2-1 indicates station posts for location reference. See Figures 2.1.3-B through 2.1.3-E for station locations.

TABLE 4.10.2-1: LAND USE AND GENERAL PLAN DESIGNATION BY ROUTE SEGMENT (STATION)

<u>Lake Water Intake Pipeline Segment</u>		
Station	Generalized Land Use	Land Use Designation
0 to M10	Orchards and Low-Density Residential	Low-Density Residential
M11 (corner of Acacia and Arrowhead)	Storage/Warehouses	Low-Density Residential
M12 to lake	Low- to Medium-Density Residential	Visitor Accommodations, Residential
<u>Main Effluent Pipeline Segment</u>		
Station	Generalized Land Use	Land Use Designation
0 to 2	SERWTP property	Public Lands
3 to 6	Orchards/Agriculture, Low-Density Residential	Low-Density Residential
6 to 21	Low-Density Residential	Rural Residential
21 to 25	Undeveloped	Rural Lands
25 to 26	Medium-Density Residential	Suburban Residential, Resort Commercial
26 to 28.5	Undeveloped and Agricultural	Rural Lands, Suburban Residential, Community Commercial
28.5 to 29.5	Lower Lake Elementary School and Union High School	Public Facilities, Suburban Residential
29.5 to 31	Medium-Density Residential	Suburban Residential
31 (corner of Lake and 2nd Streets)	3-corner Commercial	Community Commercial
31 to 33	Medium-Density Residential	Suburban Residential, Community Commercial
33 to 34	Agricultural	Suburban Residential, Rural Residential
34 to 35	Undeveloped Woodland	Rural Residential
35 to 39	Agricultural	Agriculture, Rural Lands, Rural Residential
39 to 41	Scattered Farms and Residences	Rural Residential, Service Commercial
41 to 42 (Spruce Grove Road)	Commercial	Service Commercial, Rural Residential
42 to 59	Scattered Farms and Residences	Rural Lands, Agriculture
59 to 80	Undeveloped	Rural Lands
80 to 110	Undeveloped	Rural Lands, Agricultural
110 to 138.5	The Geysers Geothermal Area	Rural Lands, Resource Conservation; Resource and Rural Development (Sonoma County) ⁽¹⁾
Unocal Jeep Trail	The Geysers Geothermal Area	Resource and Rural Development ⁽¹⁾

(1) ESA, using information from the Sonoma County General Plan

SOURCE: ESA, using information from the Lake County General Plan.

4.10.3 THE GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT

Land uses in the Southeast Geysers injection areas are the same as Station Post 124-139.

4.10.4 SERWTP FACILITIES PLAN COMPONENT

The majority of Lake County's 857,330 acres remain undeveloped. About half the lands are publicly owned, with predominant land uses devoted to agriculture and rangeland. Federal lands account for 43.2 percent of the total acreage. The County owns 2,760 acres, a large part of which consists of 1,935 acres of land at the two regional wastewater treatment plant sites owned by LACOSAN, and the Eastlake Landfill owned by the County.

The proposed project lies within the County of Lake, the City of Clearlake and/or the City of Clearlake's Sphere of Influence. Pertinent plans are the Lake County General Plan and the City of Clearlake General Plan.

The SERWTP District 1 service area includes the City of Clearlake and unincorporated residential, commercial and undeveloped land extending from the northern city limits of Clearlake to the upper end of Assessment District No. 1-6.

Land within the boundaries of the SERWTP is used for treatment, storage and irrigation disposal of wastewater and is grazed by cattle seasonally. Present land use in the area adjacent to the existing plant site is agricultural or open space. The land to the south of the SERWTP is within the City of Clearlake and is occupied primarily by walnut orchards which are gradually being converted to residential land use. This land is zoned rural residential but is planned for medium density residential development. To the north, northwest and northeast of the treatment plant the land is privately owned and although outside Clearlake City limits is within the City's sphere of influence. Except for a few scattered commercial establishments across Highway 53 to the east along Ogelene Canyon Road, this area is undeveloped.

The proposed project will involve construction on an estimated total 10 acres of the 460 acre SERWTP site.

Sizing of new water, sewer and power lines and other infrastructure is designed to meet the needs of the population in the year 2000 as discussed in the Facilities Plan.

4.10.5 PROJECT DESIGN ALTERNATIVE

Land uses are the same as those described in Sections 4.10.2 and 4.10.4.

4.11 SOCIOECONOMICS AND PUBLIC SERVICES

4.11.1 OVERVIEW OF GENERAL CONDITIONS

The geothermal industry in both Lake and Sonoma Counties and the Homestake Gold Mine in Lake County have played a significant role over the last decade in providing employment for residents in their respective counties. They have added to the jobs traditionally supplied by the area's agriculture, recreation and tourism industries. The following discussion is focused on Lake County because most potential effects of the project would occur in that County.

In September 1993, the Lake County had approximately 18,975 employed persons and about 2,750 unemployed persons. Approximately 1,000 persons were employed in mining and construction, and about 450 were employed in transportation and public utilities, a category that includes workers in the geothermal industry (Mills, 1993).

It has been estimated that about 30 percent of the Geysers primary work force resides in Lake County. The number of workers in this industry living in Lake County was estimated at 350 persons in 1987 (Lake County, 1989). More recent figures are not available, but they would likely be lower since steamfield activity has decreased since that time. This estimated work force was divided into the following subcategories:

Resource development companies	100 persons
Drilling	50
Steam line construction and renovation	20
Steamfield operation and maintenance	70
Power plant construction and renovation	30
Power plant operation and maintenance	80
TOTAL	350

About 46 steamfield workers and 39 power plant workers are currently employed in that portion of the Geysers area that would be affected by the proposed project (Smith, 1993; Cooley, 1994).

The current unemployment rate in Lake County is 12.6 percent (Mills, 1993). This is an increase over the 8.5 percent rate of unemployment that is shown in 1990 Census data for the County. This is likely due to the continuing recession that has affected all areas of California, as well as a decline in jobs in the steamfields. Also, unemployment rates vary seasonally, particularly for

areas like Lake County that rely on tourism, recreation and agriculture for their economic base. Even so, the rates for Lake County, like many rural counties in the state, are higher than the statewide mean of about 9.5 percent. The current unemployment rate of 12.6 percent in Lake County, when applied to the estimated labor force in the construction and mining industry and the transportation and utilities industry yields about 126 persons in the construction and mining industry who are unemployed and about 60 persons in the transportation and utilities industry who are without jobs. In other words, there is a significant pool of local, unemployed workers from which the labor force for the project could be hired.

In November 1993, there were 215,700 employed persons and 13,500 unemployed persons in Sonoma County. Approximately 8,600 persons were employed in construction, and about 5,800 were employed in transportation and public utilities, which includes workers in the geothermal industry (Employment Development Department, 1993).

The current unemployment rate in Sonoma County is 6.0 percent (E.D.D., March 1994 estimate). Applying this rate to the estimated labor force in the construction industry and transportation and utilities industries yields 516 persons in the construction industry and 348 persons in the transportation and public utilities industries who are unemployed. These people compose a local supply of labor that is available to work on construction of the project.

4.11.2 THE EFFLUENT PIPELINE PROJECT COMPONENT

See Section 4.11.1.

4.11.3 THE GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT

See Section 4.11.1.

4.11.4 SERWTP FACILITIES PLAN COMPONENT

The communities closest to the proposed project are the City of Clearlake which incorporated in 1980, and the unincorporated community of Lower Lake.

Historically Lake County has relied on agriculture, recreation and tourism as the base for its economy. More recently, the geothermal industry and Homestake Gold Mine have played a significant part in economics and employment.

4.11.4.1 POPULATION GROWTH

Lake County's population was 19,548 on April 1, 1970. The county sustained an 86.0 percent growth rate in the following decade to 36,366 residents in 1980. From 1980 to 1985 the county's population increased rapidly to nearly 47,000. From 1985 to 1990 the population continued to increase to 50,631, but at a slower rate. In-migration, largely of retirees, accounted for most of the growth. The current (1993) population is approximately 58,000 persons.

The 1981 Lake County General Plan identified an annual average growth in population between 1985 and 2000 ranging from 1,602-2,934 persons per year. Such a growth rate would result in a year 2000 County population of between 72,048 and 84,327. The 1994 County population estimates range from 59,362 to 66,728.

One of the principal goals of the Facilities Plan (Dewante and Stowell, 1991) was "Projection of future wastewater flows and loads influent to the Southeast plant based on population growth envisioned in the current Lake County General Plan". Population projections for the service area were developed based on previous studies and County Planning Department projections. Projections reflect consideration of seasonal increases due to tourism. The number of system users in 1989 was 16,250 and the number projected for the year 2000 is 22,630.

The incorporated City of Clearlake will be a major population center by the year 2000 (projected population of 18,417) and the land use plan promotes 1,150 acres of Suburban Reserve adjacent to the city limits sufficient to support a population of 576 persons. During the past four years the number of units (defined as equivalent to a single family dwelling in terms of wastewater generation) has increased from 4,626 to 6,498. A major part of this increase (1,570 units of the 1,872) was a result of connecting the units from Assessment District 1-6 which were existing units which had not been previously connected to the regional system. New sewer connection units have been added to the system at an average rate of 151 units a year ranging from 42-194 units per year (Lindstrom/Karen Andrews, Lake County Special Districts, personal communication). Currently, 6,880 connections are served by the SERWS. There are also 255 connections served by the Middletown WWTP.

Estimates of current and projected numbers of people using the SERWS were made from the number of unit service connections obtained from the Lake County Special District office in October 1989. Unit connections represent a loading equivalent to a single family dwelling to the

wastewater system. The District estimates the average number of persons, or users, per unit connection at 2.5. Some of the unit connections are for seasonal use homes but all connections are permanent (year-round). Estimating the number of system users from the number of unit connections therefore includes seasonal users and represents the average maximum. Since peak BOD loadings occur when seasonal users are present, the above estimate of number of users is a good design estimate. To estimate projected numbers of users for 1994 and 2000 the growth rate in the number of new unit connections was estimated from the unit connection data from 1985 through 1989. The number of connections to newly constructed dwellings is about 100 per year. This is expected to increase because the desirable land for development in other areas of Clear Lake is nearing saturation.

It is estimated that by 1995, 200 unit connections will be added each year for newly constructed dwellings. In addition, approximately 50 unit connections per year will be added for sewerage existing dwellings or additional new dwellings. The overall growth rate for user projections is 150 unit connections/year until 1992, then 250 /year after that date (Dewante and Stowell, 1991). The projected number of users of the wastewater system using these growth rates is shown in Table 4.11.4-1.

TABLE 4.11.4-1

**SOUTHEAST REGIONAL WASTEWATER TREATMENT SYSTEM
EXISTING & PROJECTED UNIT CONNECTIONS & USERS**

Year	Number of Unit Connections added/year	Number of Unit Connections	Number of Users
1989	94	6600	16,250
1990	150	6650	16,625
1991	150	6800	17,000
1992	250	7050	17,625
1993	250	7300	18,250
1994	250	7550	18,875
2000	250	8050	22,625

SOURCE: Dewante & Stowell (1991) as reproduced by Goddard & Goddard Engineering

4.11.4.2 HOUSING

The Lake County General Plan Housing Element shows that the unincorporated area north of the City of Clearlake has an extensive area with a high suitability for development which is zoned for residential uses. While sewer service exists, development should be coordinated with utility infrastructure improvements to minimize adverse impacts.

A major objective (Number Three) of the General Plan Housing Element is to improve and expand the housing supply, particularly the supply of low and moderate income housing. Providing adequate infrastructure in areas zoned and suitable for housing is another major objective.

4.11.4.3 ECONOMIC DEVELOPMENT

Agriculture and recreation play an important role in Lake County's economy. Agriculture includes fruit and nut production, field crops, vegetables, livestock and poultry. Bartlett pears are the most important crop. Recreation is centered around Clear Lake which offers an aesthetic rural setting with a variety of water related sporting activities at a reasonable distance from major population centers. Other economic activities in the County include manufacturing, construction, mining and utility operations (e.g., geothermal power production and Homestake Mine).

The County has a labor force of about 17,000-18,000 persons who are employed in retail trade, services and government. Each category accounts for 20-25 percent of wage earners while the remaining work force is employed in natural resource production (agriculture, forestry, mining, geothermal energy, and fishing). Unemployment rates vary seasonally and have been relatively high as has been the case in many rural counties.

The largest employer is the service sector including government. The City of Clearlake, which is located in the heart of the project area, serves as the commercial, financial and governmental center for the southerly area of Lake County.

4.11.4.4 WATER SUPPLIES

Public water supplies come from Clear Lake or wells. All of the surface supplies are treated by sedimentation, coagulation, filtration and disinfection. Well supplies are not treated, except for disinfection. The water suppliers for the service area were summarized previously in Table 4.4.4-1. Most of the public water supplies are metered, and per capita use is reasonable and typical. None of the water supplies have characteristics or constituents that would significantly affect the treatment and disposal of wastewater.

Federal and state water conservation regulations applying to wastewater treatment improvements are required. In addition, new connections for new single family houses require installation of water saving shower heads, water saving aerators on kitchen sinks and lavatories, water saving toilets, and pressure reducing valves, when appropriate, to maintain 60 psi or less in the system.

4.11.4.5 OTHER UTILITIES AND PUBLIC SERVICES

Other utility services for the area include electricity provided by Pacific Gas and Electric, telephone provided by Pacific Telephone, propane gas supplied by numerous private propane companies and private refuse collection services.

Local public services including police, fire, parks and recreation, flood control, schools, health care and other community services are provided by the County and other local agencies. The provision of these facilities is coordinated with local planning agencies to ensure that needs are adequate to serve future population growth forecasts. Enrollment in Lake County schools is predicted to increase 63.7 percent this decade with nearly 6,000 new students according to the State Finance Department 1991 report, ranking it sixth fastest growing of 58 counties in terms of school enrollment figures on a percentage basis.

Just north of the service area lies another wastewater service area and treatment facility facing a similar capacity problem due to wet weather flows. This is the Clearlake Oaks County Water District (CLOCWD). The CLOCWD service area serves a community of about 3,500 persons with an existing wastewater flow of 0.35 mgd projected to reach 4,200 persons and a flow of 0.42 mgd by the year 2005.

4.11.4.6 TRANSPORTATION

Regional access to the project area is provided by State Highway 53 which, via State Highway 20 to the north, connects with Interstate 5 in the Central Valley and State Highway 101 at Calpella north of Ukiah. State Highway 53 also connects with State Highway 29 to the south and west. Local access to the SERWTP is direct via a surface access road off of Highway 53.

The treatment plant site is estimated to have an average of about 20-30 vehicle trips a day associated with its operation and maintenance including employees going to and from work, deliveries and other activities.

4.11.5 PROJECT DESIGN ALTERNATIVE

Socioeconomic conditions and public utilities in Lake County are the same as those described in Section 4.11.1.

4.12 ENVIRONMENTAL CONTAMINATION HAZARDS

4.12.1 OVERVIEW OF GENERAL CONDITIONS

The proposed project involves constructing pipelines, roads, and facilities in areas that contain naturally occurring hazardous substances and near sites that may have soil or groundwater contamination caused by human activity. During construction, the primary issue related to environmental contamination would be worker health and safety during project construction. If not mitigated properly, excavation, handling, and disposal of contaminated soils or groundwater could pose hazards to workers or threaten the public. The use of hazardous substances for routine operation and maintenance activities or in accident-related scenarios could expose workers to environmental contamination hazards if the substances are not used, stored and disposed of properly.

4.12.1.1 HAZARDOUS SUBSTANCES DEFINITION

Hazardous substances are defined by the federal Comprehensive Environmental Response, Compensation, and Liability Act of 1980. The definition of hazardous substances includes both hazardous materials and hazardous wastes. Hazardous substances are also defined by state statute: certain chemical and physical properties of a substance cause it to be considered hazardous. Under Title 22, Section 66260.10 of the California Code of Regulations (CCR), a hazardous material is defined as a substance or combination of substances, which because of quantity, concentration, or physical, chemical or infectious characteristics, may either:

- (1) cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating, illness; or
- (2) pose a substantial present or potential hazard to human health or environment when improperly treated, stored, transported or disposed of, or otherwise managed.(CCR, Title 22, Chapter 11, Art. 2)

4.12.2 GEYSERS EFFLUENT PIPELINE PROJECT COMPONENT

4.12.2.1 NATURALLY OCCURRING HAZARDOUS SUBSTANCES

Two naturally occurring hazardous substances may be encountered during project construction: asbestos and mercury. Asbestos is found in serpentine rock. Mercury is contained in the mineral cinnabar. Both serpentine rock and cinnabar are known to exist in Lake and Sonoma Counties.

Asbestos

Asbestos is a naturally occurring mineral that forms extremely strong durable fibers. Health risks of asbestos are documented (Sittig, 1985). The primary pathway of asbestos exposure is inhalation of airborne asbestos fibers (the fibers become permanently lodged in lung tissue). Adverse health effects are generally manifested by chronic diseases of the respiratory system, including lung cancer, mesothelioma, and asbestosis. The diseases can have latency periods of 15 to 25 years, and are usually fatal. Some evidence also exists that links ingestion of asbestos with cancer of the digestive tract, although full correlation has not been established.

A "safe" level of exposure to asbestos has not been established by health authorities; that is, there is no agreement among experts of a quantitative level below which asbestos-induced cancer will not occur. It is prudent, therefore, to reduce potential exposures to asbestos fibers to the lowest practicable level.

In Lake and Sonoma Counties, naturally occurring asbestos is found in serpentine rock. It is a greenish colored rock that contains veins of chrysotile asbestos. If serpentine is crushed or broken down, it releases asbestos fibers into the air where they are respirable (LCAQMD, 1992). The proposed effluent pipeline route passes through areas known to have serpentine outcroppings between station posts 75 to 83, 98 to 102, and in The Geysers beyond station post 120 (see Table 4.12.2-1).

Because of the hazard of disturbing serpentine rock or soils, the Lake County Air Quality Management District (LCAQMD) requires a dust mitigation and management plan for all grading or earth moving of serpentine materials containing over one percent asbestos. The requirements for the plans are contained in LCAQMD Regulation Section 467. The regulation requires dust control measures and recommends that worker safety precautions and exposure monitoring be conducted. The Northern Sonoma County Air Pollution Control District does not have any special requirements for grading or earth moving of serpentine materials.

The Occupational Safety and Health Administration (OSHA) and the California Occupational Safety and Health Administration (Cal/OSHA) have adopted regulation to protect asbestos workers. OSHA asbestos worker regulations are found in 29 CFR Sections 1910 and 1926. If asbestos levels exceed 0.1 asbestos fibers per cubic centimeter of air, worker medical surveillance and asbestos awareness training are required. If levels exceed 0.2 asbestos fibers

TABLE 4.12.2-1: LOCATIONS OF POTENTIAL CONCERN BECAUSE OF THE
POSSIBLE PRESENCE OF HAZARDOUS SUBSTANCES

<u>Station Post</u>	<u>Possible Hazard</u>	<u>Comments</u>
LD 1.5 - 9	Agricultural Chemicals	Soil residues & current use
1.5 - 6.5	Agricultural Chemicals	Soil residues & current use
32.4 - 32.6	Petroleum Hydrocarbons	Soil stains near fuel distributor
75 - 83	Asbestos & Mercury	Serpentine outcroppings
98 - 102	Asbestos & Mercury	Serpentine outcroppings
120 & beyond	Asbestos & Mercury	Serpentine outcroppings & mercury mines

NOTE: This table is based on inferred presence of hazardous substances. No soil samples were taken to confirm the actual presence of the substances.

SOURCE: Lake County Air Quality Management District, 1992; Environmental Science Associates.

per cubic centimeter, respirators, protective clothing and various special work practices are required. Compliance with LCAQMD requirements is usually adequate to control airborne asbestos levels below 0.1 fibers per cubic centimeter.

Mercury and Other Heavy Metals

Mercury (or quicksilver) is a heavy metal that can cause neurological disorders and kidney damage. Unlike most metals, elemental mercury is a liquid at room temperature and has a measurable vapor pressure. Inhalation is a major pathway of exposure. Mercury vapor readily diffuses across the alveolar membranes of the lungs. Elemental mercury is associated with cinnabar (mercuric sulfide) deposits (Zalesak, 1993). There are many former mercury mines in Lake County. Over 2,700,000 pounds of mercury were produced by the numerous mines around The Geysers prior to World War II (Bacon, 1976). The host material for mercury in the area is generally silica-carbonate alterations of serpentine rock.

The recommended standard (time-weighted average) for permissible exposure limits for mercury vapor in the workplace is 0.05 milligrams of mercury per cubic meter of air. Above

28 milligrams per cubic meter, mercury vapor represents an immediate danger to life and health after a 15 minute exposure (NIOSH, 1987). Such exposures normally would occur only in enclosed structures or poorly ventilated areas such as a mine. Waste materials containing more than 20 milligrams of mercury per kilogram of material are legally classified a hazardous waste under state CCR 22, Section 66261.

Other heavy metals associated with serpentine in Lake County include chrome and nickel. Both these metals are associated with cancer of the respiratory tract. Inhalation of dust containing these metals should be avoided. Chromite (chrome ore) was mined near Childers Peak.

4.12.2.2 ENVIRONMENTAL CONTAMINATION CAUSED BY HUMAN ACTIVITY

Hazardous substances have been commonly used by various segments of the California economy for most of the current century. The introduction of these substance into the environment could cause environmental contamination. Given the current and past land uses along the proposed pipeline route, the two most likely sources of environmental contamination caused by human activity are agriculture and fuel storage.

Soil that is excavated from a site containing hazardous substances would be considered a hazardous waste if it exceeded specific CCR Title 22, Section 66261 criteria. Improper excavation of contaminated soil can expose workers to unhealthy levels of hazardous substances and inadvertently spread the contamination.

Agricultural Chemicals

The proposed pipeline routes within the Burns Valley (Lake Diversion stations post 1.5 to 9.0 and Effluent stations posts 1.5 to 6.5) passes through areas of cultivated agriculture, mostly orchards. Cultivated agricultural is typically characterized by intensive farm practices including extensive agriculture chemical applications. Open grazing land, which dominates the majority of the route between Lower Lake and Middletown, is not intense and generally would not be expected to receive extensive agricultural chemical applications.

The Federal Insecticide Fungicide, and Rodenticide Act (FiFRA) and the State Food and Agricultural Code (Section 11401, et seq.) governs the use of pesticides. An applicator of a dangerous (restricted use) pesticide must register its use with the County Agricultural Commissioner. Although greater in the past, the current use of agricultural chemicals in the

Burns Valley Area is minimal and limited to a few chemicals (Lockhart, 1993). Malathion is the most commonly used insecticide in the area.

The number and types of pesticides that are legal and considered safe to use have changed substantially over time. It is assumed that the historic agricultural uses also involved a wide range of pesticides that were available and legal at the time of application. Many pesticides once considered safe, such as DDT, are no longer legal to use in the United States.

Agricultural operations can cause a build-up of pesticides or their residues in the soil. Organochlorine pesticides such as DDT, lindane and chlordane, are very persistent in the environment; for example, it has been estimated that DDT decays at the rate of about 75 percent every 4 to 30 years. (Verschuere, 1983) Thus, DDT applied in the 1940s and 1950s could still be present in the soil. In the human body, DDT tends to accumulate in adipose (fat) tissue. Excavated material that contains over 1 milligram of total DDT and its derivatives (DDE, DDD) per kilogram must be treated as a hazardous waste under California regulations (CCR, Title 22, Section 66261.24). Although not certain, it is likely that DDT could be found in the soil of the pipeline route. However, the Agricultural Commissioner believes that it is unlikely that hazardous levels of DDT would be encountered in the Burns Valley Area (Lockhart, 1993).

Fuel Storage

Leaking underground storage tanks and surface storage tanks are two of the most common causes of environmental contamination in California. The practice of storing flammable materials such as gasoline below ground mitigates the potential fire hazard posed by the presence of large quantities of fuel. However, a leaking tank can contaminate soil adjacent to the leak. Fuel can reach the groundwater if a leak is not detected.

The CEQA requires lead agencies to indicate if a project involves an environmentally impaired site contained in the Cortese Database. The Cortese Database is a consolidation of information from various state agencies such as the Regional Water Quality Control Board, and local sources. It lists potential and confirmed hazardous waste or substance sites and is maintained by the State Office of Planning and Research. There are four Cortese Database sites in the general area of the project. All four of these sites are in the Cortese Database because of fuel leaks. None of these sites are within 500 feet of the proposed route and, therefore, the likelihood of encountering soil contamination caused below these sites is low for the project.

The Lake County Department of Environmental Health maintains files on properties that have experienced leaks from underground storage tanks and requiring remediation. In addition to the four Cortese Database sites, Lake County Department of Environmental Health records indicated that a service station located at the intersection of Highways 29 and 53 experienced a fuel leak that has since been remediated. The site is about 500 feet from the proposed route of the effluent pipeline at station post 31. The likelihood of this site causing environmental contamination of the pipeline route is low since the site as been remediated.

The closest site of potential concern is adjacent to the proposed pipeline route, a fuel distribution facility located at 16445 Morgan Valley Road in Lower lake (station post 32.5). The facility contains a number of surface tanks, drums, and fuel distribution trucks. Surface staining of the asphalt of the site and the soil between the facility and Morgan Valley Road have been observed, which indicates possible past fuel spills (ESA, 1993). Lake County Department of Environmental Health has no record of any hazardous materials release at the site (Ramirez, 1993).

Private surface storage tanks and fuel dispensing pumps indicating the possible presence of an underground storage tank were observed at properties in the Burns Valley Area adjacent to the proposed pipeline routes and an Industrial Park at 11455 Clayton Creek Road (station post 41). In general, regulations are not as vigorously enforced for private underground storage tanks service stations and fuel wholesaler operations. Undetected leaks are possible from these tanks. The environmental contamination may not be discovered until soil near the tank is excavated.

4.12.3 THE GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT

The Injection Program Plan Component would occur in an area that contains naturally occurring asbestos and mercury. Ongoing operations and maintenance of steam collection and power generation equipment require the use of various industrial hazardous substances and fuel. Improper storage, use or disposal of these substances could have caused isolated areas of environmental contamination that have not been identified.

Cuttings and other wastes produced from geothermal drilling activities are required by the RWQCB to be disposed of in a clay lined sump which is usually constructed adjacent to the drilling pad. The wastes in the sump often contain elevated levels of heavy metals, petroleum products, and chemicals used to thicken drilling mud (Snetsinger, 1994). Once drilling is

complete, the sump is capped and the wastes inside are isolated from the environment as long as the clay liner is intact. Most drilling currently conducted in The Geysers uses "sumpless" drilling techniques. Dewatered cuttings are disposed in approved sites. Most of the developed well pads do contain previously constructed sump structures which have been filled and covered.

4.12.4 SERWTP FACILITIES PLAN COMPONENT

At the present time LACOSAN uses chlorine to disinfect the SERWTP effluent. Chlorine is delivered weekly as one ton cylinders of chlorine gas. No chemical dechlorination is needed since reservoir storage is sufficiently long to allow the chlorine residual to dissipate. Chlorine is used to disinfect wastewater at many treatment facilities since it is an effective mechanism for the destruction of pathogens to permitted levels.

The use of chlorine will continue and may increase. The proposed filtration facilities will use coagulant aid chemicals which will be either polymers or aluminum sulfate (alum), both of which are commonly used for this purpose in domestic water supply treatment systems.

The chemicals discussed here which are considered hazardous include chlorine gas (Cl_2), sulfur dioxide gas (SO_2), alum powder ($\text{Al}_2[\text{SO}_4]_3 \cdot 14\text{H}_2\text{O}$) and synthetic organic polymer powder or solution. Information on these chemicals, their purpose and use, typical doses, amount stored on site and location, delivery schedule, toxicity and byproducts, are summarized in Table 4.12.4-1 (Dewante & Stowell, August 21, 1991).

4.12.5 PROJECT DESIGN ALTERNATIVE

The alternative effluent pipeline routes segments would not pass within 500 feet of any known sites of soil or groundwater contamination caused by human activity. Although not identified by county-wide maps, it is possible that small deposits of serpentine rock could be encountered along Alternative Route D and at the Childers Peak Regulating Tank alternate site. If serpentine is encountered, the primary issue related to environmental contamination for the alternative routes would be worker exposure to naturally occurring hazardous substances during pipeline construction. These issues and the definitions of hazardous substances are discussed in Section 4.11.2.

TABLE 4.12.4-1

CHEMICALS POTENTIALLY USED AT THE SOUTHEAST REGIONAL WWTP

CHEMICAL	Purpose	Used with	Dose, mg/l	Amount Stored On-Site and Location	Approximate Delivery Schedule	Toxicity and Byproducts
CHLORINE Chlorine Gas, Cl ₂	Disinfection	All Alternatives	Avg.: 10 Max: 30	• Two Ton Containers (2000 lbs compressed Cl₂ gas in each cylinder) • Full containment building near control building	One Ton Container by separate truck every 2 weeks	• Toxic, irritating to skin eyes, and respiratory tract; corrosive • Produces chlorinated hydrocarbons, chloro-amines and other chlorine compounds
SULFUR DIOXIDE Sulfur Dioxide Gas, SO ₂	Remove free chlorine & chloro-amines to reduce toxicity of chlorinated effluent	Surface water discharges	Avg.: 10 Max: 30	• Two Ton Containers (2000 lbs compressed SO₂ gas in each cylinder) • Full containment building near but separate from chlorine building	One Ton Container by separate truck every 2 weeks	• Toxic, respiratory irritant • Reacts with water to sulfurous acid, which reacts with chlorine compounds
ALUM Aluminum sulfate powder, dry Al ₂ (SO ₄) ₃ · 14 H ₂ O	Coagulate suspended solids into settleable solids	Title 22 treatment for surface discharge (a)	15 to 25 mg/l (up to 625 lb/day)	• 10,000 lbs, allow two weeks of up to 625 lb/day • In dry room of Advanced treatment building near existing facilities	Delivered in 100 lb bags on pallets by truck every week	• Non-toxic, does add soluble Al to effluent and reduces pH • Produces up to 1100 lbs/day of sludge (dry weight) that must be dewatered and disposed. If trucked to landfill, requires 1 trip per week.
POLYMER Synthetic organic polymer, powder or solution	Coagulate suspended solids into filterable or settleable solids Aid in dewatering oxidation ditch/clarifier sludge	Advanced treatment for surface discharge All Alternatives	1 to 2 mg/l (50 lb/day) 6 to 25 lb/day	• Depends on form. For solution, two to four 55 gallon drums, for powder, 350 to 500 lbs. • In chemical room of advanced treatment bldg • Depends on form. For solution, two to four 55 gallon drums, for powder, 350. • In sludge dewatering room.	• Two to four 55 gal drums or 500 lbs of powder by truck, 2 times per month • Additional two to three drums or additional powder, 2 times per month	• Non-toxic, extremely slippery if spilled. • Advanced treatment will produce up to 500 lb/day (dry weight) of sludge to be dewatered and disposed. If trucked to landfill, will require 2 trips per month • Produces up to 1.5 tons per day (dry weight) of sludge at about 15 to 20 percent solids. If disposed of in landfill, will require 1 truck trip per week

(a) Title 22 requires coagulation and flocculation but does not specify the chemical coagulant. Polymer may be used in place of alum but not both.

4.13 TRAFFIC AND CIRCULATION

4.13.1 OVERVIEW OF GENERAL CONDITIONS

4.13.1.1 REGIONAL ROADWAY NETWORK

Lake County

The Clearlake region is served by a roadway network of regional arterials and local streets. The roadway network in the City of Clearlake is largely characterized by a grid pattern of streets that run either north-south, or east-west. The main arterials in the City of Clearlake include State Route (SR) 53, Lakeshore Drive, Olympic Drive and Old Highway 53. SR 53 is a two-lane highway, with good pavement conditions and four- to six-foot-wide shoulders, that serves as the main north-south route through the Clearlake community, extending between SR 20 to the north and SR 29 to the south.

SR 29 is a two-lane highway, with good pavement conditions and wide shoulders, that connects Clearlake with the Napa Valley region to the south, and the Lakeport region to the west. SR 175 is a two-lane roadway, with good pavement conditions and two- to five-foot-wide shoulders, that extends northwest from SR 29 near the community of Middletown, and reconnects to SR 29 south of Clear Lake. Existing traffic volumes on regional and local project area roadways are shown in Table 4.13.1-1.

Sonoma County

Access to the Unocal project site is provided by the Geysers Road, which connects with State Highway 128 in Geyserville, and Sulphur Creek Road, which extends through the Geysers Geothermal Area of Lake County. Both of these roads lead to guard gate 1, which provides controlled access to the private road that leads to the project area. Traffic on these roads is mainly related to the geothermal industry. Public access is not permitted.

4.13.2 EFFLUENT PIPELINE PROJECT COMPONENT

The regional and local two-lane roadways within which the Geysers Effluent Pipeline alignment would affect are identified in Table 5.2.11-1.

TABLE 4.13.1-1: EXISTING TRAFFIC VOLUMES ON PROJECT AREA PUBLIC ROADS /a/

Roadway		Daily Traffic
<u>Within City of Clearlake</u>		
Lakeshore Drive	north of Villa Way	5,715
Burns Valley Road	west of Old Highway 53	1,320
Arrowhead Road	at Modoc Street	3,340
State Route 53	north of 40th Street	7,800
	between 40th St. and Old Highway 53	11,700
Olympic Drive	west of State Route 53	2,500
Davis Avenue	at Fir Avenue	1,515
Dam Road	east of State Route 53	1,330
<u>Lake County</u>		
State Route 53	between Old Highway 53 and SR 29	14,100
State Route 29	south of State Route 53	7,800
	north of State Route 175 (at Middletown)	7,400
	south of State Route 175	7,100
State Route 175	west of State Route 29	2,650
Lake Street	at Second Street	2,230
Morgan Valley Road	east of State Route 53	5,620
Spruce Grove Road	east of State Route 29	665
Harbin Springs Road	west of Big Canyon Road	320
Big Canyon Road	north of Harbin Springs Road	110
	south of Harbin Springs Road	390
Bear Canyon Road	at Calpine entrance gate	20
Socrates Mine Road	at Northern California Power Agency entrance gate	170

/a/ 1989 City of Clearlake traffic volumes, Lake County traffic volumes (counted between April, 1987 and August, 1991), 1992 Average Annual Daily Traffic Volumes (AADT) for State Routes.

SOURCE: Environmental Science Associates, Inc.; Lake County Public Works Department; Caltrans; Calpine Corporation, Northern California Power Agency, 1993.

4.13.2.1 PLANNED ROADWAY IMPROVEMENT PROJECTS

Roadway projects planned for construction by jurisdictions within the project area that could affect, or be affected by, the installation of a make-up water pipeline and effluent pipeline are summarized below.

In the City of Clearlake, the City will be reconstructing and overlaying Davis Avenue sometime during 1994 to 1995 (Wanger, 1993). The California Department of Transportation (Caltrans) will be widening a 3.5-mile long section of SR 53 north of its junction with SR 29. This section of roadway will be widened from a two-lane highway to a four-lane expressway; construction is scheduled to begin in early 1995. Caltrans also plans construction of a frontage road along SR 53 between Davis Avenue and 40th Avenue in the City of Clearlake; construction is scheduled in early 1994 (Bowermaster, 1993). There are no major roadway improvements planned by the Lake County Department of Public Works (Mansell, 1993).

4.13.3 GEYSER EFFLUENT INJECTION PROGRAM PLAN COMPONENT

As this component would involve no changes in operations within the steam field, no significant impact is expected. All roads in The Geysers in the injection area are private roads.

4.13.4 PROJECT DESIGN ALTERNATIVE

Traffic and circulation conditions are the same as for the proposed project.

4.14 ENERGY AND MATERIALS

4.14.1 OVERVIEW OF GENERAL CONDITIONS

4.14.1.1 SOURCES OF ENERGY IN CALIFORNIA

Oil, natural gas, nuclear and hydroelectric resources supply most of the power consumed in California. Oil provides about 54 percent of the state's energy need, while natural gas provides about 31 percent (California Energy Commission, 1990). The remaining 15 percent of the state's energy need is provided by nuclear and hydroelectric power, and by other sources, such as geothermal resources and solar power. The two major end-uses of energy are as fuel for transportation and electricity.

4.14.1.2 EXISTING ENERGY RESOURCES

The Geysers-Calistoga KGRA is the largest developed geothermal reservoir in the world. A total of 27 power plants now operate in the Geysers KGRA with an installed capacity of approximately 2,100 megawatts (MW). Approximately 600 production and injection wells have been drilled; about 450 of these are currently in use. Nearly all production wells produce saturated or superheated steam. The position, the nature of the bottom of the reservoir, and the source of fluid for the reservoir have not been clearly defined yet.

Energy Regulations, Plans, and Policies

The Lake County *General Plan* recognizes that capturing energy from the earth's heat is a relatively clean, efficient source of energy (Lake County, 1981). The Geothermal Resource and Transmission Element of the Lake County *General Plan* contains policies directed towards development of geothermal resources in a manner that does not compromise the physical environment of those who live and work in the vicinity of the KGRA.

The Sonoma County *General Plan* recognizes the importance of geothermal resources in the Geysers and calls for maximizing long-term use of the geothermal resource and for mitigating adverse environmental impacts associated with geothermal development (Sonoma County, 1989).

4.14.2 THE EFFLUENT PIPELINE PROJECT COMPONENT

Pacific Gas & Electric Company (PG&E) provides electricity to residences and businesses in the project area.

4.14.3 THE GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT

Each of the power plant operators maintains switchyards and high-voltage lines for transmission of steam-generated electricity.

4.14.4 SERWTP FACILITIES PLAN COMPONENT

PG&E provides electricity to the SERWTP and its ancillary facilities.

The SERWTP uses electricity for transporting wastewater through collection lines and lift stations, treating wastewater at the plant and irrigating spray fields for the land disposal system, currently in operation. During the past year, approximately 2,353,125 kilowatt hours of electricity was consumed for the operation of these facilities.

4.14.5 PROJECT DESIGN ALTERNATIVE

The energy setting for the design alternatives is the same as that described under 4.14.1, 4.14.2, and 4.14.3.

4.15 GEOTHERMAL ENERGY AND GEYSERS AREA SEISMICITY

The following information is derived from reports prepared by GeothermEx, Inc., Richmond, California. The EIR/EIS presents this information in summary form.

4.15.1 GEOTHERMAL RESERVOIR CONDITIONS

4.15.1.1 STEAM FIELD DEVELOPMENT AND CURRENT CONDITIONS

Commercial generation of electricity at The Geysers began in September 1960 with the start-up of PG&E's Unit 1 and 2. During the 1960s, growth was slow, with installed capacity rising only to 82 MW (PG&E Units 1 to 4) by 1970. However, the growth rate accelerated during the 1970s when 612 MW was brought on-line. The 1980's were a period of even greater field development, with an additional 1,412 MW of generating capacity installed (GeothermEx, 1992). In mid-1991 installed capacity reached a peak of 2,106 MW (GeothermEx, 1994). Since 1986, development at The Geysers has slowed significantly. There has been a combination of problems involving the performance of the developed steamfield, increasing development cost, resource risk, decreasing availability of favorable steam or power sales agreements, and declining steam price. At present, no new power plants are scheduled for construction at The Geysers.

The growth in generation capacity in the early 1980s was matched by the growth in production rate of steam; by 1986, the total production from the field reached a peak of approximately 30 million pounds per hour (lb/hr). However, since 1987, the total production has dropped by over 20 percent, and by June 1991, total production was down to approximately 23 million lbs/hr (GeothermEx, 1992).

Significant production decline rates were noted throughout the steam field between 1987 and 1990, although there is evidence of a lessening in decline rate since 1990 possibly due to the reduction in overall production rate from the field, local changes in injection strategies, and changes in generating strategy by moving from base load operation to load following in some areas of the field, notably the NCPA area (GeothermEx, 1992).

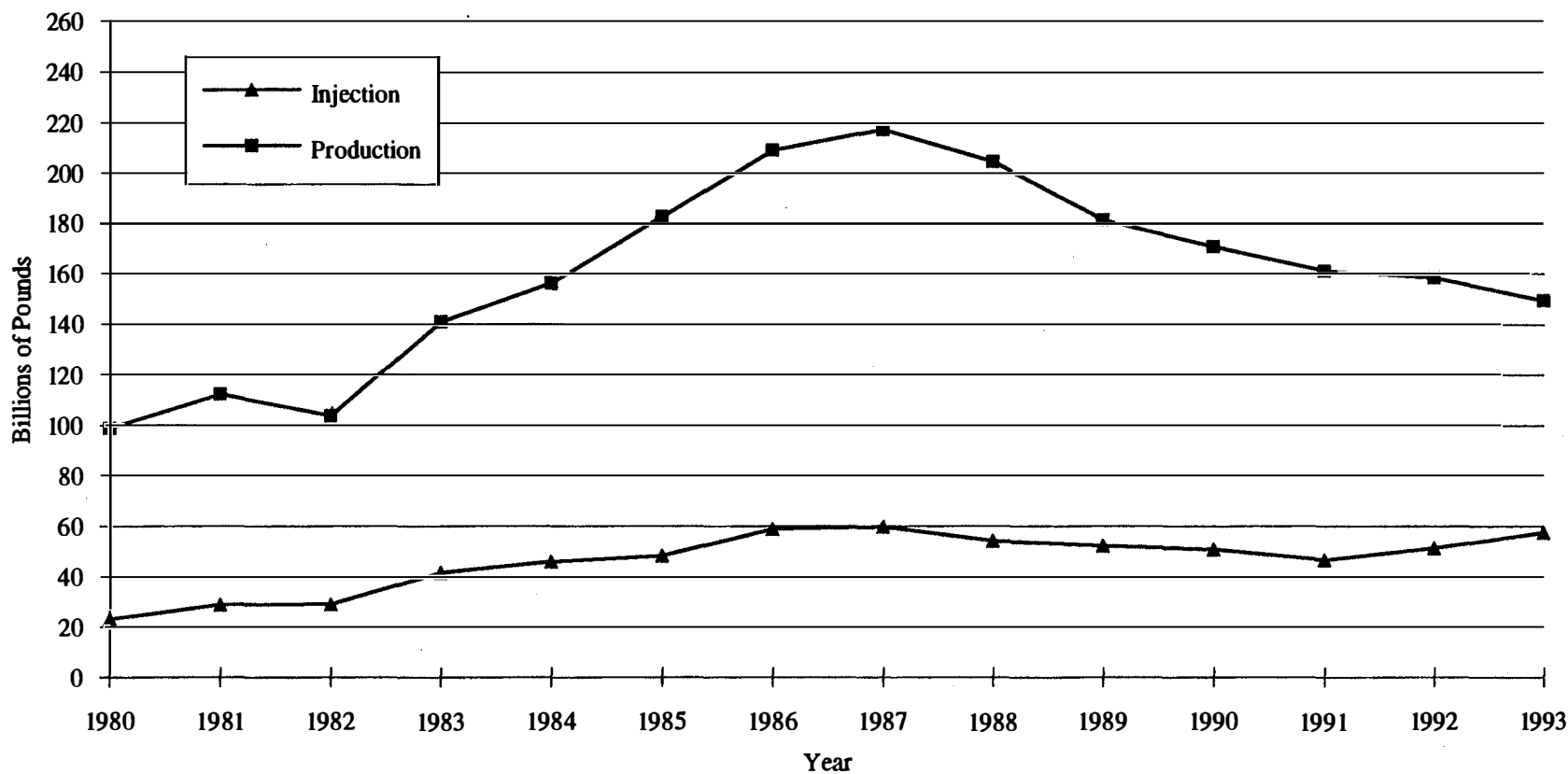
The significant drop in production rate since 1987 has resulted in substantial under-utilization of the installed facilities, along with a continuing, reduction in future remaining reserves. The installed capacity of The Geysers totals 2,106 MW; however, current output is about 1,216 MW.

These conditions of previously rising and currently declining production characterize the Southeast Geysers as much as the field as a whole. Calpine installed capacity is 367 MW, while generation was at 294 MW in February 1993. At the same time, NCPA installed capacity was 239 MW, and generation was 150 MW and Unocal installed capacity for Units 18 and 20 was 238 MW, and generation was 145 MW. The combined production by NCPA for Plants No. 1 and No. 2, by Calpine for PG&E Units 13 and 16, and Unocal for PG&E Units 18 and 20 in 1987 was about 227 billion pounds, declining to about 149 billion pounds in 1993 (Figure 4.15.1-A).

The initial pressure in the geothermal reservoir was 510 pounds per square inch - absolute pressure (psia) (sea level). This has dropped significantly, and parts of the reservoir in the Calpine, NCPA and adjoining Unocal leaseholds currently are as low as 200 psia (GeothermEx, 1994). The outlook for the future of the reservoir is presented in Section 6.2.12 (No Action Alternative).

4.15.1.2 ENHANCED INJECTION IN THE GEYSERS

Injection of water into the deep geothermal reservoir began as early as 1969 at The Geysers. This was done primarily as a means of disposing of wastewater from operations at the power plants, in particular the condensed steam in the cooling tower. About 30 percent of the water survives the cooling tower evaporative process and can be used as injection fluid. As production levels declined, the operators in The Geysers recognized that enhanced injection of fluids was a possible means to slow the rate of decline. A joint injection program of Calpine and NCPA in the Low Pressure Area (LPA) proved highly successful. Flow rates in the areas of adjacent Calpine and NCPA properties increased by 360,000 lbs/hr within six months (Eneedy, et al., 1991); comparable flow rates increase was also noted by Unocal in the southeast corner of Unit 18. This was an average for the Low Pressure Area. After the initial increase in flow rates, Calpine wells in the affected area declined at an annual harmonic rate (that is a rate "fitted" to the conditions of a mathematical equation) of 13 percent, which compared favorably with the 20 percent annual harmonic rate of decline prior to the injection program (Beall, 1993, Goyal and Box, 1992); similar reductions in decline rate were seen for wells in and around the LPA including those in Units 18, and NCPA wells. Beall (1993) notes that those results induced Calpine to establish condensate injection as a primary goal in the management of its steam field. Injection derived steam (IDS) currently is approximately 28 percent of production at Unit 13 and 16.



Source: NCPA, Calpine and Unocal, 1994

Figure 4.15.1-A
Production and Injection History of the Southeast Geysers Effluent Pipeline Project
 Combined Annual Totals of NCPA, Calpine and Unocal Operations at The Geysers
 for NCPA Plants #1 and 2 and PG&E Units #13, 16, 18 and 20

4.0 Affected Environment

4.15 Geothermal Energy and Geysers Area Seismicity

The most direct evidence that water injected into the reservoir reappears as steam at production wells is provided by analyses of stable isotopes. Historically, most of the injected water is steam condensate which has been cycled through power plant cooling towers before being piped to the injection wells. At the cooling towers, some of the condensate evaporates. This causes a shift of isotope composition in the remaining condensate, and it no longer retains the isotope composition which it had when produced as steam. When the residual cooling tower condensate is injected back into the reservoir, some fraction of it boils and mixes with native reservoir steam. When this mixed steam then appears at production wells, the fraction of "injection-derived steam" (IDS) in the mixture can be determined by comparing the isotopic composition of the mixed steam with the composition of the residual cooling tower condensate and the composition of native (unmixed) steam formerly sampled at the well.

At Units 13 and 16, the isotope method can no longer be used, because most condensate is no longer passed through cooling towers before injection. To adapt to this change, Calpine has developed a method of tracking IDS using analyses of the fraction ammonia injection non-condensable gases. During power production, the reservoir gases carried by produced steam are separated from the steam condensate, passed through hydrogen sulfide abatement equipment, then vented to the atmosphere. Ammonia gas, however, tends to stay dissolved in the condensate more than the other gas components. When the condensate then boils in the reservoir and mixes with native reservoir steam, there is a shift in the amount of ammonia relative to other gas components. Analyses of the relative ammonia concentrations at production wells enable Calpine to calculate the fraction of IDS at each well.

The above methods of tracking IDS do not serve to measure the exact time required for injection to reappear as production, and do not clearly determine connections between specific injection wells and specific production wells. To do this, it is necessary to introduce a foreign tracer, e.g., a halogenated alkane, into one injection well and to monitor, over time, the amounts of this tracer which appear at production wells. Calpine, NCPA and UNOCAL have performed a few such tracer tests, but they are not routine.

The NCPA injection experience has been summarized by Eney and others (1991 and 1993), and is summarized as follows.

NCPA operates 69 production wells and 7 injection wells (1992 and 1993). The current injection fluid is mainly cooling water condensate, as described above. Some 5% to 10% of the yearly

4.0 Affected Environment

4.15 Geothermal Energy and Geysers Area Seismicity

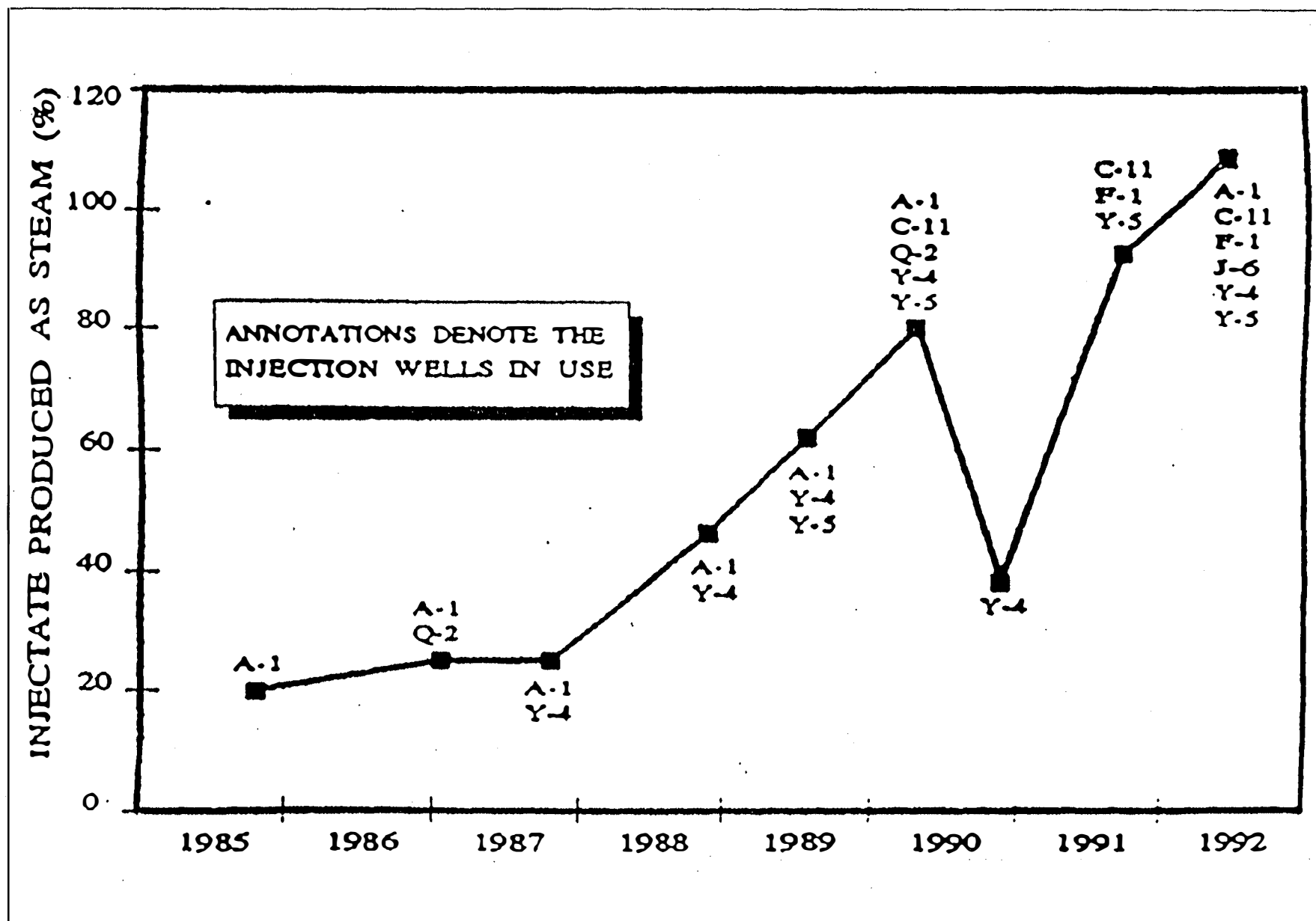
total is rain water. Injection started in January 1983, and the current annualized rate is 1,600 to 1,800 gpm. To 1993, the cumulative mass injected was 34% of production. As Figure 4.15.1-A indicates, the percentage of production which is injected has been relatively constant at this level, although the net mass has been declining.

The initial injection philosophy in the NCPA area was disposal in "peripheral" wells, away from the center of their wellfield. However, after observing the high rates of flow rates decline which started in 1986, NCPA re-evaluated this practice, and studies were carried out to determine the reservoir response to injection in wells centrally located in the production area. These studies led NCPA to the conclusion that a properly planned strategy could: 1) extract additional heat from the rocks; 2) have a positive impact on pressures and flowrates; and 3) result in minimal thermal breakthrough (cooling) at adjacent production wells.

As a result of these studies, NCPA now injects into a larger number of wells at lower rates, progressing from injection into : 2 wells in 1988, 4 wells in 1989, 5 wells in 1990-91, and 7 wells in 1992 (each with 4% to 31% of the total injection). When on-line, each injection well receives 500 to 1,500 gpm of injectate, depending upon its location and recent injection history. At these rates, communication of unflushed injectate with production wells is not a problem. Micro-earthquake data indicate that the liquid injectate is boiling near the injector wells, without significant migration deeper into the reservoir.

Stable isotope data show that the area of the NCPA wellfield with greater than 36% injectate returns is now about one-third of the total developed area. Production of IDS increased between 1989 and 1992 to 950,000 lb/hr (950 kilo pounds per hour), which is 26% of total wellfield flowrate potential at 130 pounds per square inch - gauge pressure (psig). The amount of IDS produced in 1992 was about 100% of the amount of liquid injected (Figure 4.15.1-B). Figure 4.15.1-B indicates that IDS production appears to exceed 100% of the rate of injection. This is because water that had been injected earlier produces an additive effect at a given point in time.

NCPA has done analyses of pressure and flow decline rates, which show clear correlations between areas of reduced decline and injection wells in or adjacent to those areas. The individual well decline rates ranged from 0 to 50%, with an arithmetic average of about 15%.



SOURCE: Graphic as reproduced from GeothermEx, Inc., 1994

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Figure 4.15.1-B
Percent of Condensate Recovered as
Steam, 1985 through 1992

4.0 Affected Environment

4.15 Geothermal Energy and Geysers Area Seismicity

The Calpine injection experience in Units 13 and 16 has been summarized by Beall and Box (1989), Beall and others (1989), Beall and others (1992), Beall (1993), Goyal and Box (1990) and Goyal and Box (1992). The following summary is condensed from Beall (1993).

Calpine's production well 956A-2 benefited from the Low Pressure Area joint injection program noted previously. Prior to the startup of injection well 956A-1, flow rate from 956A-2 was declining at a rate of about 35% per year. Immediately after 956A-1 came on-line the decline rate of 956A-2 was reduced to about 13%.

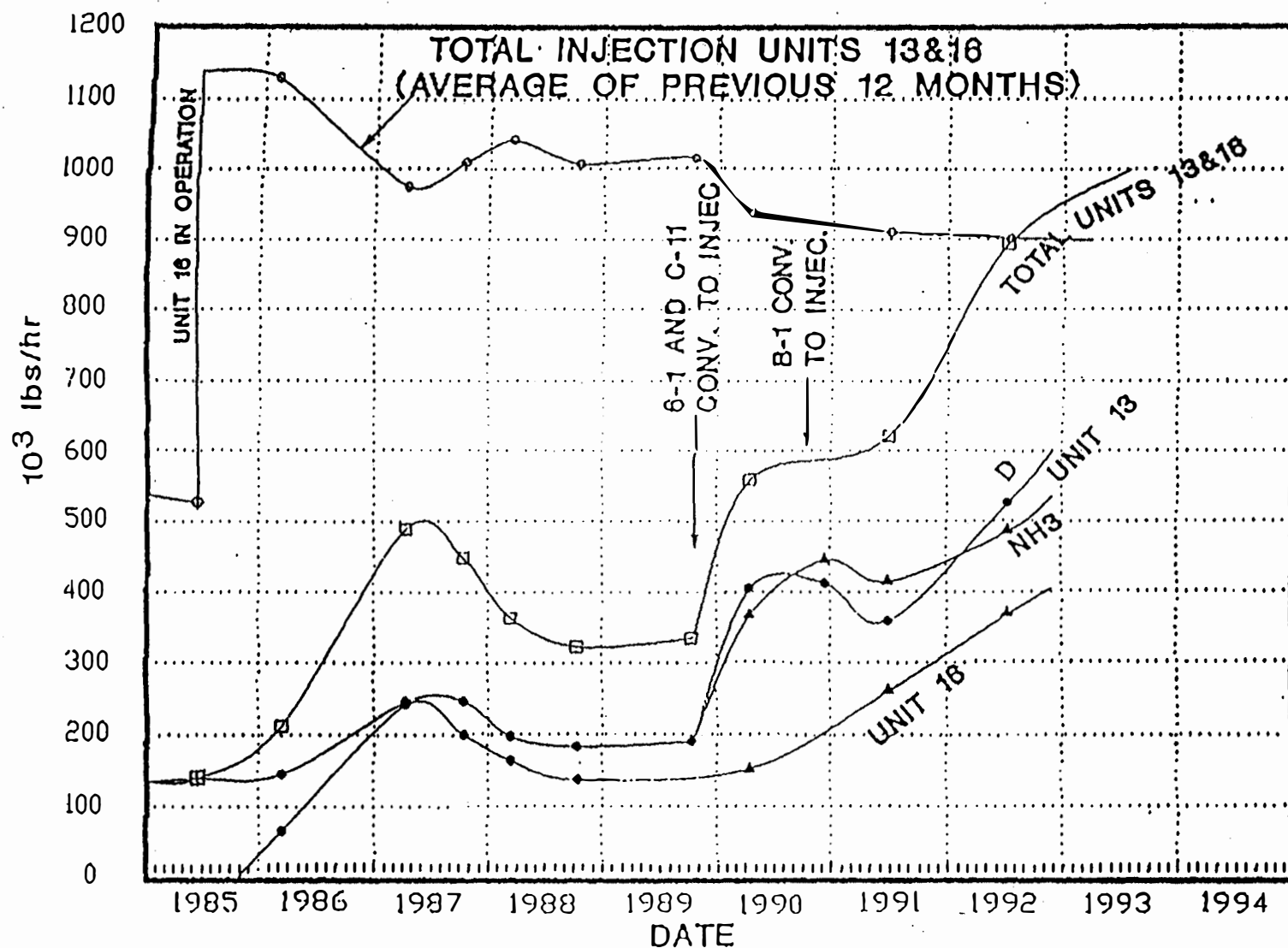
Figure 4.15.1-C shows mass flow rates of IDS in the area of Units 13 and 16 versus time. As in the NCPA area, the production rate of IDS was equal to injection rate of water as of about mid-1992. The strong increase of recovery starting in late 1989 followed the conversion of two production wells to injection, both being located in areas of strong pressure decline. One of these wells was within Unit 13; the other is in the NCPA leasehold near the boundary with Unit 13, and is operated cooperatively by both companies.

Since 1986, the annual injection rates in Units 13 and 16 have decreased along with productivity. In early 1986, injection in the Units 13 and 16 wellfield averaged over 1.1 million lbs/hr (2,200 gpm). By mid-1992, the injection rate for the previous twelve months was down to 900,000 lbs/hr (1,800 gpm).

Unocal's injection experience has been summarized in Barker and others (1992), Eneedy and others (1991, 1992), Gambill (1992), and Maney and others (1992). The following summary also relies on data obtained during meetings and conversations with Unocal personnel (March 1994).

There are two injection wells each in Units 18 and 20. DV73-33, in central Unit 18, started in 1983 but had limited use after 1987; GDC21 was started in 1985, BEF42B33 in 1990, and DV11 in late 1993. The wells started in 1985 and 1990 are both in Unit 20. Injection rates at individual wells have been as high as 400 kilotons/month (about 2,200 gpm), but rate of 150 to 300 kilotons/month (825 - 1,650 gpm) have been more typical, and periods of shut-in or minimal injection have also occurred.

Stable isotope studies, summarized for year 1991 on an Unocal map of the entire Southeast Geysers (Figure 4.15.1-D), indicate returns of up to 20% - 40% as flashed injectate in produced



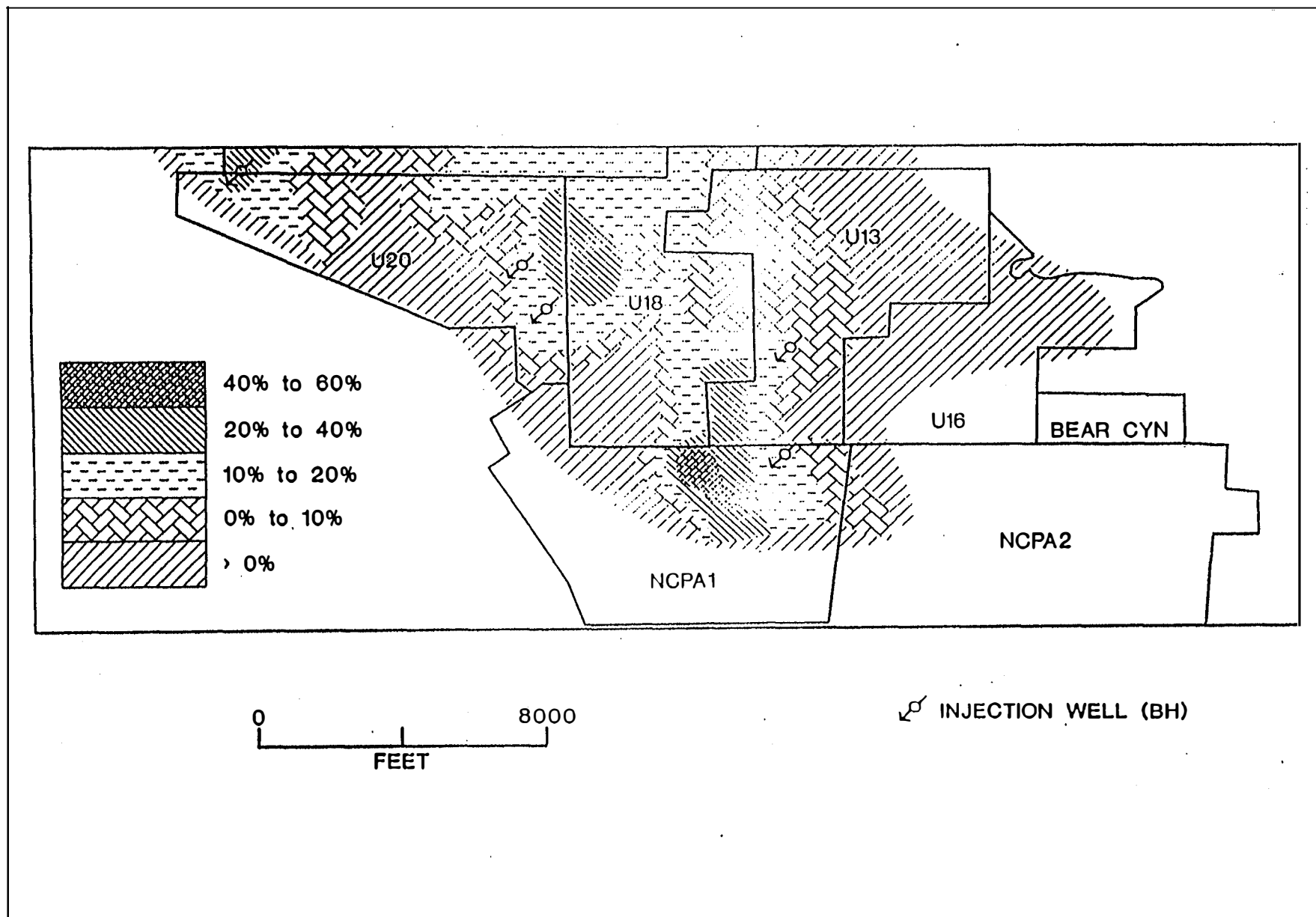
SOURCE: Graphic as reproduced from GeothermEx, Inc., 1994

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Figure 4.15.1-C

**Mass Flow Rates of Injection Derived Steam vs. Time
for Unit 13, Unit 16, Units 13 and 16 Combined.**

Two curves are shown for Unit 13 subsequent to 1989, indicating IDS mass flow rates calculated by
the geothermEx and NH₃ methods. Unit 16 curves subsequent to 1989 are calculated by the geothermEx method.



SOURCE: Graphic as reproduced from GeothermEx, Inc., 1994

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Figure 4.15.1-D
Flashed Injectate in Produced Steam 1991

steam in parts of both Unit 18 and Unit 20. The highest returns are seen at the borders between Unit 18 and 20, and between Unit 18, NCPA, and Calpine leaseholds.

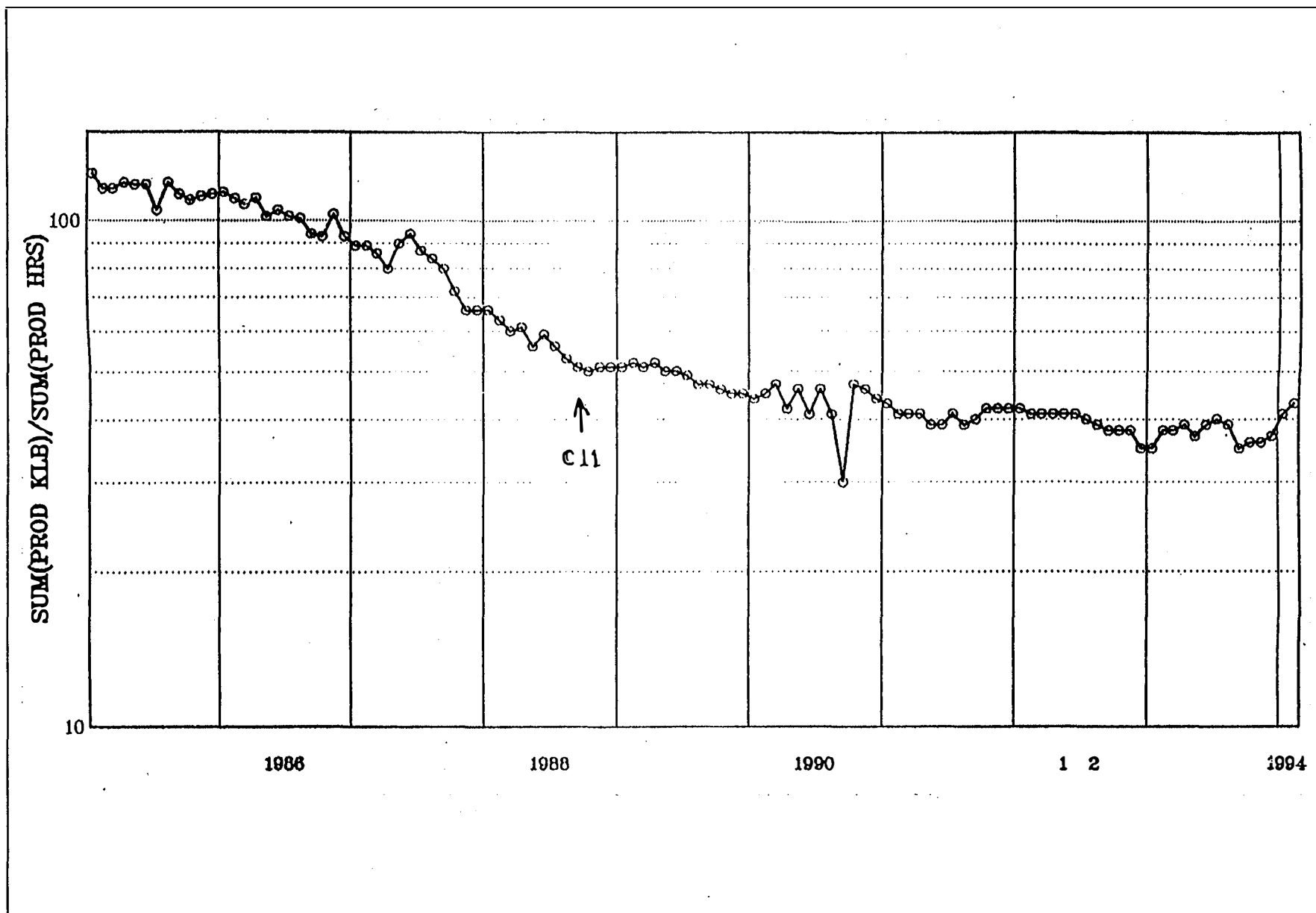
Figure 4.15.1-E shows the beneficial effect that interior injection has on production for Unocal wells in and near the Low Pressure Area. Prior to the start-up of the Low Pressure Area injection well C-11, production rate from those production wells was declining at a rate of about 25% per year. The production rate stabilized and declined at a much slower rate, about 6%, after injection in to C-11 started.

Except for instances when the rate of injection has been unusually high for a prolonged period of time, communication between the unflashed injected water and the steam production wells has not been a major problem (Enedy, *et al.*, 1992). Downhole superheat of up to 80 F was measured in well 956A-2 in May 1988, and there has been no noticeable thermal degradation caused by the injection program in the LPA in 1989. In the southwest corner of Unit 13, where production well 956A-2 is located, the wellhead superheat is around 85°F, indicating that reservoir superheat has been gradually increasing since 1988 despite interior injection. This is not surprising since the amount of vapor extracted from the reservoir far exceeds the quantity of water injected.

Similar characteristics are shown by NCPA production well F-6. Although it is located relatively near injection well C-11, downhole temperatures measured in F-6 in 1986 and 1990 show that thermal degradation had not occurred in the four year period. Thus it is reasonable to assume that the current injection is at too small a rate to cause any significant change in steam temperature. Pressure, however, has dropped significantly since 1986, as the quantity of injected fluid continues to be less than the amount of vapor extracted, thus resulting in an increase in superheat, especially in the LPA.

Initial steam superheat of about 24°F was measured for Unit 18 wells when they came on-line in 1983. Comparable level of initial steam superheat is believed to have been exhibited by Unit 20 wells. Present steam superheat data shows that the majority of production wells in these two units are producing dry steam of more than 80 degree superheat, suggesting that the reservoir is gradually drying out.

Overall, the beneficial effects of IDS recovery on deliverability and decline rates in the Low Pressure Area have exceeded those at the peripheral areas. This may be due to a combination of three reservoir factors, which appear to influence the level of benefit:



SOURCE: Graphic as reproduced from GeothermEx, Inc., 1994

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Figure 4.15.1-E
 Production Rate of Unit 18
 Wells - DV1-6, DV11-13, 15, 16

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- 1) High permeability - evidenced by wells of very high initial deliverability;
- 2) High reservoir superheat - indicating "dried out" conditions which promote efficient boiling; and
- 3) Low pressure - indicating a high degree of depletion and promoting boiling of the injectate.

Figures showing the deuterium distribution for Calpine and NCPA leases from June-August 1992, indicate that the injected water moves preferentially in the NE-SW direction toward the low pressure area around the southwest corner of Unit 13. This preferential path is probably created by the combination of: 1) a low-pressure sink at the border of the Calpine, NCPA and Unocal leases; and 2) a high-permeability pathway created by the extensive fracturing in the low pressure area (Enedy, et al., 1991).

In the present injection strategy, the eastern part of NCPA lease contains no injection wells. A few wells in this area have been known to produce small amount of liquid water, which is possibly derived from steam condensation at the edge of the reservoir. With pressure support from this water, and with the relatively small number of production wells in this area, the decline rate seen for NCPA eastern wells is mild compared to that seen in wells in the LPA. Thus, it has been beneficial to the overall production to inject most of the available water into the LPA where the need for pressure support is more acute.

In the Calpine area, power plant condensate is presently sent to four injection wells spread across Units 13 and 16 and West Ford Flat. Three additional injection wells (956A-2, 958-5, and Mckinley-4) have been set aside for injection of Lake County waste water. All three effluent injection wells are located in the highly depleted segments of Units 13 and 16 and they should provide pressure support and additional injection-derived steam to production wells nearby.

Unocal plans to mix Lake County waste water with steam condensate from the power plant and distribute the mixture to four injection wells (BEF42B-33, DV11, DV73-33, and GDC21). Production wells surrounding these injection wells will be monitored to help optimize the injection strategy. It is anticipated that the results from the monitoring program will lead to modifications of the injection program, including both the selection of the wells used for injection and the injection rates to those wells.

4.15.1.3 CHARACTERISTICS OF GEOTHERMAL FLUIDS

Fluid composition at The Geysers can be considered in terms of:

the non-condensable gases (NCG) in the steam;
the solutes dissolved in steam condensate; and,
the water produced in small amounts by some wells.

These topics are considered below, with respect to trends over space and time.

Non-Condensible Gases (NCG) in the Steam

The NCG in Geysers steam are a mixture of carbon dioxide (CO₂), hydrogen sulfide (H₂S), ammonia (NH₃), nitrogen (N₂), argon (Ar), methane (CH₄) and hydrogen (H₂), with traces of other hydrocarbons (see Table 4.15.1-1). At wells in the Southeast Geysers, the total NCG in steam have ranged from about 250 ppm-wt (parts per million by weight) to 10,000 ppm-wt, with variations seen both in space and time.

TABLE 4.15.1-1: EXAMPLES OF NON-CONDENSIBLE GASES (NCG) IN STEAM AT SOUTHEAST GEYSERS WELLS

Specie	Low-gas example (NCPA well C-1, January 1987)		Mid-range gas example (NCPA well P-2, November 1987)		High-gas example (NCPA well E-1, April 1990)	
	volume percent of dry gas	ppm-wt in steam	volume percent of dry gas	ppm-wt in steam	volume percent of dry gas	ppm-wt in steam
Total NCG	100	337	100	1248	100	11330
CO ₂	50.7	268	63.3	1015	64.8	9390
H ₂ S	10.0	41	4.7	58	3.2	354
NH ₃	6.0	12.3	6.8	42	2.7	149
Ar	0.001	0.004	0.1	1.8	0.01	1.7
N ₂	2.5	8.4	6.7	68	4.8	444
CH ₄	<.2	<.3	9.9	58	17.9	944
H ₂	30.6	7.4	8.6	6	6.7	45

SOURCE: GeothermEx, Inc. (1991)

4.0 Affected Environment

4.15 Geothermal Energy and Geysers Area Seismicity

Spatially, the NCG tend to be lowest at wells near the center of the steam field and highest at the margins. This tendency is caused by condensation of steam at the top and sides of the reservoir, where heat is lost outwards by conduction. The condensation causes steam to be drawn from the center outwards, with a counterflow of condensate moving down and back towards the center. The NCG carried in the steam remain in the condensation zone and become increasingly concentrated.

The NCG composition also shifts somewhat as a result of chemical reactions which involve gas components and rock minerals. These reactions are sensitive to changes of temperature, pressure and the overall NCG concentration. They include a mechanism which lowers the fraction of H_2S in the total NCG when the total NCG increase (see Table 4.15.1-1).

During production, the NCG in steam at many individual wells and at power plant inlets has increased. As in space, the fraction of H_2S has decreased with the increase of total NCG. The increase in NCG is linked to depletion of liquid water in the reservoir. Early production is a mixture of reservoir steam and "new" steam, which forms when reservoir condensate, trapped in the rock matrix and in smaller fractures, boils in response to the pressure decline which results from production. The reservoir steam contains gases but the "new" steam does not (except for a very small amount). As the water near a production well dries out, the NCG in reservoir steam become less diluted by "new" steam, and the wellhead gas concentration increases.

The increasing NCG concentrations have been more than offset by the declining steam flowrates. For example, in the NCPA area, the average rate of NCG per well was 5% lower in November 1990 (139 lbs/hr/well) than in January 1987 (146 lbs/hr/well), and the average rate of H_2S was 10% lower, 6.7 lbs/hr/well compared to 7.4 lbs/hr/well (GeothermEx, Inc., 1991).

There is yet no quantitative reservoir model that includes NCG in a way that enables a completely accurate and confident prediction of either the future maximum NCG, or the H_2S averaged per well, or in total steam production. However, existing trends do help establish probable bounding conditions. Beall and Box (1993) have demonstrated that the gas/steam ratio in Units 13 and 16 is inversely proportional to steam flowrate, both at individual wells and among groups of wells. Figure 4.15.1-D (from Beall and Box, 1993) shows the combined data from 41 wells at Units 13 and 16 that have been in production since January 1986, and among all Units 13 and 16 wells in production since January 1987. Because gas/steam correlates with flowrate, total gas flowrate shows a similar correlation, as shown on Figure 4.15.1-E. The data

4.0 Affected Environment

4.15 Geothermal Energy and Geysers Area Seismicity

distribute on power function curves, which can be extrapolated to indicate the gas/steam ratio and gas flowrate to be expected at lower flowrates such as those anticipated in the future. Beall and Box (1993) have done this extrapolation, showing that future gas flowrates in Units 13 and 16 are unlikely to exceed the design limits of the power plants, even if one of the power plants is retired due to diminishing steam supplies.

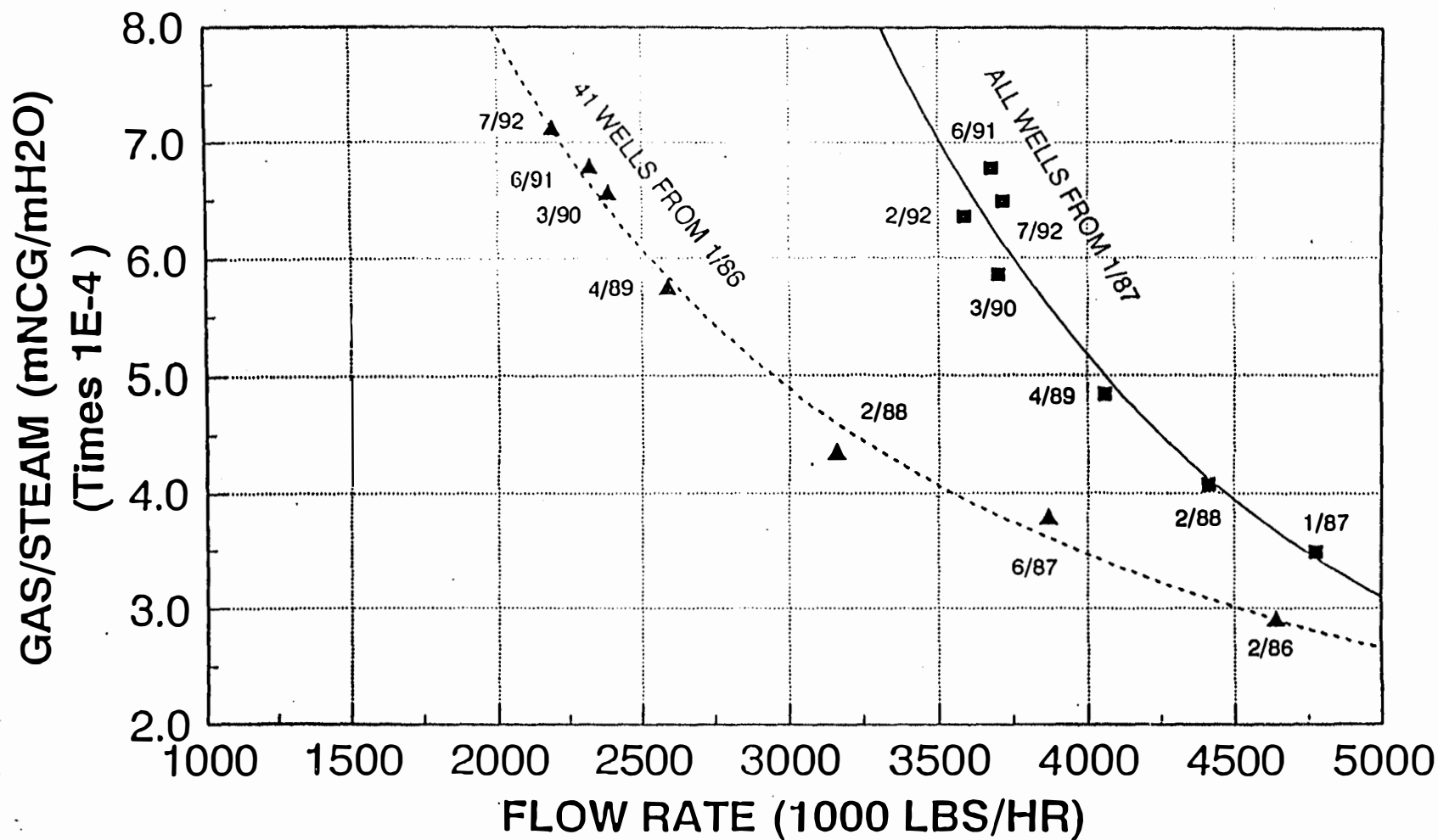
This approach to predicting NCG is essentially empirical and depends upon the assumption that future gas production will follow trends established to present. Beall and Box (1993) hypothesize that gases in the Southeast Geysers originate from outside the reservoir, and that gas production has increased as a consequence of declining reservoir pressure, which allows an influx of gases to the reservoir. This concept is not yet proven, nor is it quantified or coupled with the effects of injection. Considering this, GeothermEx believes that the empirical predictions of Beall and Box (1993) probably indicate the maximum likely gas/steam ratio and gas flowrate which will be seen in the future under conditions of declining flowrate and declining reservoir pressure. Real gas/steam and gas flowrates may be somewhat lower.

At wells in the steam reservoir at Larderello, Italy, the NCG typically have risen for periods of 5 to more than 20 years, then stabilized and finally declined. The decline at Larderello is linked conceptually to the recharge of meteoric water, and to boiling in a hypothetical deep and NCG-depleted liquid zone, which does not contribute significantly to production until there has been years of wellflow. The Geysers is considered by GeothermEx, Inc., to be somewhat similar to Larderello, although NCG at The Geysers are lower, there is no evidence that a deep liquid zone exists, and recharge may be more limited.

As of November 1990, NCG and H₂S concentration appeared to be stable at almost half of the NCPA wells, increasing at half, and decreasing at a few that have been strongly affected by injection. The stable wells were located particularly at pads on the field perimeter, where gas concentrations are relatively high (5,000 to 10,000 ppm-wt), and where there has been little to no effect of injection on the stable isotope values.

Injection Effects

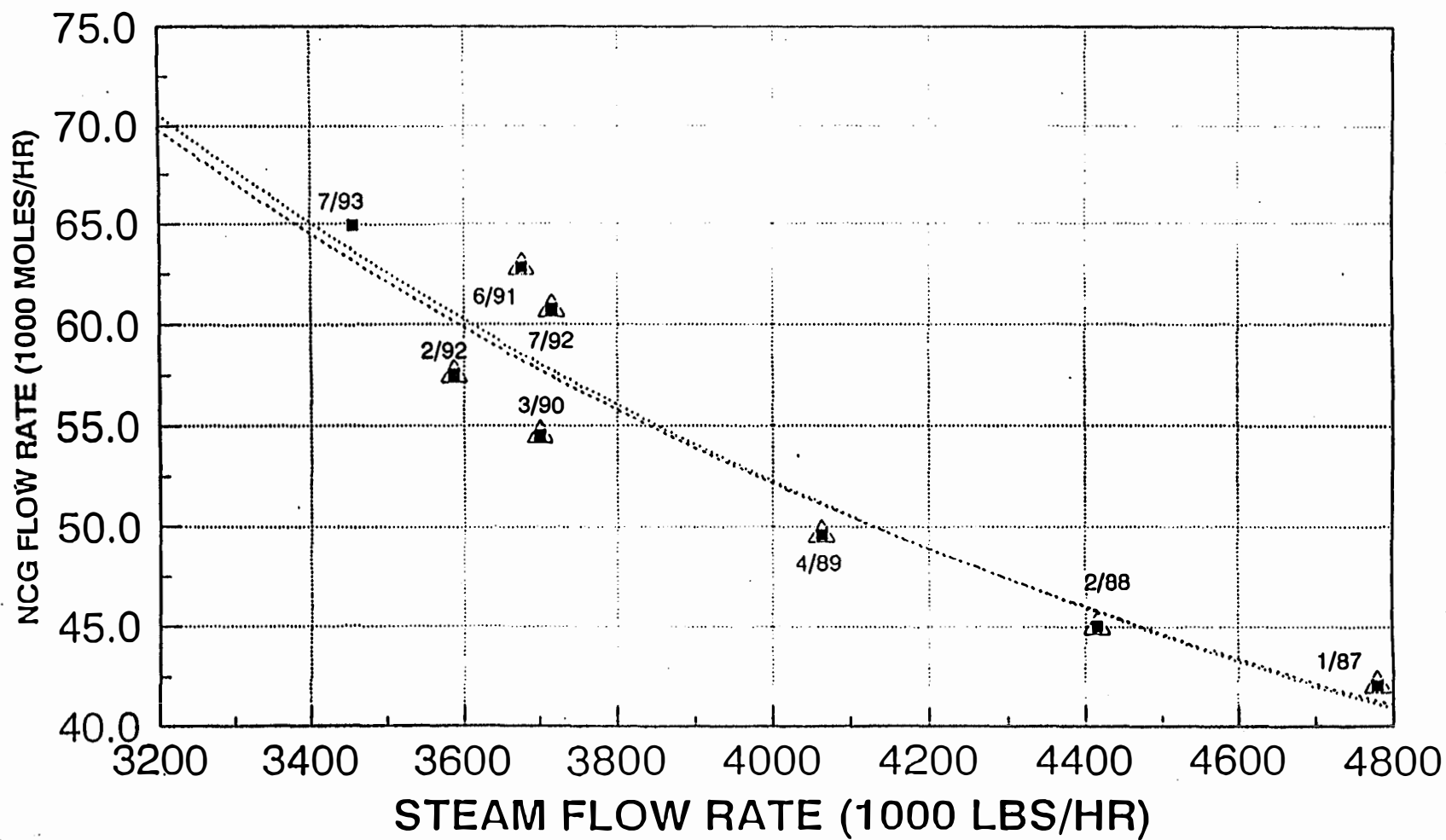
The steam condensate and meteoric water injected into the reservoir are nearly gas-free, and tend to dilute the NCG at nearby production wells so that there are regions of depressed NCG which include some of the injection wells. Returns of injected H₂O are monitored by analyses



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SOURCE: Graphic as reproduced from Calpine, 1994

Figure 4.15.1-F
 Total Flow Rate vs. Gas to Steam Ratio
 Units 13 and 16 Wells



SOURCE: Graphic as reproduced from Calpine, 1994

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Figure 4.15.1-G
NCG Flow Rate vs. Steam Flow Rate
all Unit 13/16 Wells 1/87-7/93

of the stable isotopes deuterium and ^{18}O , which depart from their background levels, as explained previously.

Injection also has an effect on NCG composition, because the injectate carries NH_3 (ammonia) dissolved upon contact with the gases in power plant condensers, and O_2 , N_2 and Ar dissolved upon contact with the atmosphere in cooling towers and holding tanks. The oxygen is reactive and essentially disappears. However, the NH_3 , N_2 and Ar appear at production wells as concentration anomalies associated with the stable isotope shift. Calpine uses the fraction NH_3 in the gas to calculate the mixing ratio between IDS and primary reservoir steam.

Steam Condensate Chemistry

The condensate that forms from steam in the Southeast Geysers is very dilute, and rarely carries more than 1 ppm of any individual solute. Exceptions are dissolved gases and their hydrated equivalents, including carbon dioxide, bicarbonate, ammonia, hydrogen sulfide, and boron species. These often are present in the range 10 to 20 ppm each, except bicarbonate, which appears at up to about 125 ppm. The exact concentrations reported from chemical analyses of the volatiles are sensitive functions of the temperature and pressure at which the condensate co-exists with, or has been separated from, the gases. Also, analyses of the condensates rarely are complete, and often show bicarbonate far in excess of co-existing cations, because NH_4^+ is often not reported.

At 25°C and in contact with the atmosphere, the condensate pH usually is between 5 and 7, alkalinity is present at 20 to over 125 ppm as bicarbonate (HCO_3^-), and sulfate (formed by oxidation of dissolved H_2S during sample storage) may be present. Condensate that has been treated for H_2S abatement may contain higher levels of sulfate, balanced chemically by sodium and/or iron.

The dissolved acidic gases make the condensate corrosive, especially after aeration in cooling towers. Therefore, chemical treatment of cooling tower waters is performed routinely. Some condensate samples contain a few ppm of Cl, but this is believed to be carried by water droplets entrained in the steam. The highly corrosive, low pH, Cl-bearing condensate found at some superheated wells in the north Geysers has not been encountered in the southeast.

Water Chemistry

There are a few wells at the margins of the steam field in the Southeast Geysers that have produced limited amounts of water along with steam. This water is believed to be condensed steam and steam condensate. However, it has the characteristics of deep groundwater that is probably present at the top and sides of the steam reservoir, where pressures are below hydrostatic. The rate of water flow rarely exceeds a few percent of total production. Samples of the water typically contain between about 20 and 500 ppm Cl, which is balanced chemically by sodium and potassium. Quantities of sulfate, bicarbonate and dissolved silica may also be present. Occasionally this water is encountered and produced during air drilling of the wells and is produced for only a short period before drying up.

4.15.2 SEISMICITY IN THE GEYSERS

4.15.2.1 INTRODUCTION

Seismicity refers to the characterization of the distribution, patterns of occurrence, and magnitude of earthquakes and their related hazards within a geographically defined region. This section describes: (a) the regional seismic setting; (b) earthquake occurrence and origins within The Geysers geothermal field, with special attention to the effects of geothermal fluid production and injection; (c) seismic ground-shaking hazard in the Putah Creek valley between Anderson Springs and Cobb Mountain; and (d) the current concepts of the seismic hazard resulting from induced seismicity in The Geysers. Key technical terms are defined in the Glossary. Information for this section was drawn primarily from a report by GeothermEx, Inc. (1994), included in the Appendix, and other sources as cited.

The issue central to this EIR/EIS is whether hazardous earthquakes are induced by geothermal industry activities in the southeastern portion of The Geysers steamfield, with particular focus on effects related to injection and production. Both earthquakes and microearthquakes are considered. Earthquakes commonly felt by the public have a magnitude over 3.0. Microearthquakes are those with a magnitude of 3.0 or less; at that magnitude the earthquake is rarely felt by the public. A good deal of concern has been expressed by residents near The Geysers regarding the increased amount of felt earthquakes since geothermal development began in the KGRA. Earthquake magnitudes reported herein are of two types, local or "Richter" (Ml), and coda-length (Mc). These two types are equivalent for magnitudes up to 4.0, but for magnitudes 4.5-5.0, Mc usually exceeds Ml by about 0.3. The U.S. Geological Survey (USGS)

reports M_c for all events, but only certain of those with magnitude over 3 have listed M_l . Because M_l is considered the standard magnitude for earthquake hazard studies, and because events with $M_l > 4$ have damage potential, it is important to distinguish between M_l and M_c for $M_l > 4.0$.

The work of several researchers to be summarized in this EIR/EIS has established that production and injection of geothermal fluids triggers large numbers of microearthquakes at The Geysers geothermal field. The important question, however, is whether earthquakes induced by geothermal production and injection activities in the Southeast Geysers are a potential threat to human safety and property over and above naturally occurring seismicity .

4.15.2.2 REGIONAL SEISMIC CONSIDERATIONS

Plate Tectonic Setting

Most earthquake activity in California is related to large scale movements of the Earth's crust (Bolt, 1988). These movements, termed "tectonics", occur on the scale of immense sections of the crust (called tectonic plates) and more locally in the form of mountain building, for example, the deformation of rocks in the Coast Ranges and creation of volcanic forms. The primary tectonic interaction affecting northern California is that between the North American Plate and the Pacific Plate. Along the western margin of the North American plate, the predominant mode of deformation for the past three to five million years (m.y.) has been "right-lateral shearing". Shear is a mode of failure whereby two adjacent parts of the crust "slide" past one another parallel to the plane of failure. The shearing is characterized as right-lateral because the movement is generally horizontal and such that an observer facing the shear zone on one plate perceives the movement of the opposite plate as being to the right. As the two plates move at this interface, the predominant movement of the western edge of California is toward the northwest relative to the rest of the state. Most of the mountain ranges in the Coast Ranges similarly display a crest alignment on a northwest-southeast axis.

As described by Bolt (1988), deep-seated tectonic forces beneath the surface cause the deformation of the rock. The rocks are strained by the deformation, until eventually the weakest rocks, or those at the point of greatest strain, break (that is, fracture). The fracture is followed by a "springing back" (termed elastic rebound) on each side of the fracture, which is the immediate cause of earthquakes. The location of the break may be deep in the crust or closer to the surface. Where the location of fracture is manifested at the surface, it is mapped as a fault.

Figure 4.15.2-A shows the most important faults recognized as active or potentially active within most of the northern Coast Ranges.

Repeated geodetic surveys over the past century have documented that right-lateral shear displacement is widespread in the central and northern California Coast Ranges, with the San Andreas fault as the principal zone of movement. Highly precise measurements performed over the past two decades indicate that the relative rate of movement (right-lateral shear) of the Pacific and North American plates in Northern California is about 5.5 cm/yr. Most of this displacement is accommodated within the Coast Ranges along major faults of the San Andreas fault system. Nearly one-half (around 2 cm/yr) of this takes place along the San Andreas fault, the master fault of the San Andreas system.

The San Andreas fault system includes most of the major active faults of the Coast Ranges, from Santa Barbara on the south to those north of Cape Mendocino. North of Hollister, the San Andreas fault splays into two principal trends, the San Andreas fault and the Hayward-Calaveras fault zone, both of which are active. North of San Jose, the Hayward-Calaveras fault zone splays to form the Hayward and Calaveras fault zones, and the latter splays yet again to form the Marsh Creek-Greenville fault zone.

The Hayward fault zone extends northward to form the Rodgers Creek-Maacama fault zones; and the Calaveras fault zone joins the Green Valley fault zone, which is believed to extend northward past Lake Berryessa to connect with the Hunting Creek and Bartlett Springs fault zones (based upon seismicity trends shown in Figure 4.15.2-A). All of these fault zones have Holocene (most recent 10,000 years) ground-surface displacements and present-day movement.

Many faults of short length in the Clear Lake region are normal faults (that is, faults in which a block of the crust moves up or down relative to the block on the opposite side), and their development has been ascribed to east-west crustal extension, in response to tectonic processes that occurred 5 to 10 million years ago and regional right-lateral shear. This crustal extension is thought to have been the source of the Sonoma and Clear Lake volcanic sequences (McLaughlin, 1981). Emplacement of the pluton (magma chamber) which is the probable heat source for The Geysers geothermal system was probably closely related to these events.

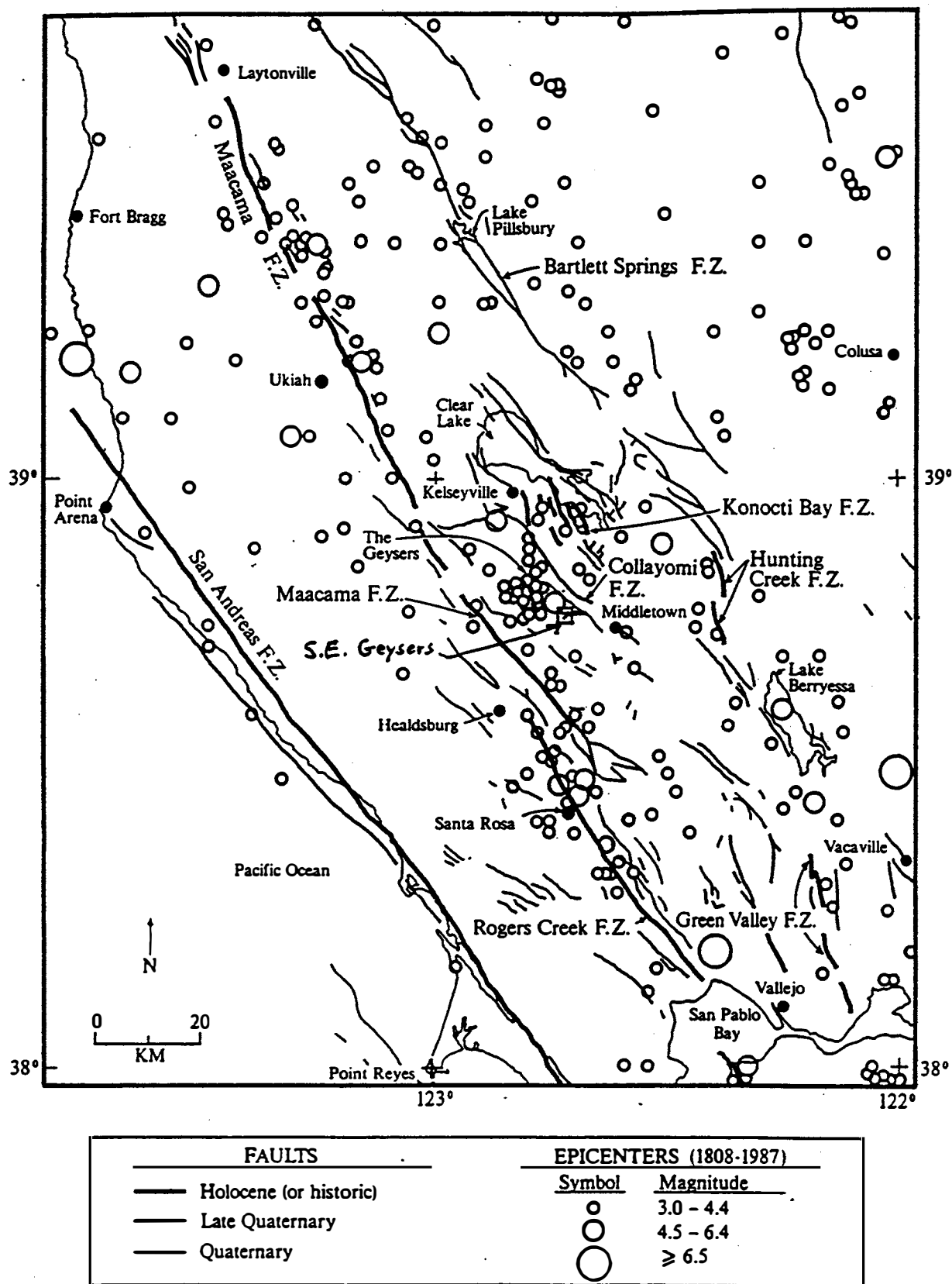


Figure 4.15.2-A: Map showing regional capable faults and seismicity, $M_l \geq 3$. (Faults after Jennings, 1992; epicenters after Guter, 1988).

SOURCE: Graphic as reproduced from GeothermEx, Inc.

4.15.2.3 CAPABLE REGIONAL FAULTS AND SEISMICITY

Capable faults are defined as those faults which are now or which reasonably can be expected to become seismically active, that is, cause earthquakes. Faults whose most-recent ground-surface displacements are historic (last 200 years) or Holocene (last 10,000 years) in age are assumed to be capable. Those whose most-recent ground-surface offsets are of Late Quaternary age (about 1 m.y. to 10,000 years ago) usually are considered capable in California. Faults with most-recent offsets of Early Quaternary age (1 to 2 m.y.) may or may not be considered capable, depending on details of their relationship to regional features.

The San Andreas fault system in or near the Clear Lake region is comprised of three principal fault zones, all of which are capable. From west to east, these are the San Andreas fault, the Rodgers Creek-Maacama fault zone (northward extension of the Hayward fault zone), and the Concord-Green Valley-to-Bartlett Springs fault system (northward extension of the Calaveras fault zone).

Their ages of most-recent ground-surface offset range from early Quaternary to historic time. Figure 4.15.2-A combines faults designated as "historic" and "Holocene" by Jennings (1992). The only historically active faults shown by Jennings in this region are the San Andreas and the Big Valley faults. Earthquake epicenters shown in Figure 4.15.2-A are taken from a map entitled "Seismicity of California, 1808-1987" (Goter, 1988). They show alignment with all of these fault zones, indicating continuing slippage at depth. It is noted that a trend of epicenters appears to connect the Green Valley and Bartlett Springs fault zones, which are designated as Holocene by Jennings (1992).

Figure 4.15.2-B, adapted from Eberhart-Phillips (1988), shows the epicenters of numerous earthquakes with magnitudes much smaller than those in Figure 4.15.2-A. Magnitudes are as low as 1.5 for the period March 1972 - December 1981. These illustrate abundant seismicity along major fault trends, including the interval between the Green Valley and Bartlett Springs fault zones, as mapped by Jennings (1992).

The San Andreas fault ruptured most recently in this region during the great 1906 earthquake; the Rodgers Creek fault zone was the source of the 1969 Santa Rosa earthquakes. The Rodgers Creek-Maacama and Green Valley-to-Bartlett Springs fault zones display Holocene surface offsets, and have very youthful expression in the topography, including shutter ridges, benches,

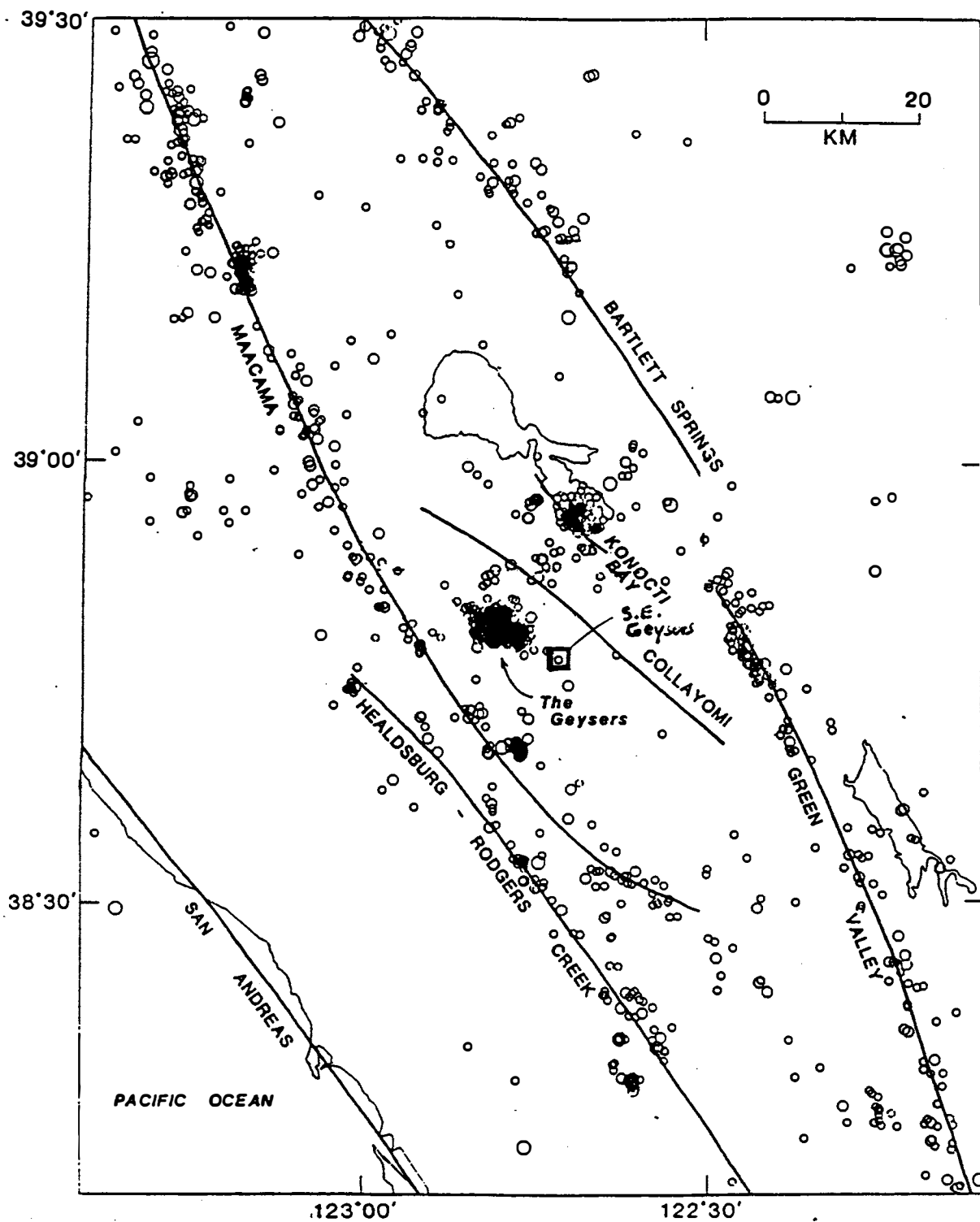


Figure 4.15.2-B: Map showing regional faults and seismicity, $M_c \geq 1.5$, March 1972 - December 1981. (Adapted from Eberhart-Phillips, 1988)

SOURCE: Graphics reproduced from GeothermEx, Inc.

and sag ponds. Contemporary surface creep (slow movement along a fault in which displacement occurs without an earthquake) has been reported for the Maacama fault zone in a few locations, as discussed below; therefore that fault can also be considered as "historic" in age.

Table 4.15.2-1 lists important attributes of capable faults of the region as interpreted by GeothermEx (1994) for this EIR/EIS, including relatively minor faults whose descriptions are given below. Attributes include estimated slip rate, age of most recent ground-surface offset, presence of aligned seismicity, length, and maximum historic and maximum credible earthquake magnitudes. Predicted effects of maximum peak ground acceleration and Modified Mercalli intensity at Anderson Springs are also included in Table 4.15.2-1. The Modified Mercalli Earthquake Intensity Scale is presented in Table 4.15.2-2.

San Andreas Fault

This is the most active fault in California. Its northern segment (that portion of the fault north of Hollister) has a slip rate of around 21 millimeters per year (mm/yr) (Niemi and Hall, 1990), and maximum historic and credible earthquake magnitudes of 8.25, which is the approximate size of the great 1906 earthquake. A repeat of the 1906 earthquake magnitude is possible presently at any time and likely within the next 100 years.

Rodgers Creek-Maacama Fault Zone

The activity of this fault zone has been documented over the past decade. Measurements of slip rate on the Maacama fault range from 1 to 5 mm/yr (Galehouse and others, 1992) and on the Rodgers Creek fault from 1 to 8 mm/yr (Wesnousky, 1986); a 5 mm/yr is a reasonable average for the latter fault. Excavations near Willits showed evidence of two or more surface rupture events in the last 16,200 years (Upp, 1989). Figures 4.15.2-A and 4.15.2-B indicate a significant alignment of seismicity along this fault trend.

The largest earthquakes reported for the Rodgers Creek fault are the October 1, 1969 events near Santa Rosa, MI 5.6 and 5.7. This earthquake also caused damage at Anderson Springs. On the Maacama fault, the two largest reported shocks occurred on November 22, 1977 (MI 4.8) near Willits and on March 25, 1978 (MI 4.4) near Ukiah (Coffman and others, 1982). The first of these caused moderate damage to buildings, mostly older structures, in Willits; the maximum reported intensity was VII, and some southern Clear Lake communities reported intensity VI. The second had maximum intensity VI, and caused only minor damage.

Table 4.15.2-1
Capable faults: earthquake potential and effects at Anderson Springs

FAULT NAME	FAULT ATTRIBUTES							SITE EFFECTS	
	AGE ¹	AS ²	SLIP ³	L ⁴	Mh ⁵	MCE ⁶	R ⁷	PGA ⁸	MMI ⁹
UNITS ->			mm/yr	km			km	g	
San Andreas/ north segment	Hist	Y	21/m	420	8½	8½	55	.14	VI
Rodgers Creek- Maacama	Hist	Y	5/m	188	4.8	7½	15	.38	VIII-
Green Valley- Bartlett Springs	Holo	Y	4/m	180	4.5	7½	25	.23	VII
Collayomi	LQ	N	.8/i	26	5?	6½	2	.50	VIII
Konocti Bay	Holo	Y	1/s	15	3.1	6	15	.16	VI
Big Valley	Hist	Y	.8/i	6	5?	5½	21	.09	VI

NOTES:

- ¹ Hist=historic, Holo=Holocene, LQ=Late Quaternary (Jennings, 1992)
- ² Alined Seismicity: Y = yes, N = no (see text)
- ³ Slip rate: /m = measured, /i = inferred from geological data, /s = supposition (see text for sources of data)
- ⁴ Mapped length of fault or fault zone (Jennings, 1992)
- ⁵ Maximum historic earthquake magnitude attributed (see text)
- ⁶ Maximum credible earthquake (see text)
- ⁷ Nearest approach of fault to Anderson Springs (Jennings, 1992)
- ⁸ Peak ground acceleration at Anderson Springs (see text)
- ⁹ Modified Mercalli intensity at Anderson Springs, assumed hard-rock conditions (see text)

TABLE 4.15.2-2

MODIFIED MERCALLI INTENSITY SCALE OF 1931¹

(Abridged)

- I. Not felt except by a very few under especially favorable circumstances. (I Rossi-Forel Scale.)**
- II. Felt only by a few persons at rest, especially on upper floors on buildings. Delicately suspended objects may swing. (I to III Rossi-Forel Scale.)**
- III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibration like passing truck. Duration estimated. (III Rossi-Forel Scale.)**
- IV. During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, and doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably. (IV to V Rossi-Forel Scale.)**
- V. Felt by nearly everyone; many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop. (V to VI Rossi-Forel Scale.)**
- VI. Felt by all; many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight. (VI to VII Rossi-Forel Scale.)**
- VII. Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well built ordinary structures; considerable in poorly built or badly designed structures. Some chimneys broken. Noticed by persons driving motorcars. (VIII- Rossi-Forel Scale.)**

(continued)

¹ Harry O. Wood and Frank Neumann, in Bulletin of the Seismological Society of America, Vol. 21, No. 4, December 1931.

TABLE 4.15.2-2 (continued)

- VIII.** Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motorcars disturbed. (VIII+ to IX Rossi-Forel Scale.)
- IX.** Damage considerable in specially designed structures; well-design frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken. (IX+ Rossi-Forel Scale.)
- X.** Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rail bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks. (X Rossi-Forel scale).
- XI.** Few, if any (masonry), structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
- XII.** Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into the air.

SOURCE: GeothermEx, Inc.

Green Valley-Bartlett Springs Fault Zone

The Green Valley fault has long been recognized as active, based upon measured creep of about 4 mm/yr (Wesnousky, 1986) and aligned seismicity (Figures 4.15.2-A and -B). The Bartlett Springs fault zone displays Holocene displacement at its northern end, near Lake Pillsbury, and at its southern end, along the Hunting Creek fault (Earl Hart, personal communication, March 11, 93). Figures 4.15.2-A and -B reveal a continuous belt of seismicity along the entire length of the Green Valley, Hunting Creek and Bartlett Springs faults, and along intervening unnamed faults located on the west side of Lake Berryessa. Figure 4.15.2-B shows the fault interpretation adopted by Eberhart-Phillips (1988), in close agreement with that of Hearn and others (1988). This makes the Green Valley fault continuous from its position east of Napa as shown by Jennings (1992), northward past Lake Berryessa, to the latitude of Middletown. The largest associated earthquakes have had magnitudes reported in the range M_l 4.5-6.4 (Figure 4.15.2-A), but none is likely to have exceeded M_l 5.

Collayomi and Big Valley Faults

The Collayomi fault is mapped as Late Quaternary by Jennings (1992). Hearn and others (1988) stated that it apparently offsets volcanic flows dated as 0.6 m.y. in a right-lateral sense by 0.5 km, this being a slip rate of 0.8 mm/yr. However, they point out that the displacement could be vertical rather than horizontal. They also indicate that the fault apparently had dammed the flows of the Clear Lake Volcanics on the southwest, suggesting that a northeast-facing scarp previously existed there. They consider the Big Valley fault to be a prominent splay of the Collayomi fault, and note that a 2-km-long segment showed en echelon ground rupture (i.e., broken into "blocks" each displaced in series relative to the adjacent block, like a stack of dominoes on edge) at the time of the great 1906 San Andreas earthquake. This same segment shows evidence of right-lateral offset of 0.42 km during the past 0.5 m.y., for a slip rate of 0.8 mm/yr. Seismicity appears to cluster in the vicinity of the Big Valley fault (Figures 4.15.2-A and -B), but none appears near the Collayomi fault.

Southern Clear Lake Basin

The vicinity of the southern end of Clear Lake displays numerous short faults of Holocene age and abundant microseismicity. The Konocti Bay fault zone and the Big Valley fault appear to be the principal seismically active faults in this area (Figure 4.15.2-B; Hearn and others, 1988; Eberhart-Phillips, 1988). Beneath Konocti Bay, a fault has produced a 1-meter-high scarp in

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lake-bottom sediments. However, microseismicity also occurs farther to the east, along unidentified faults of the southern Clear Lake basin. Hearn and others (1988) described several faults besides the two mentioned above, and they also noted that the principal displacements on all faults in Clear Lake basin are normal rather than strike-slip. This fits with their observation that the 0.6-m.y.-old basin has subsided 1,000 m or more during eruption and deposition of the volcanic rocks. They calculate an overall subsidence rate of 1.7 mm/yr over the past 0.6 m.y. On this basis, Greensfelder estimates the very approximate slip rate of 1 mm/yr on the Konocti Bay fault zone, apparently the most active fault zone of the basin (GeothermEx, 1994).

Three felt earthquakes in the southern Clear Lake Basin are listed by Coffman and others (1982), and additional information concerning magnitude and felt area was obtained from the Seismographic Station of the University of California, Berkeley. The first is dated 10 November 1954 (Ml 4.4), and caused slight damage at Lakeport. The second and third occurred near Kelseyville on 29 April and 5 May 1955, with Ml 3.6 and Ml 4.6-5.0 respectively. The 29 April shock had a maximum intensity of VI and was felt over 900 square miles. Chimneys and windows were broken at Lower Lake. There were two felt aftershocks the same day. The 7 May shock also had a maximum intensity of VI, and was followed closely by aftershocks only a little smaller in magnitude. This was felt over an area of 1,700 square miles, including Clearlake Highlands, Lower Lake and Clear Lake Oaks. A few chimneys fell and plaster was cracked in some older buildings. One of these shocks has its reported epicenter located near the Big Valley fault.

Numerous earthquake swarms (similar-sized events clustered in time and space) with $M_l \leq 3.5$ have occurred in the southern Clear Lake basin, and many of these epicenters are shown in Figure 4.15.2-B. Eberhart-Phillips reported that focal mechanisms indicate an oblique right-lateral strike-slip, that is, a strike slip with a dip-slip component, on north-northwest-trending planes, subparallel to mapped faults. Focal depths range from 2 to 6 km here, as in The Geysers geothermal field, and the shallow maximum depth may be the result of elevated crustal temperatures resulting from the presence of a magma body at shallow depth.

4.15.2.4 SEISMICITY IN THE GEYSERS GEOTHERMAL FIELD (GGF)

Figures 4.15.2-A and -B show a very dense cluster of seismicity in the GGF. However, this cluster is composed of small events, with $M_l \leq 4.2$ ($M_c \leq 4.6$). Since 1972, only four earthquakes have had $M_l \geq 4.0$, and these had only $M_l 4.0-4.4$ ($M_c 4.0-4.6$). They occurred in the years 1982,

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1984, 1990 and 1992. The two largest events on record for the GGF had M_l 4.2 (18 August 1990) and M_l 4.4 (19 September 1992).

Seismicity at the GGF cannot easily be correlated with mapped faults, but the faulting process appears to largely reflect the regional pattern of crustal stress. The magnitude-frequency behavior of GGF seismicity is shown in Figure 4.15.2-C; these data are discussed later. The GGF seismicity appears to be spatially continuous with that of the southern Clear Lake basin, although temporal relationships have not been investigated.

Seismicity in the GGF appears to have developed and to continue principally as a result of geothermal development activities occurring over the past twenty or more years. Numerous scientific studies covering many geophysical aspects of the GGF have been published since around 1970; many of these are mentioned below and in Section 5.3.2. These studies describe measured subsidence of the land surface, increases in seismicity associated with production increases, and detailed correlations of seismicity with injection wells and volumes of injection fluid.

4.15.2.5 HISTORY OF INDUCED SEISMICITY STUDIES

In 1960, twelve wells began to supply steam to an 11 MW power plant built by PG&E. In 1966, power output increased to 51 MW, and by 1978 approximately 95 wells delivered steam to eleven power plants, with a total installed capacity of 502 MW.

Seismicity associated with development of the GGF was not documented until 1972, because seismographic networks did not have the capability to do so. As a result, no adequate baseline exists to identify local seismicity before geothermal development was initiated. Before 1972, the only seismographic network in the region was operated by the Seismographic Station of the University of California, Berkeley, and the station nearest to the GGF was located at Calistoga, about 30 km to the south. The smallest earthquakes whose epicenters could be located within the GGF area had magnitude of nearly 3. However, numerous events with $M_l \geq 2$ within 60 km of the Calistoga station were recorded at Calistoga between 1962 and 1977. Based upon available information, it is reasonable to conclude that many of the pre-1972 events, as well as later ones, had epicenters in the GGF.

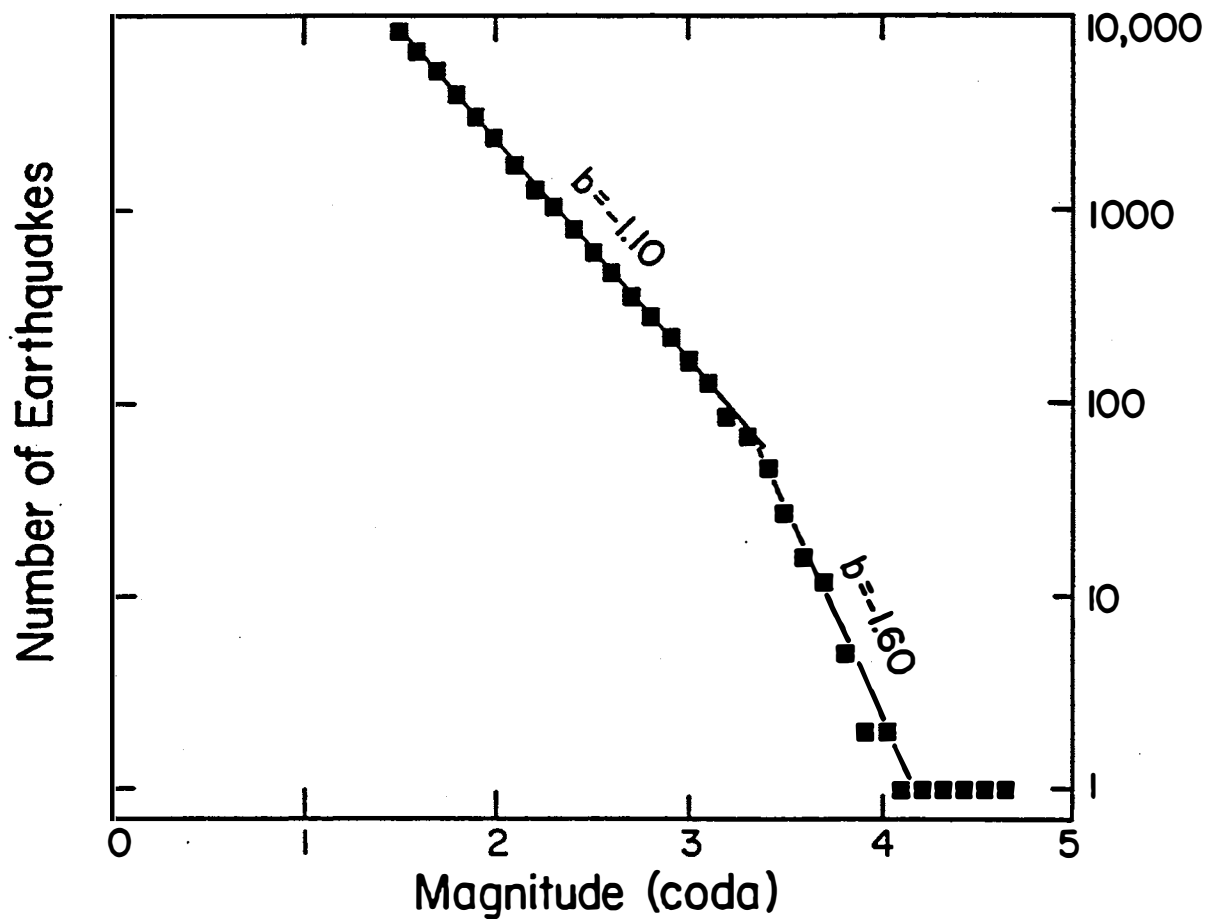


Figure 4.15.2-C: Magnitude versus frequency-of-occurrence of earthquakes occurring in the GGF. (Data from USGS).

SOURCE: Graphic as reproduced from GeothermEx, Inc.

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The rate of occurrence of events recorded at Calistoga during 1975-77 was nearly twice that recorded during 1962-63. It is reasonable to conclude that much or most of this increase in seismicity was related to increased power production in the GGF (Eberhart-Phillips and Oppenheimer, 1984).

One of the very earliest studies concerning small earthquakes at the GGF involved the use of eight portable seismographs over a three-week period to record and locate 53 events during the spring of 1971. The epicenters were concentrated in a narrow zone, 5-km long by 1-km wide, lying along the north side of Big Sulphur Creek, where the bulk of the more-than-50 steam production wells and two injection wells were located. Principally because some 22 of the epicenters were scattered as far as 7 km beyond this zone, the authors concluded that the seismicity was not caused by geothermal activities.

By 1972, the highly sensitive seismographic network operated by the U.S. Geological Survey in northern California (CALNET) was routinely providing hypocentral locations (epicenters and focal depths) of most events with $M_c \geq 1$ in the GGF (Bufe and Ludwin, 1980). In 1975, CALNET's capability in the GGF was greatly increased by the addition of four new stations located at the periphery of the field. With this enhancement, CALNET (and the computer system used to process its data) began to provide hypocentral locations of all events with $M_c \geq 1.2$ (Oppenheimer, 1986). Since 1975, CALNET hypocentral coordinates have typically had a precision of around 0.4 km (1,300 feet) in the horizontal and 0.6 km (2,100 feet) in depth. CALNET currently consists of six widely spaced stations across The Geysers.

There are three other earthquake monitoring systems in The Geysers. Unocal has operated 22 stations since 1988, including six in the Southeast Geysers. Some of the Unocal data have been published, but most of the information is proprietary. The Lawrence Berkeley Laboratory (LBL) and the Lawrence Livermore National Laboratory (LLNL) also operate 24 and 5 stations in The Geysers, respectively. These stations have the capability to record microearthquakes with a high degree of resolution. The LBL and LLNL data are quite extensive for the Northwest Geysers. A large amount of data has been collected for the Southeast Geysers. However, at present, the data have not been reduced and analyzed in a manner useful to the analysis in this EIR/EIS. Because these three monitoring programs do not have readily available reduced data, the USGS CALNET data are the basis for this analysis.

Patterns of Seismicity in The Geysers

Seismicity in the GGF is described in Figures 4.15.2-C through -E. Figure 4.15.2-C is a plot of earthquake magnitude versus frequency of occurrence for well-located events in The Geysers from 1975 to 1991. The figure reveals a large number of microearthquakes and a small number of earthquakes greater than M_c 3, with no earthquakes greater than M_c 4.6.

Figure 4.15.2-D is a map of epicenters of events with $M_c \geq 3.0$, 1972-1993. The figure indicates the geographic concentration of earthquake epicenters and the northwest and central Geysers region. In contrast, only a few earthquake epicenters are located in the southeast Geysers in the same time period.

Figure 4.15.2-E is a histogram showing the annual numbers of well-located microearthquakes with $M_c \geq 1.4$ in The Geysers from 1975 to 1991 (all data were provided by David Oppenheimer of the USGS). Limitations of the CALNET seismographs prevent accurate location of all microseismic events. Including the poorly located events not shown on the Figures, the actual numbers of events are roughly double those shown (David Oppenheimer, personal communication, March 1993). Figure 4.15.2-E reveals a major increase in seismicity from 1975 to 1983, accompanying the large increase in steam production in the GGF. Plots of epicenters for the three periods 1976-1980, 1981-1985 and 1986-1990 were examined. They clearly show the southeastward development of seismicity in response to the progressive step-out of geothermal exploitation in the same direction. However, it is important to note that Figure 4.15.2-D shows that only two events with $M_c \geq 3.0$ have occurred in the southeast GGF, south and east of Section 21.

Magnitude Distribution in The Geysers

Figure 4.15.2-C presents USGS data on the magnitude-frequency data for well-located events $M_c \geq 1.4$ in the GGF during the period 1 January 1975 to 31 December 1991, comprising 10,404 events. (Forty-three percent of all events $M_c \geq 1.4$ were rejected for poor location, so that the actual number of events is 2.3 times those shown.) However, all events with $M_c \geq 4.0$ are included, because such large events always are well-located. The relationship indicated on Figure 4.15.2-C is quite linear for M_c 1.5 to 3. For $M_c > 3$ the slope of the line steepens, indicating a marked drop off in the number of larger seismic events. The data for $M_c > 4$ does not fit a straight line. The data on this graph reflect the fact that induced seismicity in the GGF

SOURCE: Graphic as reproduced from GeothermEx, Inc.

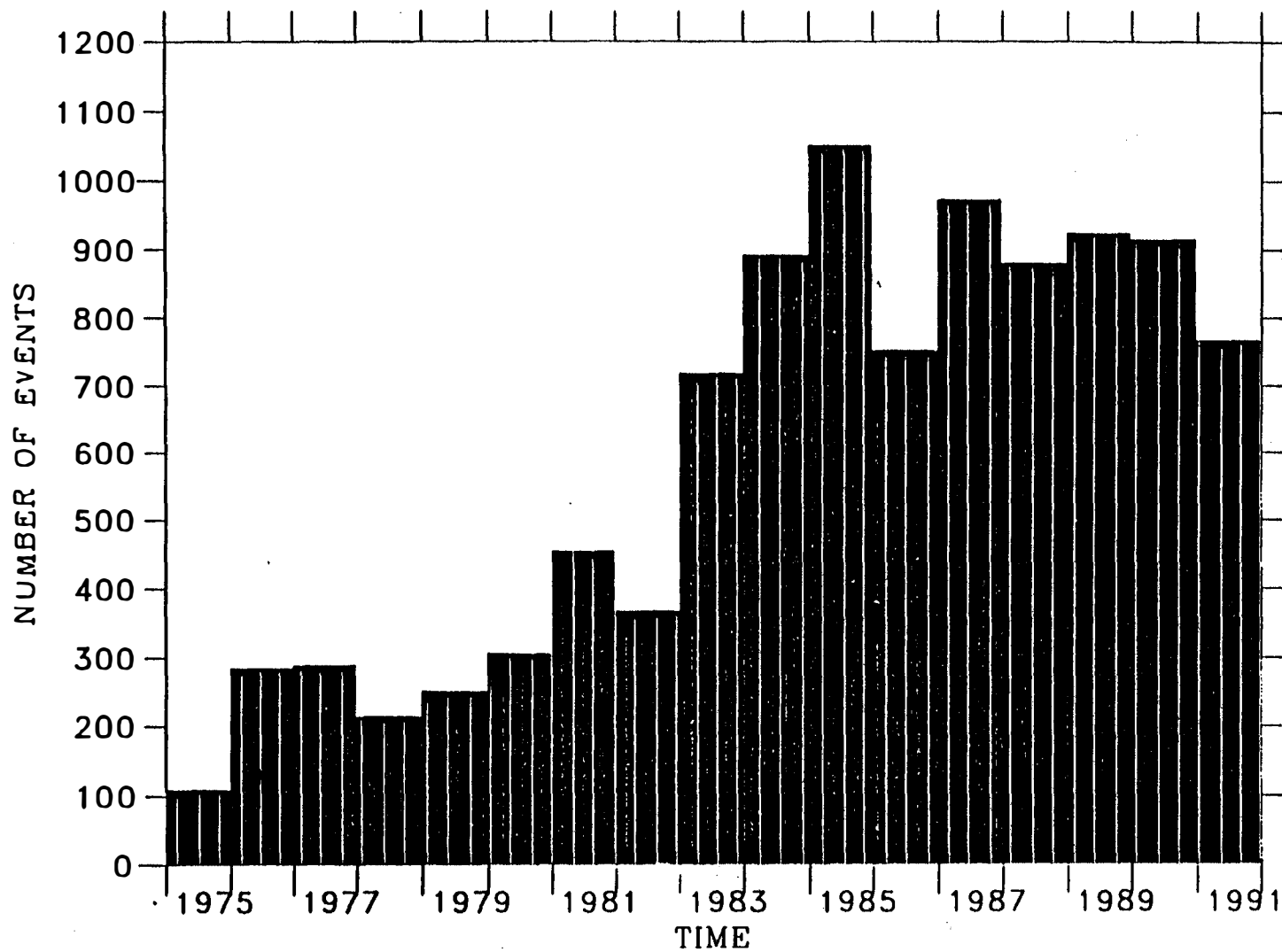


Figure 4.15.2-E: Histogram showing annual numbers of shocks with $M_c \geq 1.4$ occurring in the GGF, 1975 - 1991 (Data from USGS)

SOURCE: Graphic as reproduced from GeothermEx, Inc.

4.0 Affected Environment

4.15 Geothermal Energy and Geysers Area Seismicity

is much more abundant than the regional seismicity for $M_c < 3$. For $M_c > 3$, the GGF seismicity drops off rapidly, with no events greater than $M_c 4.6$ (MI 4.2).

Finally, it is noted that the magnitudes of the largest earthquakes in the GGF have increased over time. The largest shock through 1977 had MI 3.8, but four events since 1980 have had MI 4.0 to 4.2. However, the time intervals for these observations are so short that no useful conclusions may be drawn from the apparent magnitude increase.

On the whole, seismicity of the GGF has fault mechanics very similar to that of the entire northern Coast Ranges. However, in detail, fault/fracture mechanics in the GGF appear to be highly heterogeneous.

4.15.2.6 INDUCED SEISMICITY IN THE SOUTHEASTERN GEYSERS

Epicenters of 1,048 microearthquakes in the southern GGF with focal depths greater than 2 km are shown in Figure 4.15.2-F (data provided by David Oppenheimer, personal communication, March 1993). Also shown are the traces of the eight injection wells known to exist in the area shown (data provided by Ali Khan, California Division of Oil and Gas (CDOG), personal communication March 1993). There are two dense clusters of epicenters: one in the central portion of the map, extending from the north-central part of Unit 13 to the southern end of West Ford Flat; the other, in the northwest corner of the map area. This second cluster is within the area investigated by Stark (1990), which extended south into Unit 18 (where a third cluster is evident); however, only a handful of events occurred there during the period covered by his work (November 1988 to August 1989). Figure 4.15.2-F also reveals the rapid decline in rate of seismicity southward from West Ford Flat. Figure 4.15.2-F shows a pattern of only a few small earthquakes occurring in the Southeast Geysers between 1975 and 1992.

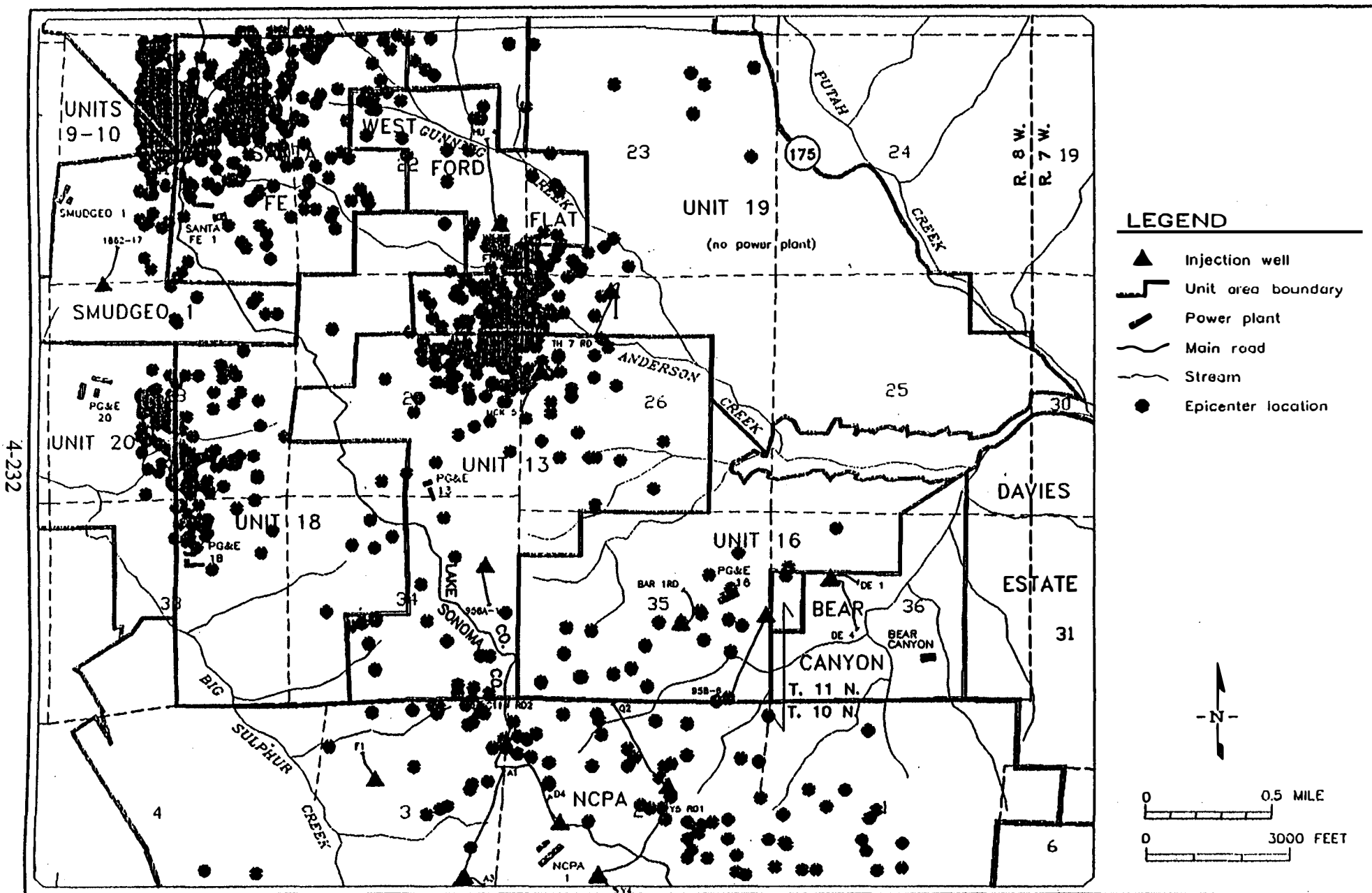


Figure 4.15.2-F: Map showing epicenters of earthquakes $M_c \geq 0.7$ and depth greater than 2 km in the southern GGF, 1975 - 1992. (Data from USGS).

SOURCE: Graphic as reproduced from GeothermEx, Inc.

5.0 ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES OF THE PROPOSED PROJECT

5.1 STUDY APPROACH AND METHODS

5.1.1 PRESENTATION OF IMPACTS

The impacts of the project are presented in this section of the EIR/EIS. For each topical section, the criteria by which the significance of impacts are determined is presented first. Impact significance criteria are drawn primarily from policies and regulations of federal, state and local agencies. The Council on Environmental Quality (CEQ) has prepared general guidelines for identifying impact significance for purposes of NEPA. The California Office of Planning and Research (OPR) similarly has provided guidelines for CEQA impact significance determination. The latter are generally cited in this document because of the greater specificity of the OPR CEQA Guidelines. Some criteria have been developed from general practice in environmental impact assessment based on the experience and judgment of the impact analyst.

Impact statements are printed in boldface print and numbered sequentially according to the section of the document in which they occur. Each impact statement identifies the nature of the impact and its level of anticipated significance prior to implementation of any mitigation measures. As appropriate, a discussion may follow the impact statement, generally providing more detail about the nature of the impact or the basis for the significance determination.

If mitigation is required or recommended, the impact statement and discussion are followed by mitigation measures. Mitigation measures identify actions that can be taken to avoid the impact, lessen its effect on the environment or compensate for losses and adverse changes in existing conditions. Mitigation measures are presented in boldface print and numbered to match the impact to which they are addressed. Discussions also may follow a specific mitigation measure, generally elaborating on details of its implementation. Multiple mitigation measures may apply to an individual impact. After all mitigation measures are presented, a statement is made regarding the effect of implementation of the mitigation measure(s) on the level of impact. Any residual impacts following mitigation are identified.

While both CEQA and NEPA are focused on addressing the significant impacts of a proposed action/project in an EIR/EIS, some less than significant impacts of the project are identified and discussed. This is done in order to respond to specific issues and concerns raised during the scoping process for the project. The discussion explains why the impact analyst believes the impact would be less than significant.

Impact significance is rated as follows:

No impact. Available data indicate and/or reason suggests that the project components would not alter the environment.

Insignificant impact. Available data indicate and/or reason suggests that the project components would not alter the environment sufficiently to create a conflict with existing laws, standards, policies and/or objectives for the regulation, management, and general maintenance of the environment. The terms "insignificant impact" and "less than significant impact" are interchangeable.

Significant impact. Available data indicate and/or reason suggests that the project components would alter the environment sufficiently to create a conflict with existing laws, standards, policies and/or objectives for the regulation, management, and general maintenance of the environment. Significant impacts are further identified as "unavoidable" or "mitigable." Significant unavoidable impacts refer to effects of the project component that could not be reduced to a less than significant impact through the application of mitigation measures. Under CEQA, a finding by the lead agency that a significant impact is unavoidable means that the permitting agency either must (1) reject the project as it is proposed (2) direct the project sponsors to pursue alternatives that would not result in significant unavoidable impact or (3) make a Statement of Overriding Considerations, by which is meant that the impact is regarded as acceptable based on the perceived greater need for going forward with the proposed action/project. Significant mitigable impacts are those which can be reduced to a less than significant level (that is, insignificant impact) through implementation of mitigation measures identified in the EIR/EIS. The proposed mitigation measures generally are made conditions of the permit to construct and operate the project.

Under CEQA/NEPA only significant impacts require mitigation. In this EIR/EIS, mitigation measures for less than significant impacts also may be identified as "Recommended" for

implementation. Recommended mitigation measures identify opportunities to hold impacts to a minimum.

Potentially Significant Impact. Available data indicate and/or reason suggests that the project components are capable of altering the environment sufficiently to create a conflict with existing laws, standards, policies and/or objectives for the regulation, management, and general maintenance of the environment. Unlike significant impacts, there is a degree of uncertainty in the impact. This is because of insufficient information about the project or the environment on which to determine the level of significance, uncertainty in the level of the impact because of variability in existing or future conditions, or lack of certainty about the probability of the impact (usually in reference to hazards). Potentially significant impacts are further identified as unavoidable or mitigable.

Undetermined Impact. Available data are not sufficient to form the basis for determining the significance of the impact. Undetermined impacts are derived primarily from speculation by the analyst.

Beneficial Impact. Available data indicate that the project component would result in an improved condition of the existing or future environment.

Impacts presented in this EIR/EIS also are identified according to three considerations, as follows.

Long Term Impacts. Impacts that would persist for more than a few years are considered long term. This may include impacts that would occur because of permanent changes in the environment created by project construction and/or the project's long term operation. Long term impacts may be significant or insignificant.

Short Term Impacts. Impacts would be of short duration or would occur only for a few years at most. Short term impacts may be significant or insignificant.

Cumulative Impact. Impacts of the project would contribute to broader alterations of the environment created by multiple sources of impact in time and space within the affected environment of the project. While project-induced impacts may be individually small, they may

be considered significant if they would contribute to ongoing or expected adverse changes of the environment that may be significant when considered as a whole.

5.1.2 METHODS OF IMPACT ASSESSMENT

This EIR/EIS presents the results of numerous topical studies assembled and prepared for this report. The specific methods of impact assessment are not presented in this EIR/EIS except where they are needed to understand how the findings were made. For most sections of the report, separate documentation of methods of data collection, data limitations and methods of analysis are on file with the County of Lake. General methods of analysis for this EIR/EIS include review of published literature and data, including some that is proprietary in nature. Field studies were also conducted specifically for this EIR/EIS. Most of the field studies were conducted in spring, summer and autumn of 1993.

The methods used in preparing the impact assessment conform with guidance provided by the State of California Office of Planning and Research for preparation of EIRs under CEQA and by the Council on Environmental Quality for preparation of EISs under NEPA. Specific methodologies for topical areas (for example, biological and cultural resources survey techniques, etc.) also conform to standard protocols and practices particular to professional conduct of research and scientific methods for that discipline.

5.2 IMPACTS AND MITIGATION MEASURES RELATED TO THE GEYSERS EFFLUENT PIPELINE COMPONENT

5.2.1 GEOLOGY, SEISMICITY, AND SOILS

IMPACT SIGNIFICANCE CRITERIA

Under Appendix G of the CEQA *Guidelines*, a project would have a significant impact if it would:

- cause substantial erosion or silt deposition;
- expose people or structures to major geologic hazards; or
- create a potential hazard to the public involving the use of hazardous or dangerous materials such as explosives.

Major geologic hazards include exposure to unstable soils subject to failure (landslides, rockfalls, and weak soils) and hazards associated with earthquakes.

IMPACTS AND MITIGATION MEASURES

Impact 5.2.1.1. Construction of the proposed pipelines, pump stations and tanks would result in accelerated erosion. The impact would be significant in some areas.

Moderate or high erosion hazards exist along approximately 40,200 feet (7.6 miles) of the pipeline components and at the location of other project facilities (Table 5.2.1-1). These hazards are caused by the presence of moderately or steeply sloping areas with erodible soils. Along some of the pipe segment locations, particularly along unimproved roads (4-wheel-drive required) in rugged terrain locations, accelerated erosion is ongoing and would be further aggravated by proposed grading and other construction activities. In other areas, clearing and grading for project construction would trigger erosion. Rilling, rutting and eventually gullying would result, in response to uncontrolled wet-season runoff and concentrated (construction induced) runoff. Some areas have existing conditions of potentially unstable slopes (see Impact 5.2.1.3). Erosion caused by project construction could aggravate the conditions contributing to slope instability. These processes could lead to the loss of soil resources, creation of unstable ground, and silt deposition in watercourses, or lead to potential damage to project components. Similarly, spoils disposal could expose loose sand, silt and clays to erosion unless specially covered or stabilized.

TABLE 5.2.1-1: LOCATIONS (BY STATIONS)* OF POTENTIALLY SIGNIFICANT
EROSION IMPACTS

<u>Moderate Hazard</u>	<u>High Hazard</u>
0 to 2	6.8 to 8.7
8.7 to 13.5	13.5 to 13.7
13.7 to 17.8	17.8 to 18.1
18.1 to 23.1	23.1 to 24.8
45.5 to 48.5	34.0 to 35.5
53.0 to 54.5	40.2 to 40.8
57.9 to 58.5	49.5 to 51.5
59.0 to 60.0	52.5 to 53.0
76.8 to 79.5	54.5 to 55.0
79.8 to 81.2	56.8 to 57.0
81.6 to 82.5	57.8 to 57.9
82.8 to 84.6	58.5 to 59.0
85.8 to 86.2	60.0 to 76.8
97.0 to 99.5	79.5 to 79.8
110.0 to 121.0	81.2 to 81.6
Unocal Jeep trail	82.5 to 82.8
	84.6 to 85.8
	86.2 to 95
	99.5 to 102.7
	121.0 to 124.5

* See Figures 2.1.3-B through 2.1.3-E for station locations.

SOURCE: Michael J. Dwyer and Environmental Science Associates, 1994.

Mitigation 5.2.1.1.A. Detailed design plans and specifications for construction of the project shall conform to the Lake County Grading Ordinance. Detailed design plans and specifications for construction of the re-graded Unocal access road shall conform to the Sonoma County Grading Ordinance.

Mitigation 5.2.1.1.B. All construction and grading activities shall expose as little new ground surface as possible. In all areas requiring removal of vegetation but no grading, root crowns shall be left intact so as to retard soil erosion. (See also Mitigations 5.2.3.10.B and C.)

Mitigation 5.2.1.1.C. Site grading shall be minimized to reduce the possible risk of future slope and/or foundation instability. In areas to be graded, the ground surface shall be cleared and stripped of vegetation and surface soils containing organic materials. The

strippings shall not be used in compacted fills, but shall be saved for reuse in landscaping, unless disposed off-site in a location approved by the Lake County Planning Department or Sonoma County Planning Department, as appropriate.

The estimated stripping depth should be determined in the field by the applicant's engineer, subject to the approval of the Lake County Building and Safety Department. Stripped soil for the Unocal road should be disposed at the existing D&V 18 disposal fill or other offsite disposal location approved by the County. Alternatively, the strippings could be used for landscaping along the trail if needed, or in other locations within the leasehold requiring the material.

Mitigation 5.2.1.1.D. Revegetation of graded areas shall take place as quickly as possible as weather permits, but generally no later than October 15th.

Extensions beyond October 15 may be obtained from the County under special circumstances such as unusually dry weather. At a minimum, revegetation shall consist of reseeding with grass all graded areas. Silt fences shall be used during construction and straw and/or mulch shall also be used to control erosion on all graded banks and slopes over 10%. For projects with slopes of 20% or greater, or located within 100 ft. of a blue line water feature (as identified on a USGS map), the project sponsors shall also install a silt fence or straw bales with rebar around downhill perimeters or lakeward of the fill areas prior to grading activities. Following construction, all debris entrapped in silt fences should be collected and removed to a suitable soil disposal site.

Replanting of all exposed surfaces consistent with approved revegetation and slope stabilization plans shall be accomplished within the first growing season following disturbance, unless other scheduling is approved by the Planning Department.

Mitigation 5.2.1.1.E. Upon completion of final design and route survey, an erosion control plan should be developed and implemented. Emphasis should be on site specific methods to prevent or minimize erosion at each stream crossing identified in Table 4.4.2-1 and areas identified in Table 5.2.1-1 as having high potential for accelerated erosion. Specific plans and drawings should be submitted prior to initiating any ground clearing or surface disturbing activities and should be incorporated into Stream Alteration Agreements with the California Department of Fish and Game.

The mitigation measures identified in this EIR/EIS provide the basis for specific erosion control measures (see also Section 5.2.2 and 5.2.3).

Mitigation 5.2.1.1.F. Construction monitoring should be performed on an on-going basis during all site preparation and grading activities.

This work shall be done by properly qualified technicians or field engineers. The presence of a geotechnical engineer and engineering geologist may be periodically required in areas of difficult terrain and potentially unstable slopes, as construction conditions warrant. A County (or County-retained) environmental inspector should monitor the project construction activities that have potential (as identified in this document) to impact the environment. Site preparation and grading activities in general, and all crossings of streams (both perennial and intermittent) specifically, as well as post-construction cleanup and grooming, shall be observed for environmental compliance. The inspector shall have the authority to halt construction if pre-established mitigation measures, including erosion control and stream crossing protection plans, are not being properly implemented by the construction contractor.

Mitigation 5.2.1.1.G. Reports and certification should be routinely prepared and submitted by the project sponsors to the Lake County Planning Department, BLM, and Sonoma County Planning Department (as appropriate) documenting that construction of the project components has conformed to the design plans/specifications, best construction practices, and mitigation measures.

Mitigation 5.2.1.1.H. Construction activity involving ground disturbance (including clearing, grading, and placement fill or spoils) shall be limited to the dry season between April 1 and November 1.

Variances from this requirement would be permissible from a geologic impact standpoint in less sensitive areas, such as on flat to very gently sloping areas and areas well away from streams. In the event of dry weather conditions in November, ground-disturbing construction may be extended by permit from the County on a weekly basis, but shall be terminated immediately when significant rainfall is predicted within five days to allow time for site clean-up.

Mitigation 5.2.1.1.I. Following completion of construction of the various project components, and prior to the first rains of the wet season, all accumulations of loose soil and other debris associated with project construction should be removed and properly disposed. The environmental inspector should make observations of the project components when completed (or at the end of each construction season) and certify that clean-up/grooming has been properly completed.

Mitigation 5.2.1.1.J. The project sponsors should prepare and implement for the project a long-term inspection and maintenance plan for the right of way and all ancillary facility sites. Routine inspections shall be performed on a periodic basis and following major storms.

Mitigation 5.2.1.1.K. Unocal should cover the regraded Jeep trail with a layer of crushed rock, or other material acceptable to Sonoma County, in order to minimize further rutting and rilling of the road bed.

Following implementation of Mitigation Measures 5.2.1.1.A through 5.2.1.1.K, erosion impacts would be reduced to insignificant with the exception of intervals along Sweet Springs Creek and the unnamed tributary to Big Canyon Creek. Short-term erosion effects are anticipated to be significant in these sections, but not for the long-term. Significant impacts are anticipated for one to two rainy seasons following completion of construction, with less than significant impacts after that time.

Impact 5.2.1.2. Construction of the project would result in streambank erosion and silt deposition in stream channels. The impact would be significant.

The crossings of large streams and smaller drainage features by the main Geysers Effluent Pipeline present high potential for streambank erosion and construction-induced siltation. This potential is highest in the mountainous central and southwestern parts of the pipeline route where the pipeline would be located along major streams located at the bottoms of steep-walled deep canyons. High potential bank erosion hazard also exists where major stream crossings (Clayton, Copsey, Big Canyon and Putah Creeks) and crossings of their tributaries would occur. This includes the locations shown in Table 5.2.1-2.

Other components of the project, principally construction of the new Bear Canyon Access Road connector to the NCPA M-Pad (Stations 121.0 to 124.0) and the placement of fill in the unnamed tributary of Big Sulphur Creek for the Unocal Road and pipeline crossing present similar potential for stream siltation.

Mitigation 5.2.1.2. To reduce impacts of silt deposition, implement Mitigation Measures 5.2.1.1.A through J for areas of potentially significant streambank erosion and silt deposition (listed in Table 5.2.1-2). Mitigation Measures contained in Sections 5.2.2 and 5.2.3 should also be implemented.

Implementation of these measures would reduce the siltation impacts to insignificant with the exception of intervals of Sweet Springs Creek, intervals along the tributary to Putah Creek, parts of the unnamed tributary to Bear Creek where the proposed Bear Canyon Access Road connector to the M-Pad would be constructed, and parts of the unnamed tributary to Big Sulphur Creek where the proposed maintenance road would be constructed. Siltation effects are anticipated to

TABLE 5.2.1-2: LOCATIONS (BY STATION)* OF POTENTIALLY SIGNIFICANT STREAMBANK EROSION AND SILT DEPOSITION

4.4 (Burns Valley Creek)	84.5 (Cockerell Creek)
39.1 (Clayton Creek)	93.2
54.6 (Copsey Creek)	94.5 (Harbin Creek)
56.8	98.5
59.6 (Copsey Creek)	99.1
60.2 to 66.8 (Sweet Springs Creek)	100
67.6 to 68.3	102.4
70.2 to 72.7	102.5 to 102.7 (Putah Creek)
76.6 to 76.9 (Big Canyon Creek)	123 to 124 (unnamed tributary of Bear Creek)
	Unocal road crossing (unnamed tributary of Big Sulphur Creek)

* See Figures 2.1.3-B through 2.1.3-E for station locations.

SOURCE: Environmental Science Associates, and Michael J. Dwyer, Inc., 1994.

be significant in the previously mentioned areas and extend downstream beyond the immediate confines of the pipeline. While significant, the impacts would be short-term. It is anticipated they would become insignificant after one to two wet seasons following construction.

Impact 5.2.1.3. Slope failures and/or soil settlements could damage project components. The impact is potentially significant.

Areas of soil creep (the slow, nearly imperceptible downslope movement of soils under the influence of gravity) and landsliding are present in the hilly areas occupied by project components. These areas include the SERWTP pump station and the Geysers Effluent Pipeline segments, as noted in Table 5.2.1-3.

Soft, weak lake bottom sediments are also anticipated at the pump station site and in the offshore part of the Lake Diversion Pipeline. Expansive or weak soils are occasionally present along the pipeline components or beneath other project components including Stations 0.0 to 0.5 and 86.3 to 93.3 along the main Geysers Effluent Pipeline. The pipeline route immediately north of the Childers Peak Regulating Tank site (Stations 66.4 to 66.8) is an especially constrained area. The

TABLE 5.2.1-3: LOCATIONS (BY STATIONS)* OF POTENTIALLY SIGNIFICANT SLOPE FAILURE AND SOIL SETTLEMENT HAZARDS

M 12.5 to M 14.5	
M 16+ (lake bottom)	
0.0 to 0.5	
17.8 to 18.1	60.2 to 63.7
26.5 to 27.5	66.1 to 66.3
34.6 to 35.6	67.0 (Childers Peak Regulating Tank)
37.8 to 39.5	70.2 to 72.5
40.2 to 40.6	74.8 to 75.3
49.5 to 51.5	110 to 117.3
52.5 to 53.0	121.0 to 124.0 (new road)
54.6 to 56.5	
57.8	
58.5 to 59.0	

* See Figures 2.1.3-B through 2.1.3-E for station locations.

SOURCE: Environmental Science Associates and Michael J. Dwyer, Inc., 1993.

serpentine rocks are deeply gullied and form steep slopes that drop directly into the headwaters of Sweet Springs Creek. An existing old road (trail) which forms the alignment of the pipeline is partly washed out here. These geologic processes or conditions could result in damage or rupture of the pipeline or cause structural damage to other project components including access roads. Construction in those areas may create hazardous conditions of construction trench wall failure and inflows of water. The Childers Peak Regulating Tank (Station 67.0) would be located on serpentine soils with poor foundation characteristics related to their expansive properties.

Mitigation 5.2.1.3.A. To minimize hazards of slope failure at the Childer's Peak Regulating Tank site and pipeline alignments listed in Table 5.2.1-3, geotechnical investigation should be undertaken in potentially unstable areas which could be destabilized by erosion. Recommendations for adequate foundation design will be followed.

The investigations may include all or some of the following elements: 1) geologic mapping; 2) subsurface exploration (bore holes, exploration pits and geophysics); 3) sampling of subsurface materials; 4) laboratory testing; 5) analysis and preparation of reports containing recommendations for geotechnical design and/or abatement of geologic hazards.

Mitigation 5.2.1.3.B. The Geysers Effluent Pipeline should span the serpentine soil and deeply gullied area between Stations 66.4 to 66.8. The support piers shall be located a few tens of feet to either side of the serpentine deposit (Stations 66.4 to 66.8).

With implementation of Mitigation Measure 5.2.1.3.A and B, the impact would be reduced to insignificant levels.

Impact 5.2.1.4. Construction activity for the Geysers Effluent Pipeline could reactivate an old landslide between Stations 57.3 and 57.4. This impact is potentially significant.

A large old, presently dormant landslide may be present east of and upslope of the pipeline route. Construction activity, including trenching or access road construction, may undermine the toe of the slope and reactivate this landslide. In the long-term, if the slope reactivates, it could bury the pipeline with debris or damage the pipeline if the slope were to slip out.

Mitigation 5.2.1.4. Project design should include a determination of the level of construction-related vibration the project components can withstand without reactivation of the landslide. A geotechnical engineer should be present on site during construction to determine whether grading and construction activities or related vibration may be undermining the stability of the slope.

With implementation of Mitigation Measure 5.2.1.4.A, this impact should be reduced to insignificance.

Impact 5.2.1.5. Blasting may be required in some areas for constructing the Geysers Effluent Pipeline. Potentially significant impacts of blasting include potential damage to nearby structures from vibration and fall-out of particulates at the blast site.

There are segments of the effluent pipeline in the vicinity of developed areas (in Clearlake) including Stations 6.6 to 8.8 and 23.0 to 23.4 that are underlain by large blocks of very hard rock. To bury the pipeline, it will probably be necessary to use blasting to reduce the size of these blocks to manageable dimensions in order to complete the excavation to required depth. Pipeline segments 72.7 to 73.7 similarly may require blasting, but there is no hazard to existing development, as no developed structures are present in this area.

Mitigation 5.2.1.5. A blasting plan that reduces the impact to non-hazardous levels in developed areas should be developed. The plan shall comply with all county, state and federal safety regulations pertaining to blasting. The plan shall be submitted for approval by LCAQMD to ensure that appropriate dust and noise control elements have been included. If such a plan cannot be successfully developed and implemented, the pipe

segments should be built above ground or relocated to an area not requiring blasting or which is inherently more safe for blasting.

With implementation of Mitigation Measure 5.2.1.5 this impact would be reduced to insignificant. See also Mitigation Measures 5.2.5.1.C (Noise).

Impact 5.2.1.6. Improper or unauthorized spoils disposal could result in unstable slopes and accelerated erosion. The impact is potentially significant.

About 52,580 cubic yards of spoils would be created by project construction. Proposed spoils disposal would occur in several ways. As proposed, two existing permitted spoils disposal sites would be used: the Eastlake Landfill located east of Clearlake, and the Bear Canyon disposal site on the Bear Canyon Access Road. These facilities are operated under existing permits which require fill placement according to preestablished procedures to minimize failure or erosion.

Spoils also would be taken to the MWTP. The site is relatively flat, but its location near Putah Creek raises some concern about erosion and sediment discharge into Putah Creek.

Spoils also would be placed at the Childers Peak Regulating Tank site. Most of the spoil would be used as a base for the tank. That material would be compacted to proper engineering design to support the tank. Excess material probably would be placed near the tank and possibly would not be engineered. That material could erode and the sediment would discharge into the unnamed tributary of Big Canyon Creek and Putah Creek.

Between Lower Lake and the roadless area of Sweet Springs Creek Valley (about Station 62), and between Big Canyon Road and the MWTP, the spoil material would be spread within the ROW and/or placed at sites selected by the landowner. In some cases, the spoils could be taken offsite (to unspecified locations) and used for fill by other property owners and developers. In each of these cases, there is a potential for enhanced erosion of exposed spoils and the potential for failure if the material were stockpiled or placed without proper engineering.

Mitigation 5.2.1.6.A. All spoil disposal sites should be located, graded, compacted, seeded and left in such a manner that they are well-drained and protected from erosion. Spoil disposal sites should not be located within or in the immediate vicinity of streams. Under no circumstances shall spoil be sidecast into or in close proximity to canyons, sidewalls, streams, gullies, drainage ditches or wetlands.

Mitigation 5.2.1.6.B. Spoils disposed at the MWTP should be compacted and seeded and spray-irrigated to establish an erosion resistant surface. Additionally, a straw bale check dam to trap sediment should be constructed on any drainage way between the fill site and Putah Creek to prevent sediment discharge into the creek.

Mitigation 5.2.1.6.C. At the Childers Peak site, in addition to Mitigation 5.2.1.6.A, carry out land imprinting, hydroseeding of all exposed fills and irrigate it to allow vegetation to establish. Construct silt fences and straw bale check dams to trap sediment from the fill site before it can enter the unnamed tributary to Big Canyon Creek.

Mitigation 5.2.1.6.D. In areas along the pipeline corridor where spoils would be spread, carry out Mitigation 5.2.1.6.A and sprinkle irrigate the surface until the vegetation is established and the onset of the rainy season begins (until mid-October at the earliest). In no cases should spoil be left in piles or unprotected from erosion and sites with over three percent gradient should be avoided.

Mitigation 5.2.1.6.E. In areas along the pipeline corridor where spoils would be spread, the construction contractor should be held responsible for all spoils stabilization and erosion control to the satisfaction of the County. Each contractor should be required to post a bond (refundable upon satisfactory completion of clean up and reestablishment of the vegetation cover) to ensure that proper methods have been implemented for spoils disposal in all areas within his construction segment.

Mitigation 5.2.1.6.F. Spoils disposal in unspecified offsite areas should be evaluated by the County Planning Department at the time such sites are proposed to receive the soil.

Implementation of Mitigation 5.2.1.6.A through F would reduce the impact to an insignificant level.

Impact 5.2.1.7. Seismic groundshaking could damage project components. The impact is potentially significant.

Active and potentially active faults are present both within and beyond the confines of Lake County. Within the lifetime of the project one or more of these faults could generate groundshaking which could be potentially damaging to some or all of the project components.

Areas where earthquake groundshaking effects, including liquefaction (the sudden transformation of loose, granular, saturated material like sand to a fluid state similar to quicksand due to ground shaking), most commonly occur include locations underlain by valley alluvium and alluvium in narrower stream valleys. Underwater deposits, including lake

sediments are also subject to earthquake shaking effects. Along the project alignment, the areas which could be subject to the earthquake shaking effects include those in Table 5.2.1-4.

TABLE 5.2.1-4: APPROXIMATE LOCATIONS (BY STATIONS)* OF POTENTIALLY SIGNIFICANT EARTHQUAKE GROUNDSHAKING HAZARDS

<u>Station</u>	<u>Location</u>
M0.0 - 9.0 ¹	Burns Valley
0.0 - 5.5	Burns Valley
25.0 - 31.0	Anderson Flat
36.5 - 43.0	Excelsior Valley
76.5 - 99.0	The narrow stream valleys of Big Canyon and Harbin Creeks
102.5 - 109.5	Collayomi Valley

* See Figures 2.1.3-B through 2.1.3-E for station locations.

¹ Lake Diversion Pipeline

SOURCE: Michael J. Dwyer and Environmental Associates, 1993.

The actual potential for these areas to experience damaging groundshaking effects should be determined by alignment-specific, design-level geotechnical investigations. The potential exists for damage to the pipeline because of groundshaking and/or liquefaction in these areas.

Mitigation 5.2.1.7. The project final design should include development of a "maximum credible design earthquake" which the project components can withstand without failure or major damage.

The project engineers should consult with the Lake County Department of Public Works to establish an appropriate level of protection from major earthquakes that may be anticipated during the project's design life. Automatic shut off of pumps triggered by groundshaking should be provided in the design.

With implementation of Mitigation Measure 5.2.1.4.A this impact should be reduced to insignificant.

Impact 5.2.1.8. The Collayomi Fault crosses the alignment of the Geysers Effluent Pipeline. The impact is potentially significant.

The Collayomi fault zone is not well defined along the majority of its mapped length (Bryant, 1982). A few miles to the north of the pipeline alignment where the fault is mapped relatively better, it consists of a number of discontinuous, sub-parallel segments, comprising a zone up to several hundred feet wide. In the project vicinity, it is shown as a single trace along the northeast side of Collayomi Valley and is concealed by the valley sediments (Wagner and Bortugno, 1982). To date, detailed investigations have not been undertaken to precisely locate the trace(s) of the fault in the general vicinity of the pipeline alignment; nor have trenching investigations been undertaken in attempts to expose the fault plane and related soil stratigraphy.

Hearn, et. al. (1976) and McLaughlin (1981) have observed evidence of mid to late-Pleistocene (less than 600,000 years but more than 11,000 years before present) offset along the Collayomi fault several miles north of the pipeline alignment. Evidence of possible Holocene (less than 11,000 years before present) movements -- that is, active faulting -- has not been observed (Bryant, 1982). This lack of evidence for fault activity is reflected by the fact that no part of the Collayomi fault has been included within an Alquist-Priolo Special Study Zone (Hart, 1992). The fault is potentially active, but has not been classified as presently active (Special Report 42, California Division of Mines and Geology, 1992). On the basis of the foregoing information, it is reasonable to infer that the risk of surface fault rupture to the pipeline due to movement along the fault is low.

However, the Collayomi fault and its possible extensions to the north and south, suggest a possible total length on the order of 40 to 60 miles (Wagner and Bortugno, 1982; Hearn et al., 1981; California Department of Water Resources, 1962). An active fault of this length could be capable of a large magnitude earthquake with a resultant surface displacement of a few to several feet. Instantaneous fault displacement of this amount, confined to a narrow fault zone would present high risk of pipeline rupture. Based on its approximately known length, the fault is capable of a maximum credible earthquake 6.5 Richter Magnitude. In the event of a large magnitude earthquake, surface rupture would probably range from a few to several feet. This would rupture the pipeline.

In conclusion, existing regional information does not suggest the Collayomi fault is active (has undergone surface rupture in the last 11,000 years). Detailed site specific investigations have not been performed to confirm or modify this condition.

Mitigation Measure 5.2.1.8. As a precautionary mitigation measure, the installation of isolation valves on either side of the projected fault trace is recommended. This would include the pipeline segment between about Station 102.5 and 105.0, roughly from the northeast edge of Collayomi Valley, northwesterly to the Middletown WWTP.

With implementation of Mitigation Measure 5.2.1.8, this impact should be insignificant.

Impact 5.2.1.9. Soils that are subject to some severe limitations could damage the pipeline. The impact is of undetermined significance because of limited data, but should be regarded as potentially significant.

Soils with high shrink/swell properties may be present along the Geysers Effluent Pipeline between Stations 86.3 to 93.3 along Big Canyon Road and along Unocal's proposed widened access road north of the H-Pad. Actual limitation would depend on the amount of clay in the soil and the moisture content. These soils may not be suitable for backfill. Saturated soils are present between Stations 97.6 to 98.0. This could present special problems for construction as well as poor support for the pipeline.

Mitigation 5.2.1.9.A. Conduct soil testing to identify shrink/swell properties between Stations 86.3 to 93.3. If the soil is subject to severe shrink/swell, the material should not be used as backfill unless amended with other materials to achieve an acceptable level for engineering.

Mitigation 5.2.1.9.B. Dewatering may be required during construction for Stations 97.6 to 98.0. Special drainage may be needed for the backfill and/or greater support needed for the pipeline if the soils are soft.

Dewatering entails the removal of groundwater from a trench or channel during construction. The water would be pumped from the trench and discharged into surface runoff or allowed to spread across nearby pastures. Dewatering in this rural agricultural area is not likely to involve discharge of contaminated groundwater as there is no development in the area.

Implementation of Mitigation Measures 5.2.1.9.A and -B would reduce the impact to a less than significant level.

5.2.2 HYDROLOGY AND WATER QUALITY

IMPACT SIGNIFICANCE CRITERIA

Under CEQA Guidelines, a significant impact on hydrology and water quality would result if a project would:

- substantially degrade water quality
- contaminate a public water supply
- substantially degrade or deplete ground water resources
- substantially interfere with ground water recharge
- use water resources in a wasteful manner for either construction or operation
- cause substantial flooding, erosion or siltation and/or
- cause adverse effects or constitute an incompatible form of development in floodplains.

IMPACTS AND MITIGATION MEASURES

Impact 5.2.2.1. Construction of the Geysers Effluent Pipeline Project component would have a significant short-term impact on water quality of Sweet Springs Creek, the unnamed tributary of Bear Creek, and the unnamed tributary of Big Sulphur Creek. The impact is partially mitigable through use of best construction practices.

Construction activities in all water courses would result in some degradation of water quality through the generation of sediments (see Impact 5.2.1.2), damage to stream banks and vegetation cover (see Impact 5.2.3.10), and potential spills of undesirable chemicals into the stream channels (Impact 5.2.10.4). Because most construction would occur during the dry season when most of the watercourses would be dry, the immediate and direct impacts would be relatively small and short-term in duration. Most effects would not become apparent until flows return to the stream channels following autumn and winter rains. This would primarily be manifested in increased loads of silts and clays, that would increase turbidity characteristics of the water. The effects would be strongest following the first storms when the first flows would move the loose sediments downstream, then decrease over time. In most cases, the effects would dissipate after two or three rainy seasons. Except for the multiple crossings of Sweet Springs Creek and the fill placed in the channels of the unnamed tributaries to Bear Creek and Big Sulphur Creek, most water courses would be subjected to a single relatively narrow ditched crossing. Crossings of this nature would not be sufficiently substantial to pose a major threat to water quality of the water course because of the small area of disturbance involved at the crossing site and the

5.0 Environmental Consequences & Mitigation Measures

5.2 The Geysers Effluent Pipeline Component

proposed period of construction during the dry season (crossings of Big Canyon Creek and Putah Creek are described later).

Fill in the creek channel of the unnamed tributary of Big Sulphur Creek would be placed during the low flow period, when the channel may be dry. Therefore, immediate impacts during construction likely would be small. Siltation could occur later, during the subsequent wet season. Because the unnamed tributary to Big Sulphur Creek goes underground about 25 feet beyond the crossing point of the proposed maintenance road, impacts of sedimentation would only occur for a short distance. The undergrounding of the watercourse would act as a natural filter for sediment.

The impact of access road and aerial pipeline construction would have the most significant impact on Sweet Springs Creek. The absence of an existing road in the upper watershed of the creek means that a new road is proposed to bring in materials, to construct the proposed pipeline and to use for long-term inspection and maintenance. As noted in Section 4.4, the meandering configuration of the creek channel in a narrow valley provides constraints to construction that make impact on the watercourse unavoidable. At a minimum, there would be approximately 22 crossings of the creek. Additionally, in places the valley floor is so narrow that it would be difficult to place a new road without impinging directly on the bank of the channel. In addition, for at least half of the channel crossings, it may be necessary to provide channel stabilization to maintain the position of the watercourse and thereby prevent undercutting of both the road and the pipeline (the pipeline would be of aerial construction throughout this segment). Sediments from all exposed disturbed soils would eventually be directed by runoff into the watercourse. Vegetation killed by construction activity also is a source of debris and particulate in the water. Removed vegetation dumped into or alongside the channel could be a substantial source of water pollution in the creek.

Because the affected channel segment drains the upper Sweet Springs Creek watershed, it is likely that the watercourse would be dry during the construction period, or at most containing a very low flow (a gallon per minute or less). As a result, the construction would not increase silt loads or turbidity in downstream segments during the immediate construction period. The first storm(s) of the season to produce flow in the channel will entrain a substantial amount of the fine sediments (silt and clays). The initial pulse of sediment from these disturbance sources, combined with the input of the normal seasonal build-up of sediments from other parts of the watersheds, would result in a measurable increase in turbidity in these creeks. These fine

sediments will be carried into the lower stream channel and eventually into Copsey Creek. Sweet Springs Creek does not appear to provide habitat for fish. As noted in Section 4.4, Copsey Creek already contains somewhat turbid water, although this is primarily an aesthetic consideration as its waters are not used for drinking water supply. While the impact would be unlikely to substantially impair the human beneficial uses of these water courses, they could adversely affect biological resources that are dependent on them, namely salamanders and frogs (see Section 5.2.3). The first few pulses of sediment movement would produce the greatest effects on turbidity, thereafter, dropping off during successive storms and over several years. Sweet Springs Creek has a moderate gradient, and therefore, the transfer of sediment through the water course would be expected to occur relatively quickly. Eventually, the impacts would be indistinguishable from the normal, background seasonal pattern of sediment transfer as the fines are washed downstream (provided that the stream bottom itself is not destabilized by the road and occasional vehicle travel.

During the course of construction, there is a potential for introducing hazardous chemicals into water courses from spills of fuel and oil, grease, transmission fluid, antifreeze, and other toxic substances. In the Sweet Springs Creek and the unnamed tributaries of Bear Creek and Big Sulphur Creek, any spills would have relatively short travel distances to reach the channel. While the potential for a major spill is low, if such a spill were to occur, it could have significant impact on water quality and sicken or kill the associated wildlife of the creek and fish in Bear Creek.

Mitigation 5.2.2.1. The construction contractor should employ best construction practices in compliance with CVRWQCB and NCRWQCB requirements and the Manual for Construction Stormwater Management and County grading ordinance.

Application of Mitigation Measures 5.2.1.1.A through K, 5.2.3.1.G, 5.2.3.10.A, B and C, and 5.2.3.12.A and B, should also be required.

Impact 5.2.2.2. The crossing of Copsey Creek, Big Canyon Creek and Putah Creek could result in direct degradation of water quality from sediment and dead vegetation. The impact would be short-term and is potentially significant, but mitigable.

Copsey Creek, Big Canyon Creek and Putah Creek likely may contain flow during the late summer - early autumn construction period. Therefore, trenching of these channels has the potential for direct generation of silt and clay and dead vegetative debris that would be entrained in the flow. The overall effect could increase turbidity and water temperature downstream of the

crossing site, affecting the health of fish and other aquatic wildlife, as well as aesthetics of the water courses. The impact would be short-term. The proposed construction methods (Section 2.3.5.1) are intended to minimize these impacts through diversion of the flow in the immediate construction area. This "in-the-dry" method of construction has become a fairly standard method to minimize construction impacts, and should be effective, given the likely sizes and volumes of flow that these three watercourses would have during the low flow period. Once construction is completed and flow is restored to the channel, some loading of silt and clay in the water is anticipated. The streams would have low energy at that time of year, and therefore, the capacity and competency are likewise low. Clays would be easily transported in such low flow conditions, silts would be heavier particles and take longer to wash through the system. The major effects would occur in the first storms when flows increase and the streams have higher energy to transport the loose sediment and debris.

Mitigation 5.2.2.2.A. The construction contractor should limit construction in the channels of Copsey Creek, Big Canyon Creek and Putah Creek to the period of low flow (generally between August 1 and September 30).

Mitigation 5.2.2.2.B. The construction contractor should use "in-the dry" construction methods in the channels of Copsey Creek, Big Canyon Creek and Putah Creek and should remove all cleared dead vegetative debris upon completion of construction from the ROW.

Mitigation 5.2.2.2.C. The construction contractor should not dispose of any soil or vegetative debris in any part of the stream channel of Copsey Creek, Big Canyon Creek and Putah Creek.

Impact 5.2.2.3. The placement of fill in the channel of the unnamed tributary to Bear Creek and the unnamed tributary to Big Sulphur Creek could result in significant degradation of water quality.

The proposed construction of the new connector road between the Bear Canyon Access Road and the NCPA M-Pad would entail complete alteration of the stream channel of the unnamed tributary of Bear Canyon Creek. The primary source of sediment would be the placement of fill in approximately 180 feet of stream channel.

The channel of the Bear Canyon Creek tributary has a high gradient, dropping in a series of narrow pools with bedrock risers and boulders forming the lower lip of each pool up to about four to five feet high. It is proposed that a culvert would be placed to capture the flow, and the steep-sided canyon would be filled. The placement of the fill will be a source of considerable

sediment that will be washed downstream, eventually into Bear Creek. As previously discussed, the increase in sediment would be a short-term impact, with the most severe effects occurring in the first few seasons following construction. The primary effect on water quality would be increased turbidity of the water. This stream is not used as a water supply and it does not appear to contain fish. However, the impact would be aesthetic in Bear Creek and it could affect trout identified in 1992-1993 in Bear Creek. Because of the high gradient of the stream, the rate of sediment transport through the system would be relatively rapid.

Mitigation 5.2.2.3.A. To avoid impacts of fill placement in the unnamed tributary to Bear Creek, construct a span crossing of the pipeline in the canyon and install an isolation valve on the uphill side of the pipeline.

This mitigation would eliminate the placement of fill in the channel of the unnamed tributary to Bear Creek, but it also would preclude completion of the connector road.

OR, as alternative mitigation to 5.2.2.3.A,

Mitigation 5.2.2.3.B. If fill is placed in the unnamed tributary to Bear Creek as proposed, the fill slopes should be terraced and roughened to reduce direct runoff and covered with jute or other types of netting. The fill slopes should be seeded according to BLM specifications and sprinkled to promote seed germination and growth.

Mitigation 5.2.2.3.C. If fill is placed in the unnamed tributary to Bear Creek and the unnamed tributary to Big Sulphur Creek, as proposed, carry out a detailed program of silt control including avoiding construction where there is water in the creek. Additionally, place straw bales and rock check dams to collect silt and dissipate stream flow energy. These should be cleaned manually for the first three years after construction.

Mitigation 5.2.2.3.D. The fill slopes for both the unnamed tributary to Bear Creek and the unnamed tributary to Big Sulphur should be inspected yearly for the life of the project. Any gullying or mass wasting of the fill should be corrected immediately.

Mitigation 5.2.2.3.E. Rock rip rap should be placed along the creek bottom for both the unnamed tributary to Bear Creek and the unnamed tributary to Big Sulphur Creek at the outlet of the culvert to dissipate erosive energy of water flowing through the culvert.

With implementation of Mitigation 5.2.2.3.B - 5.2.2.3.E, the impact would remain potentially significant for the unnamed tributary of Bear Creek but less than significant for the unnamed tributary of Big Sulphur Creek.

Table 5.2.2-1 presents a summary of mitigation measures identified for geological hazards, water resources and biological resources for each stream crossing and for Clear Lake.

Impact 5.2.2.4. Construction of the Lake Diversion water intake and pipeline would substantially increase local turbidity in Clear Lake at the construction site. This is a potentially significant, although short-term, unavoidable impact.

As noted in Section 2.3.5.1, construction of the Lake Diversion water intake and laying of approximately 200 feet of pipeline would occur underwater. The construction activities will stir up bottom materials, increasing turbidity of the water. The nature of the sediments in this area is not known. If the bottom sediments are predominantly sand and coarse sediments, the impact on turbidity would be insignificant. If the bottom sediments are predominantly silts and clays, and/or contains substantial layers of detritus (decayed and partially decayed vegetative debris), a substantial increase in turbidity would occur. Increased turbidity would have three primary effects. First, it can adversely affect fishes, clogging their gills and impairing their oxygen intake. It is assumed that most fishes would swim away from the area of disturbance, so that the impacts would be minimal. However, some fishes would have limited opportunity or ability to do so (see Section 5.2.3). Second, the disturbance of the bottom sediments could cause a redistribution of potentially toxic substances, such as metals like mercury, which become temporarily suspended in the water column. These substances may become ingested by fish and other aquatic organisms. Third, there would be some aesthetic degradation resulting from the cloudy water.

The effects would be short-lived (approximately one week to 30 days) and likely would affect a relatively small area, depending on currents in the water. As the construction would occur during the low water period in the lake, when there is relatively little inflow, lateral mixing and current effects probably would be at their minimum (however, vertical mixing still would occur). The effects are unavoidable and cannot be mitigated to result in a substantial reduction in effect. The impacts would subside relatively rapidly as soon as construction ceases.

The deposition of any fill materials for the pipeline and intake structure may require a permit from the U.S. Army Corps of Engineers. Similarly, any excavated material from the lake bottom may have to be removed and disposed to an appropriate landfill. In addition, a Lake Alteration Agreement probably would be required.

TABLE 5.2.2-1: SUMMARY INDEX OF GEOLOGICAL, HYDROLOGICAL AND BIOLOGICAL MITIGATION MEASURES FOR STREAM CROSSINGS AND WATER FEATURES

<u>Stream Crossing Station</u>	<u>Mitigation Measure</u>
Lake Diversion	
M 3.5 unnamed	Geology: 5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.6.A Hydrology: - Biology: 5.2.3.1.A; 5.2.3.1.B; 5.2.3.1.C; 5.2.3.1.D; 5.2.3.1.E; 5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.H; 5.2.3.1.I; 5.2.3.1.J; 5.2.3.1.K; 5.2.3.1.L; 5.2.3.3
M 4.2 unnamed	Geology: 5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.6.A Hydrology: - Biology: 5.2.3.1.A; 5.2.3.1.B; 5.2.3.1.C; 5.2.3.1.D; 5.2.3.1.E; 5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.H; 5.2.3.1.I; 5.2.3.1.J; 5.2.3.1.K; 5.2.3.1.L; 5.2.3.3
M 5.8 unnamed	Geology: 5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.6.A Hydrology: - Biology: 5.2.3.1.A; 5.2.3.1.B; 5.2.3.1.C; 5.2.3.1.D; 5.2.3.1.E; 5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.H; 5.2.3.1.I; 5.2.3.1.J; 5.2.3.1.K; 5.2.3.1.L; 5.2.3.3
Geysers Effluent Pipeline	
4.4 Burns Valley Creek	Geology: 5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.E; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.2; 5.2.1.6.A Hydrology: 5.2.2.6.I Biology: 5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J; 5.2.3.3

(Continued)

TABLE 5.2.2-1: SUMMARY INDEX OF GEOLOGICAL, HYDROLOGICAL AND BIOLOGICAL MITIGATION MEASURES FOR STREAM CROSSINGS AND WATER FEATURES (Continued)

<u>Stream Crossing Station</u>		<u>Mitigation Measure</u>	
Geysers Effluent Pipeline (Continued)			
5.2	unnamed	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I; 5.2.1.1.J; 5.2.1.6.A
		Hydrology:	-
		Biology:	5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J
15.5	Molesworth Creek	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I; 5.2.1.1.J; 5.2.1.6.A
		Hydrology:	-
		Biology:	5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J
17.9	unnamed	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I; 5.2.1.1.J; 5.2.1.6.A
		Hydrology:	-
		Biology:	5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J
25.0	Clear Lake Outlet Channel	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I; 5.2.1.1.J; 5.2.1.6.A
		Hydrology:	5.2.2.6.I
		Biology:	5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J
36.6	unnamed	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I; 5.2.1.1.J; 5.2.1.6.A
		Hydrology:	-
		Biology:	5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J
37.2	unnamed	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I; 5.2.1.1.J; 5.2.1.6.A
		Hydrology:	-
		Biology:	5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J

(Continued)

TABLE 5.2.2-1: SUMMARY INDEX OF GEOLOGICAL, HYDROLOGICAL AND BIOLOGICAL MITIGATION MEASURES FOR STREAM CROSSINGS AND WATER FEATURES (Continued)

<u>Stream Crossing Station</u>		<u>Mitigation Measure</u>	
Geysers Effluent Pipeline (Continued)			
39.1	Clayton Creek	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.E; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I; 5.2.1.1.J; 5.2.1.2; 5.2.1.6.A
		Hydrology:	5.2.2.6.I
		Biology:	5.2.3.2.A; 5.2.3.2.B; 5.2.3.2.C; 5.2.3.3
45.5	unnamed	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.6.A
		Hydrology:	-
		Biology:	5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J
52.0	unnamed	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.6.A
		Hydrology:	-
		Biology:	5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J
54.6 54.8 59.6	Copsey Creek	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.E; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.2; 5.2.1.6.A
		Hydrology:	5.2.2.2.A; 5.2.2.2.B; 5.2.2.2.C; 5.2.2.6.I
		Biology:	5.2.3.1.A; 5.2.3.1.B; 5.2.3.1.C; 5.2.3.1.D; 5.2.3.1.E; 5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.H; 5.2.3.1.I; 5.2.3.1.J; 5.2.3.1.K; 5.2.3.1.L; 5.2.3.2.A; 5.2.3.2.B; 5.2.3.2.C; 5.2.3.3
60.2 to 67	Sweet Springs Creek	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.E; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.2; 5.2.1.3.A; 5.2.1.3.B; 5.2.1.6.A
		Hydrology:	5.2.2.1; 5.2.2.6.I
		Biology:	5.2.3.1.A; 5.2.3.1.B; 5.2.3.1.C; 5.2.3.1.D; 5.2.3.1.E; 5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.H; 5.2.3.1.I; 5.2.3.1.J; 5.2.3.1.K; 5.2.3.1.L; 5.2.3.3; 5.2.3.12.A; 5.2.3.12.B or 5.2.3.12.C

(Continued)

TABLE 5.2.2-1: SUMMARY INDEX OF GEOLOGICAL, HYDROLOGICAL AND BIOLOGICAL MITIGATION MEASURES FOR STREAM CROSSINGS AND WATER FEATURES (Continued)

<u>Stream Crossing Station</u>		<u>Mitigation Measure</u>	
Geysers Effluent Pipeline (Continued)			
68.0 to 72.5	unnamed tributary of Big Canyon Creek	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.E; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.2; 5.2.1.6.A; 5.2.1.6.C
		Hydrology:	5.2.2.6.I
		Biology:	5.2.3.1.A; 5.2.3.1.B; 5.2.3.1.C; 5.2.3.1.D; 5.2.3.1.E; 5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.H; 5.2.3.1.I; 5.2.3.1.J; 5.2.3.1.K; 5.2.3.1.L; 5.2.3.3; 5.2.3.12.A; 5.2.3.12.B or 5.2.3.12.C
76.6	Big Canyon Creek	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.E; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.2; 5.2.1.6.A
		Hydrology:	5.2.2.2.A; 5.2.2.2.B; 5.2.2.2.C; 5.2.2.6.I
		Biology:	5.2.3.1.A; 5.2.3.1.B; 5.2.3.1.C; 5.2.3.1.D; 5.2.3.1.E; 5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.H; 5.2.3.1.I; 5.2.3.1.J; 5.2.3.1.K; 5.2.3.1.L;5.2.3.3
83.0	unnamed	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.6.A
		Hydrology:	-
		Biology:	5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J
84.5	Cockerell Creek	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D;5.2.1.1.E; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.2; 5.2.1.6.A
		Hydrology:	-
		Biology:	5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J
93.2	unnamed	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.E; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.2; 5.2.1.6.A
		Hydrology:	-
		Biology:	5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J

(Continued)

TABLE 5.2.2-1: SUMMARY INDEX OF GEOLOGICAL, HYDROLOGICAL AND BIOLOGICAL MITIGATION MEASURES FOR STREAM CROSSINGS AND WATER FEATURES (Continued)

<u>Stream Crossing Station</u>		<u>Mitigation Measure</u>	
Geysers Effluent Pipeline (Continued)			
94.5	Harbin Creek	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D;5.2.1.1.E; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.2; 5.2.1.6.A
		Hydrology:	5.2.2.6.I
		Biology:	5.2.3.1.A; 5.2.3.1.B; 5.2.3.1.C; 5.2.3.1.D; 5.2.3.1.E; 5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.H; 5.2.3.1.I; 5.2.3.1.J; 5.2.3.1.K; 5.2.3.1.L;5.2.3.3
98.5	unnamed	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.E; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.2; 5.2.1.6.A
		Hydrology:	-
		Biology:	5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J
99.1	unnamed	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.E; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.2; 5.2.1.6.A
		Hydrology:	-
		Biology:	5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J
100.0	unnamed	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.E; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.2; 5.2.1.6.A
		Hydrology:	5.2.2.6.I
		Biology:	5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J
102.4	unnamed	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.E; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.2; 5.2.1.6.A
		Hydrology:	-
		Biology:	5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J
102.5	Putah Creek	Geology:	5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.E; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.2; 5.2.1.6.A; 5.2.1.7
		Hydrology:	5.2.2.2.A; 5.2.2.2.B; 5.2.2.2.C; 5.2.2.6.I
		Biology:	5.2.3.1.A; 5.2.3.1.B; 5.2.3.1.C; 5.2.3.1.D; 5.2.3.1.E; 5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.H; 5.2.3.1.I; 5.2.3.1.J; 5.2.3.1.K; 5.2.3.1.L;5.2.3.3
(Continued)			

(Continued)

TABLE 5.2.2-1: SUMMARY INDEX OF GEOLOGICAL, HYDROLOGICAL AND BIOLOGICAL MITIGATION MEASURES FOR STREAM CROSSINGS AND WATER FEATURES (Continued)

Stream Crossing Station	Mitigation Measure
Geysers Effluent Pipeline (Continued)	
108.2 unnamed	Geology: 5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.6.A Hydrology: - Biology: 5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J
120.8 unnamed	Geology: 5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.6.A Hydrology: - Biology: 5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.I; 5.2.3.1.J
123.8 unnamed tributary of Bear Creek	Geology: 5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.E; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.2; 5.2.1.6.A Hydrology: 5.2.2.1; 5.2.2.3.A or 5.2.2.3.B; 5.2.2.3.C; 5.2.2.3.D; 5.2.2.3.E; 5.2.2.6.I Biology: 5.2.3.1.A; 5.2.3.1.B; 5.2.3.1.C; 5.2.3.1.D; 5.2.3.1.E; 5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.H; 5.2.3.1.I; 5.2.3.1.J; 5.2.3.1.K; 5.2.3.1.L; 5.2.3.3 5.2.3.14.A; 5.2.3.14.B; 5.2.3.14.C; 5.2.3.14.D
Unocal unnamed tributary of Big Sulphur Creek	Geology: 5.2.1.1.A; 5.2.1.1.B; 5.2.1.1.C; 5.2.1.1.D; 5.2.1.1.E; 5.2.1.1.F; 5.2.1.1.G; 5.2.1.1.H; 5.2.1.1.I 5.2.1.1.J; 5.2.1.1.K; 5.2.1.2; 5.2.1.6.A Hydrology: 5.2.2.1; 5.2.2.3.A; 5.2.2.3.C; 5.2.2.3.D; 5.2.2.3.E Biology: 5.2.3.1.A; 5.2.3.1.B; 5.2.3.1.C; 5.2.3.1.D; 5.2.3.1.E; 5.2.3.1.F; 5.2.3.1.G; 5.2.3.1.H; 5.2.3.1.I; 5.2.3.1.J; 5.2.3.1.K; 5.2.3.1.L; 5.2.3.3 5.2.3.17.A; 5.2.3.17.B
Clear Lake	Geology: 5.2.1.7 Hydrology: 5.2.2.4.A; 5.2.2.4.B Biology: 5.2.3.9

Mitigation 5.2.2.4.A. LACOSAN and the BLM shall consult with the COE to determine if any permits are required, and conditions which may apply to the permits, for disturbance of lake bottom sediments.

Mitigation 5.2.2.4.B. LACOSAN shall consult with the CDFG to determine the requirements for a Lake Alteration Agreement.

Implementation of Mitigation 5.2.2.4.A and B would reduce impacts to a minimum and would be within acceptable levels. The residual water quality impact would be insignificant.

Impact 5.2.2.5. Construction of the Geysers Effluent Pipeline would require the closure of an irrigation well. Improper well closure could introduce surface contaminants into the groundwater. This is a potentially significant impact. It is mitigable through compliance with standard well closure procedures.

An existing well near Station 46 may have to be closed for the pipeline. All wells provide a potential route of contamination from the surface to the aquifer which they tap. Closure of the well is a required precaution to prevent a possible pipeline leak from contaminating the well and aquifer.

Mitigation 5.2.2.5. The project sponsors shall comply with all requirements of the California Division of Mines and Geology (CDMG) for well closure. A CDMG inspector shall certify that the well has been properly sealed and capped.

Implementation of Mitigation 5.2.2.5 would reduce the impact to an insignificant level.

Impact 5.2.2.6. Failure of the Geysers Effluent Pipeline could result in a spill of wastewater and related wash-out at the discharge point. This is a potentially significant impact. It is mitigable to acceptable levels of risk.

Like any water or wastewater conveyance system, the proposed Geysers Effluent Pipeline and associated facilities would be susceptible to failure under certain circumstances. The Geysers Effluent Pipeline would be built using standard construction techniques and materials, and conventional technology. The pipeline system to convey the water from its source to the injection area would be similar to water and wastewater conveyance systems used in hundreds of cities and districts throughout California. Standard design and construction measures for wastewater force main systems will be incorporated into the final project design to reduce the risk of upset to a less than significant level. Possible failure mechanisms and measures typically used to prevent pipeline failure are described in this section.

Failure of the Geysers pipeline could lead to a release of effluent into the environment. Pipeline failure, in the unlikely event it were to occur, would probably be a result of operational error, vandalism, mechanical/structural failure, or failure of the monitoring and control system.

Circumstances that could lead to system upsets are described below:

- Operational error could occur if proper procedures are not followed during pump start-up or shut down, valve operation, or emergency operations (such as during a power failure). Improper system operation could lead to pressure surges that exceed the strength of the pipe and the capacity of surge protection devices, and thereby result in pipe breakage. This usually would be expected to occur at joints in the pipe.
- Vandalism may include the unauthorized operation of pumps and valves, the theft of appurtenances (sometimes for their brass content), or the deliberate damage and destruction of facilities.
- Mechanical or structural failure could be caused by faulty equipment, inadequate final design, poor quality construction, unpredictable conditions (such as soil movement and earthquakes), or corrosion.
- Failure of the monitoring system could prevent potential operational problems from being identified, and failure of the remote control equipment in emergency conditions could necessitate manual operation, which may not be fast enough to prevent effluent spillage.

The Geysers pipeline would be pressurized by pumps, and therefore the quantity of effluent released in a system upset would be limited to what is contained in the system at any moment, assuming pumping is immediately halted in the event of a major leak. The proposed conveyance system, including 138,500 feet of 24-inch pipeline and the 620,000-gallon Childers Peak Regulation Tank, would contain a total of approximately 3.6 million gallons of effluent. However, due to the peaks and valleys of the pipeline route, and check valves (to prevent reverse flow) at the pump stations and at 2-mile intervals along the pipeline, all of this effluent could not be released from a single pipe break. As a break in the pipeline could occur at any point in the system, a worst-case scenario is presented below.

In a worst case scenario, a leak or blow-out would occur at the low-point near the Cockerell Creek crossing (station 84.5) and release 800,000 gallons from the pipeline and 620,000 gallons from the Childers Peak Regulating Tank. The discharge would occur under pressure. If a blow-out were to occur, it probably would result in substantial wash-out at the break. A substantial volume of soil would be washed into Cockerell Creek. Cockerell is a tributary to Putah Creek. The pipeline crossing at Cockerell is about 400 feet above the confluence with Putah Creek. The soil would be washed down Cockerell Creek and into Putah Creek. This would result in a

substantial amount of deposition of mud in lower Cockerell Creek and for some distance downstream in Putah Creek.

The spillage of this quantity of effluent through a leak would probably take several hours or days, and would most likely be partially contained during that time by manual shut-down of the system. The loss of pressure from a blow-out in the pipeline system would be detected at the NCPA operations center almost immediately. However, isolating the location of the break likely would require several hours, depending on when and where the break occurs. A blow-out at Cockerell Creek would be readily accessible by public roads from staff at the MWTP who could reach the site within a half hour after notification of a problem. However, at present there is an operator present at the MWTP only two or three days each week. This means that, if MWTP staff were not present, personnel from either the SERWTP or from NCPA would be the first response to the situation. Travel from either location probably would extend the response time to one or two hours. Upon reaching the point of the break, the operator would have to locate the nearest isolation valve and initiate shut-off.

A leak, however, might go undetected for some time, depending on the rate of effluent loss. Regular visual inspection activities would be the primary means of identifying the location of the leak. A leak would not produce the same degree of damage, and only a small wash-out probably would result.

In the event of either a blow-out or a leak, the discharge of treated effluent into the watercourses would not pose a significant threat to public health from either the volume of flow or the quality of the water. As noted, the chief problem probably would be the deposition of mud in the channels of both creeks and a temporary surge of muddy water through the affected creek system. The latter effect could result in fish kills.

Mitigation 5.2.2.6.A. Prior to start-up, prepare an Operations Manual that details procedures for remote and manual system operation of the system. The manual should specify training requirements and responsibilities of district personnel, and should include an inspection and maintenance schedule for all components of the system.

Mitigation 5.2.2.6.B. Prior to start-up, prepare an Emergency Response Plan.

The plan should include provisions for the notification of appropriate personnel in the event of an emergency, and emergency shut-down procedures. At all times, key personnel identified in

the plan should have with them or have quick access to the equipment needed to carry out emergency procedures, such as appropriate vehicles, radios, keys to facilities, valve wrenches and tools, and maps and diagrams. The plan should also include directions for agency notification (Department of Health Services, Regional Water Quality Control Board, etc.).

Mitigation 5.2.2.6.C. Establish a valve exercising program for the isolation valves. By regularly turning valves, they will be more likely to function properly if needed.

Mitigation 5.2.2.6.D. Spare parts and repair equipment should be stocked by the project sponsors.

Mitigation 5.2.2.6.E. Install locking covers on all valves and switches to prevent unauthorized use.

Mitigation 5.2.2.6.F. Evaluate the effectiveness of a cathodic protection system to prevent pipeline corrosion.

Mitigation 5.2.2.6.G. The project sponsors should provide full-time inspection during all phases of project construction. The completed system should be fully tested prior to regular operation.

Mitigation 5.2.2.6.H. Final design of the pipeline, Childers Peak Regulating Tank and other facilities should incorporate groundshaking intensity associated with a maximum credible earthquake.

Other features will be incorporated into the project design in the normal course of project development to reduce the risk of system upset. Some of these features include thrust restraints, pressure release valves, and vacuum release valves and check valves where appropriate; isolation valves at approximately two-mile intervals; surge and pressure regulation tanks; weathering steel pipe and coatings to resist corrosion; and a computerized Distributed Control System to operate the pipeline.

Mitigation 5.2.2.6.I. Install isolation valves at a minimum of 2-mile intervals, as proposed, as well as (or spaced to include a location at) at the following stream crossings: Burns Valley Creek; the Clear Lake Outlet Channel; Clayton Creek; Copsey Creek (upper crossing at El Roble Grande Ranch); Sweet Springs Creek at Station 60; Big Canyon Creek; Harbin Creek; Station 100; Putah Creek; and at the crossing of the unnamed tributary of Bear Creek.

The implementation of standard engineering design practices features and the Mitigation Measures listed above would reduce the risk of upset to an acceptable level of risk, and therefore, to a less than significant level.

Impact 5.2.2.7. The Geysers Effluent Pipeline could experience slow leaks that could contaminate local groundwater. This would be a potentially significant effect. The impact is mitigable.

Slow leaks in the pipeline could occur at locations in which pollutants in the effluent could come into contact with groundwater used for a water supply. As the City of Clearlake and the Lower Lake areas receive domestic water from a public water supply system, the hazard would be small unless the leaking effluent pipeline also was located near a damaged water line. Lower Lake obtains some of its supply from wells, but these are all distant from the pipeline alignment. The principal areas of groundwater contamination hazard would be in the Excelsior Valley area which has a scattered population that depends on well water. In this area, the only water-bearing geologic materials are alluvium. The alluvium is composed of clay or floodplain silt and clay with gravel. Well yields in this area are small. The underlying rock materials have poor water-bearing characteristics. There are some residences relatively close to Copsey Creek that have wells. No other portions of the pipeline are located near wells used for domestic water supply.

Mitigation 5.2.2.7.A. Conduct a detailed survey of wells located within 100 feet of the final pipeline alignment. Identify any wells that are used for domestic water supply, their depths and capacities.

Mitigation 5.2.2.7.B. As part of the final design, install impermeable liners in the pipeline trench where the alignment comes within 100 feet of an existing domestic water well.

OR, as alternative mitigation to 5.2.2.7.A and B,

Mitigation 5.2.2.7.C. Conduct annual sampling of well water for any domestic water well within 100 feet of the pipeline alignment, and provide contractual assurances to the well-owner of a guaranteed supply of potable water at the expense of the Project Sponsors in the event a leak in the pipeline is identified as the source of groundwater contamination.

Implementation of Mitigation 5.2.2.7.A and B or 5.2.2.7.A and C would reduce the impact to an acceptable level of risk and, therefore, to a less than significant level of impact.

Impact 5.2.2.8. The Geysers Effluent Pipeline would have an insignificant impact on surface water resources, flood hazard and ground water. The project would transfer approximately an average of 8,564 acre-feet per year out of the Clear Lake Basin.

The project would entail the diversion of between approximately 5.1 (in 2021) and 6.3 mgd (in 1996) of raw water from Clear Lake. The rates of withdrawal would be highest initially, then would decrease over time as wastewater flows increase in the SERWTP service area. The average projected withdrawal rate of 6.24 mgd equates to approximately 6,994 AF in 1996. This is equivalent to approximately 0.6 percent of the lake's total capacity of 1,153,000 af (Lake County General Plan Technical Appendices, Working Paper #4, p.12).

As noted in Section 2.1.4, the proposed project entails the use of approximately 7.64 mgd of water that is drawn from Clear Lake. This figure, for the 1996 case includes about 6.24 mgd of raw lake water diverted to the SERWTP and 1.40 mgd of wastewater from the SERWTP. It is assumed for this analysis that all of the SERWTP water represents a withdrawal of water from Clear Lake, although this is a liberal assumption because some of the water would be derived from wells, especially that from the Lower Lake area. Also, some of the SERWTP water would be derived from infiltration and inflow, although it is reasonable to include this within the assumed Clear Lake withdrawal, since under natural conditions this water would be part of the surface and groundwater recharge of the lake. Of the 8,564 af/yr total transfer, 6,994 af/yr would be derived from withdrawals from Clear Lake under contract with the YCFCWCD.

Table 5.2.2-2 indicates the percentages of raw, make-up water diverted annually for the project in relation to three water resource capacities in Clear Lake: the total capacity of Clear Lake, the total reservoir capacity of the lake (that is, water available for withdrawal because of the Clear Lake Dam) and, the portion of the reservoir capacity that is a reserve for the Yolo County Flood Control and Water Conservation District (YCFCWCD). The figures in Table 5.2.2-2 indicate that the make-up water diversion for the project comprises a small percentage of the resource in the lake even for years with the high annual withdrawal.

Table 5.2.2-2 also presents the make-up water annual diversion in relation to a drought condition, for which a 15% reduction in volume is assumed. It is also assumed that during a drought only the high annual withdrawal rate would apply. Even during the projected drought, the make-up withdrawal represents a small withdrawal.

TABLE 5.2.2-2: PERCENTAGES OF PROJECT MAKE-UP WATER WITHDRAWAL IN RELATION TO CLEAR LAKE WATER SUPPLIES

	Average Annual Withdrawal (6,994 af)	Low Annual Withdrawal (6,600 af)	High Annual Withdrawal (7,950 af)
Total Lake Capacity (1,153,000 af)	0.61%	0.57%	0.69%
Total Reservoir Capacity (303,000 af)	2.31%	2.18%	2.62%
YCFCWCD Lake Reservoir Reserve (150,000 af)	4.66% ^a	4.40% ^a	5.30% ^a
Total Lake Capacity in Drought (980,050 af) ^b	-	-	0.81%
Total Reservoir Capacity in Drought (130,050 af) ^b	-	-	6.11%
YCFCWCD Lake Reservoir in Drought (127,500) ^{a,b}	-	-	6.24%

^a Assumes the total diversion would be from YCFCWCD water.

^b Assumes a 15% reduction in volume.

SOURCE: Environmental Science Associates, 1994

Under the conditions of normal lake level, the withdrawal of the average raw lake water diversion (6,994 af) would result in a theoretical drop in the lake level of 1.93 inch. When withdrawal is 7,950 af/yr, at low water (0.0 Rumsey) the theoretical drop in lake level would be 2.41 inches. Under the same withdrawal at mean lake level, the equivalent drop would be 2.30 inches and at high lake level (full pool) the drop would be 2.18 inches. However, these figures do not take into account the fluctuation of lake level created by actual conditions represented by inflow during individual storm events and recharge; such conditions would reduce the drop in lake level to small amounts in a given period. Additionally, these fluctuations would not likely exceed the natural variation in lake level. Reductions of this magnitude are considered insignificant in relation to the water resource of Clear Lake, to recreation opportunity as well as to water quality and aquatic ecosystems.

The total withdrawal for wastewater and raw lake water diversion also constitute small percentages of the total capacity and reservoir of Clear Lake. Assuming a total of 7.64 mgd, which equates to 8,564 af/year, the proposed water withdrawal represents approximately 0.74% of the storage capacity and about 2.83% of the reservoir of Clear Lake.

It is important to note that the above withdrawals also are permanent removals of water resources from the Clear Lake basin and the Cache Creek watershed for the design life of the project. The proposed Geysers Effluent Pipeline would convey the water to the Southeast Geysers, which is located in the Putah Creek and Big Sulphur Creek watersheds. However, the effluent and raw lake water would not become a part of the water resources of either the Putah Creek or Big Sulphur Creek watersheds because deep injection and steam production would effectively separate the water from the hydrologic regime of the creeks.

As noted in Chapter 2, it is the intent of the project sponsors to purchase the raw lake water from the YCFCWCD at a rate to be determined.

The project construction would entail the use of a substantial amount of water for purposes of required dust control as well as final pipeline pressure testing (estimated at about 500,000 gallons). As this is a short-term use of the water resources, and is required for other environmental purposes, the impact is considered less than significant.

The project would not substantially alter surface runoff conditions, and therefore, would not have an impact on flood hazards. Neither is the project likely to cause adverse effects or incompatible development in floodplains. While informal consultation with the Corps of Engineers may be advisable, there is no apparent conflict with the goals incorporated into Executive Order 11988-Flood Plain Management. All facilities and pipelines associated with this component would be at or near the ground surface, and, therefore, would have no impact on aquifers and would have a less than significant impact on recharge. While some use of groundwater may be used for construction purposes, the sources would be scattered and of short term effect; thus, this is considered an insignificant impact on ground water resources. The use of the wastewater as injection fluid would make that volume of water unavailable for other uses. At present, there has been no other demand for the wastewater expressed to LACOSAN. While this may change in the future, there is no local demand for the wastewater and there are no facilities available for conveying the water out of the County and region to areas where such uses might be made of the wastewater.

No mitigation is required.

5.2.3 BIOLOGICAL RESOURCES

IMPACT SIGNIFICANCE CRITERIA

These criteria have been paraphrased by ESA from the Federal Endangered Species Act, California Endangered Species Act, and CEQA in respect to impact to endangered species, natural communities and biological resources. Impacts to wetlands are in reference to wetlands under US COE jurisdiction pursuant to Section 404 of the Clean Water Act.

Significant and unmitigable impacts would occur if the project would result in:

- the loss of a population of plants or animals that are listed by federal or state resource agencies as rare, endangered or threatened.
- the loss of a substantial amount of the local habitat for an endangered or threatened species of animal.
- the filling of more than 10 acres of wetland under the jurisdiction of the U.S. Army Corps of Engineers as "isolated waters".
- the loss of a large part of a Natural Community considered rare by the California Natural Diversity Data Base (e.g., wetlands).
- the loss of habitat for animals, as listed by the CDFG, loss of individual plants of county-listed or candidate species or loss of a large percentage of a Natural Community protected by the County of Lake.

Significant but potentially mitigable impact would occur if the project would:

- result in the filling of more than one but less than 10 acres of wetland or "Waters" in an area "above the headwaters" under the jurisdiction of the U.S. Army Corps of Engineers.
- result in the loss of a limited amount of habitat used for feeding, nesting or roosting by endangered, threatened or candidate species of animals.
- result in the substantial reduction of numbers of individuals plants of a species listed by federal or state resource agencies as endangered, threatened or candidate.
- result in the loss of a limited part of a natural community considered rare by the California Natural Diversity Data Base.
- substantially reduce the diversity of plant or animal species.
- create a substantial barrier to animal movement or plant distribution.

Adverse but not significant impact (requires no mitigation) would occur if the project:

- would reduce numbers of common hardwood or coniferous tree species.
- would remove or seriously degrade common Natural Communities such as grassland or woodland.
- would remove or degrade habitat for common species of animals.
- construction or implementation would result in the death of common non-game animal species.

IMPACTS AND MITIGATION MEASURES

Impact 5.2.3.1. Construction of the Geysers Effluent Pipeline and Lake Diversion Pipeline could result in loss of habitat and direct injury to or loss of individuals of California red-legged frog (*Rana aurora draytonii*) by construction activities and/or potential spill of harmful chemicals. This would be a significant but mitigable impact.

The California red-legged frog, while currently not listed as endangered or threatened, has been proposed as endangered and is under review by the U.S. Fish and Wildlife Service (USFWS). It is likely to be listed by early 1994. This species is listed by the State of California as a species of concern.

California red-legged frogs require shallow ponds or streams with emergent vegetation to lay their eggs in and to develop their tadpoles. Loss of habitat for a federally proposed endangered species is a significant impact.

Construction of the Lake Diversion Pipeline would result in the loss of stream (about 750 sq. feet) and wet meadow (about 0.3 acres) areas that provide habitat for red-legged frog. Other creek crossings of the Geysers Effluent Pipeline including Copsey Creek, Lower Sweet Springs Creek, Upper Sweet Springs Creek, an unnamed tributary to Big Canyon Creek, Big Canyon Creek, Harbin Creek, Putah Creek, the unnamed tributary to Bear Creek and the new road and distribution pipeline at the unnamed tributary of Big Sulphur Creek, and access roads adjacent to these creeks, could cause potential habitat loss and direct destruction of individual red-legged frogs. While habitat loss for the individual creeks would be small, a cumulative significant impact could result.

Mitigation 5.2.3.1.A. A survey for all life-cycle stages of California red-legged frog should be conducted immediately prior to initiating construction to determine whether California red-legged frogs are present in all perennial and intermittent streams and wet meadows potentially crossed by or in close proximity to the pipelines, access roads and construction areas.

Survey results, including methods required by the USFWS, locations, and population numbers shall be sent to the USFWS for review. The project sponsor shall initiate an informal, or if the species is listed, formal consultation with USFWS to secure approval for incidental take.

If the species is not found to be present, no mitigation is required. If the California red-legged frog is present but not officially listed as federally endangered prior to construction of the pipeline, the above impact is considered adverse but not significant.

Mitigation 5.2.3.1 B. All construction work in streams and wetlands should be conducted during the dry season, between July 1st and October 30. If frogs are present and if there is any streamflow, a check dam above and below the trench must be installed to prevent adult red-legged frogs from entering the trench. The trench should be inspected daily prior to starting construction activities to determine if red-legged frogs are in the trench and the frogs should be removed carefully out of the construction areas.

July 1 to October 30 is the temporal "window" when the northern red-legged frog is not mating or laying eggs, and the tadpoles have reached mature frog size.

If California red-legged frog adults, eggs or tadpoles are identified in the field surveys and they are officially listed as threatened or endangered then Mitigation Measure 5.2.3.1.C shall be undertaken.

Mitigation 5.2.3.1.C. In accordance with USFWS and CDFG requirements, if frogs are present, the project sponsors should prepare and implement a mitigation program prior to the initiation of any ground clearing, grading, construction or any other activities which would disrupt this species.

The mitigation plan shall provide for no net loss of California red-legged frog populations in the area of disturbance of any part of the pipeline route. Mitigation in conformance with Section 15370 of the CEQA *Guidelines* should:

- avoid the impact altogether by not taking certain actions, e.g. avoiding construction until a water course is dry or spanning of the water course,

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- minimize the impacts by limiting the degree of magnitude of an action and its implementation, e.g., careful capture and removal of adults to a safe area near but outside the construction zone, such as an upstream area: such actions shall be documented and submitted to the CDFG and USFWS,
- rectify the impact by repairing, rehabilitating, or restoring the impacted environment,
- reduce or eliminate the impact over time by preservation and maintenance operations during the life of the project,
- compensate for the impact by replacing or providing substitute resources of environments.

The effectiveness of the mitigation shall be monitored annually for five years (minimum) after implementation to ensure its success. If at any point during the five-year monitoring period, the mitigation plan is judged to be unsuccessful, revised mitigation actions shall be prepared in consultation with USFWS and CDFG and monitored for a succeeding five-year period.

Mitigation 5.2.3.1.D. In disturbed habitat of the red legged frog, surface soil in the trench ROW and stream sediments should be carefully excavated and stockpiled to be returned to the top of the finished trench at the same elevation as the original ground level.

Mitigation 5.2.3.1.E. Spoils should not be disposed within habitat of the red-legged frog. Spoils should be placed no closer than 50 feet from streams and wetlands and should be spread so as not to create mounds or other barriers. All spoils should be replanted with plant species common to the area.

Mitigation 5.2.3.1.F. As required by County ordinance, all work should be completed within the dry season to minimize the amount of sediment that is suspended in the water of the swale or stream course.

This mitigation measure would reduce impacts to red legged frogs and other aquatic species that may be present in downstream areas.

Mitigation 5.2.3.1.G. Application of chemicals harmful to wildlife in the right-of-way (ROW) during construction and operational phases of the project should be prohibited.

Mitigation 5.2.3.1.H. The pipeline construction corridor should be as narrow as is possible to work within, and no wider than 15 feet in stream crossings or wetlands in which red legged frogs are found.

The corridor should be flagged or ribboned to prevent workers and equipment from damaging habitat outside the corridor.

Mitigation 5.2.3.1.I. If vegetated at the time of project construction, the banks of the stream should be replanted with the same native species present on the undisturbed banks upstream and downstream from the disturbance.

The banks shall be replanted with species native to the riparian plant community of Lake County (see Valley-Foothill Riparian community description in Affected Environment section 4.5.1) and to the specific native vegetation of the disturbed sites. Photo documentation of each site shall be submitted prior to construction and following replanting.

If banks are rendered unstable by the pipe placement, it may be necessary to hydromulch with a grass seed mix recommended by the Lake County Agricultural Extension or the County Planning Department. If a native grass mix is available it may be used, but adequate bank cover and the prevention of erosion must be the first priority.

Mitigation 5.2.3.1.J. A qualified representative of the County should monitor construction to ensure contractor compliance with these requirements.

Mitigation 5.2.3.1.K. The construction contractor should be required to provide all workers with information about identification and impact avoidance for red-legged frogs. The construction contractor shall document that each worker has been provided the necessary information.

The worker education program shall provide information about how to identify the species and specific actions to avoid injury to red-legged frogs. It shall include information about penalties for failure to report sightings and to take corrective avoidance actions. The construction contractor shall submit documentation signed by each worker on the construction site that he/she has been informed about potential hazards to the red-legged frog.

Mitigation 5.2.3.1.L. Standard provisions to control construction activities, protect water quality, and provide for dust and erosion control as well as the designation of Environmentally Sensitive Areas (ESAs) to protect this habitat should be implemented to substantially reduce or eliminate potential indirect impacts to red-legged frog.

Additional measures which could be instituted at these potential habitat sites include clearly flagging the limits of this habitat, re-vegetating disturbed and adjacent areas with native species, utilizing erosion control techniques to reduce silt deposition of low lying areas, watering of the construction area to reduce dust impacts, and providing an on-site biologist to ensure avoidance and to implement any necessary corrective measures during the construction period.

The preceding Mitigations 5.2.3.1.A-L would reduce the impacts to the California red-legged frog to a less than significant level.

Impact 5.2.3.2. Construction of the main Geysers Effluent Pipeline could result in loss of habitat, as well as injury to or direct loss of individuals, of northwestern pond turtle (*Clemmys marmorata marmorata*) from construction activities and spills of harmful chemicals. This would be a potentially significant, but mitigable, cumulative impact.

The northwestern pond turtle is classified by the USFWS as Category 2, candidate for listing under FESA as threatened or endangered, and is listed by the State of California as a species of concern.

This species requires perennial streams with areas for sunning, such as stream banks or logs. Creeks may be affected by the removal of trees and shrubs along the creek which would create small but cumulative increases of water temperature, changes in hydrology, and erosion. Additionally, construction could create accidental discharge of harmful fluids and harm or disturb the turtles by incidental intrusion by construction workers or equipment.

Construction of the Geysers Effluent Pipeline spanning Clayton Creek, and spanning Copsey Creek at the north end of El Roble Grande Ranch, and as a buried crossing at its south end, may result in small but cumulative degradation of habitat for the northwestern pond turtle along those creeks. The impact would be short-term during and shortly following construction.

Mitigation 5.2.3.2.A. Immediately prior to construction, a specific survey should be conducted to determine the presence of this species within Clayton and Copsey Creeks for an area 100 yards upstream and downstream of each crossing site.

Documentation of the survey including methodology, discussion of sightings of individuals or populations of this species (if present) and photo documentation shall be forwarded to the CDFG for their review. Approved survey methodologies are to be used. If these methods reveal no individuals of this species within the right-of-way, no further mitigation is necessary. A 100-yard survey area is recommended as an approximate migration distance for the species (John Brode, CDFG).

Mitigation 5.2.3.2.B. Standard provisions to control construction activities, protect water quality, and provide for dust and erosion control (including Mitigation 5.2.3.1.B through L but with reference to the pond turtle) as well as the designation of Environmentally

Sensitive Areas (ESAs) to protect this habitat should be implemented to substantially reduce or eliminate potential indirect impacts to turtles.

Additional measures which could be instituted at these potential habitat sites include clearly flagging the limits of this habitat, re-vegetating disturbed and adjacent areas with native species, utilizing erosion control techniques to reduce silt deposition of low lying areas, watering of the construction area to reduce dust impacts, and providing an on-site biologist to ensure avoidance and to implement any necessary corrective measures during the construction period.

Mitigation 5.2.3.2.C. Prior to and during construction, the streams supporting northwestern pond turtles shall be temporarily dammed both up- and down-stream of construction areas. Daily inspection of the construction area should be conducted and turtles should be carefully relocated upstream of construction activities by a qualified biologist.

Temporary dams will remain in place until construction activities have ceased. Rapid construction would be carried out in these areas. If flows are substantial, the water would be diverted around the construction area. Turtles will be marked and carefully relocated to stream habitats near but outside of the construction areas. Following dam removal, the marked turtles will be returned to the original location.

Implementation of Mitigation Measures 5.2.3.2.A-C would reduce the impact to a less than significant level.

Impact 5.2.3.3. Construction of the Geysers Effluent Pipeline could result in loss of habitat and direct loss of individuals of foothill yellow-legged frog (*Rana boylei*). This would be a potentially significant, but mitigable, cumulative impact.

The foothill yellow-legged frog is classified by the USFWS as Category 2, candidate for listing under FESA as threatened or endangered, and is listed by the State of California as a species of concern.

Impacts to this species could occur along the same creeks as for California red-legged frogs. These areas could experience habitat loss and direct destruction of individual of foothill yellow-legged frogs. The impact would be short-term during and shortly following construction.

Mitigation 5.2.3.3. Apply Mitigation 5.2.3.1.A and B but with reference to the foothill yellow-legged frog.

Implementation of these mitigation measures would reduce the impact to a less than significant level.

Impact 5.2.3.4. Construction of the project pipeline could result in loss of habitat, as well as direct loss of individuals, of California horned lark (*Eremophila alpestris actia*). The impact is a potentially significant cumulative effect, but is mitigable.

California horned lark is classified by the USFWS as Category 2, candidate for listing under FESA as endangered or threatened, and is listed by the State of California as a species of concern.

The horned lark is usually found in open habitat, such as grassland and agricultural areas, where trees and shrubs are absent. This species has been observed from sea level to above treeline in various habitats, such as grasslands of all varieties, deserts and alpine dwarf-shrub habitat. It uses grasses, shrubs, forbs, rocks, litter, clods of soil, and other surface irregularities for cover from predators. This species nests in grasslands during the months of February through July. Construction activities could disturb the nesting activities of the species. The impact would be short-term.

Construction of the Geysers Effluent Pipeline from Stations 46 to 54, 54 to 58, 66 to 69, 69 to 73, and 73 to 76 and at the Childer's Peak Regulating Tank and spoils disposal site could impact foraging and nesting areas for California horned lark.

Mitigation 5.2.3.4. Conduct California horned lark nest surveys prior to construction and, if identified, avoid construction during the nesting period.

Surveys should be conducted by a qualified ornithologist between mid-February and July. Flag areas with potential nest sites and do not allow construction equipment and private cars outside the construction corridor. If birds are nesting during the time of the survey, construction should be delayed until after July. If birds are not nesting during the time of the survey, no restrictions need be placed on the timing of construction.

Implementation of Mitigation 5.2.3.4 would reduce the impact to a less than significant level.

Impact 5.2.3.5. Construction of the project pipeline could result in loss of habitat, as well as direct loss of individuals of loggerhead shrike (*Lanius ludovicianus*). The impact is a potentially significant cumulative effect, but is mitigable.

Loggerhead shrike is classified by the USFWS as Category 2, candidate for listing under FESA as endangered or threatened, and is listed by the State of California as a species of concern.

This species occurs in open habitats, such as grasslands, using shrubs, trees, posts, fences, and utility lines for perching surfaces. Habitats with little to no human disturbance are preferred, such as open canopied valley, oak woodlands, and valley foothill riparian. This species nests on stable branches in densely foliated tree or shrubs. The nesting season ranges from March through August.

Construction along the pipeline, from Stations 60 to 73 within any riparian woodland, oak woodland or chaparral, the alignment of the proposed connector road from the Bear Canyon Access Road to NCPA's M-Pad, and the Childer's Peak Regulating Tank and spoils disposal site could affect nesting and foraging areas for loggerhead shrike.

Mitigation 5.2.3.5. Apply Mitigation Measure 5.2.3.4, but with reference to the loggerhead shrike.

Implementation of Mitigation 5.2.3.5 would reduce the impact to a less than significant level.

Impact 5.2.3.6 Construction of the project pipeline could result in loss of habitat, as well as direct loss of individuals, of black-shouldered kite (*Elanus caeruleus*). This is a potentially significant, but unlikely, cumulative impact. It could be mitigated.

Black shouldered-kite, a California fully protected species, forages in wetlands and open brushlands, usually near water and streams. Oak woodlands, valley oak or live oak, or trees along marsh edges are used for nesting sites during the months of February through June. Construction during April, May and June could disturb the nesting activities of the species.

Construction of the Geysers Effluent Pipeline from Morgan Valley Road to Clayton Creek Road would result in the loss or degradation of approximately one acre of annual grassland in close proximity to a perennial stream that may be nesting and foraging habitat for black-shouldered kite. This impact would be short term.

Mitigation 5.2.3.6.A. Conduct black-shouldered kite nest surveys in the early nesting season and avoid construction near nesting sites during the nesting period if identified.

A survey should be conducted between February and July in the potentially affected area by a qualified ornithologist. Trees with potential nest sites should be flagged to prevent damage to unused nesting habitat during construction. If black-shouldered kites are nesting during the time of the survey, construction should be delayed until after August 1, to allow all young to fledge. If no birds are nesting during the time of the survey, no restrictions need be placed on the timing of construction.

Mitigation 5.2.3.6.B. Between Morgan Valley Road and Clayton Creek Road, place new access roads without loss of trees and restore grassland areas to their original condition.

Implementation of Mitigation Measures 5.2.3.6.A and B would reduce the impact to the black-shouldered kite to a less than significant level.

Impact 5.2.3.7. Construction of the project pipeline could result in loss of habitat, as well as direct loss, of Cooper's hawk (*Accipiter cooperi*) and sharp-shinned hawk (*Accipiter striatus*). This is a potentially significant, but unlikely, cumulative impact. It could be mitigated.

Cooper's hawk and sharp-shinned hawk are California species of concern and both are protected under Fish and Game Code 3503.5, which states that nests or eggs of any raptor shall not be damaged or destroyed.

Cooper's hawks prefer cottonwoods, coast live oaks and black oaks (Call 1978). This species also nests in second growth conifer stands or deciduous riparian areas. The breeding season occurs in late March-June, depending on the climate, with young being fledged by mid July. Sharp-shinned hawks nest in trees with a breast-height diameter of 8-15 inches, usually in species of the region such as Douglas fir, and mixed conifer communities. Along the Coast Ranges, sharp-shinned hawks nest in coastal scrub and riparian areas. The breeding season occurs in April-July with the young being fledged by mid-July.

Construction of the Geysers Effluent Pipeline connector road from the Bear Canyon Access Road to NCPA's M-Pad would permanently remove approximately 6.32 acres of montane hardwood woodland, and montane hardwood-conifer woodland, thus reducing habitat for nesting Cooper's and sharp-shinned hawk. These habitat types are well represented in the region and,

therefore, the impact primarily is considered a cumulative effect. If nesting hawks are present in the pipeline and new road ROW and at the Childer's Peak Regulating Tank and spoils disposal site and at the MWTP spoils disposal site, the birds could be dislocated from their habitats. The proposed construction in this area would occur from August 1 through the end of October, and therefore, effects on breeding and fledging are unlikely.

Mitigation 5.2.3.7.A. Immediately prior to construction conduct a nesting survey of Cooper's hawk and sharp-shinned hawk.

The survey should be conducted by a qualified ornithologist. If construction of the new connector road would not occur as scheduled, e.g., during February through June, a nesting survey would be conducted by a qualified ornithologist to determine if any Cooper's hawk or sharp-shinned hawk are nesting on or near the ROW.

If birds or nests of these species are present, construction shall proceed only after July to prevent nest abandonment. If birds or active nests are not found, construction can proceed during the early period. If construction of the new connector road occurs from July to November, no nest survey is required.

Mitigation 5.2.3.7.B. Spoils disposal should not occur around the base of coast live oaks, black oaks and cottonwoods.

To avoid damage to these tree species which are used Cooper's hawk and sharp-shinned hawk, spoils along the pipeline route and at the Childers Peak Regulating Tank spoils disposal site and the MWTP spoils disposal site should not be placed close to the trees. The dripline of the trees can be used as the approximate limit for avoiding spoils disposal.

Implementation of Mitigation 5.2.3.7.A and B would reduce the impact to a less than significant level.

Impact 5.2.3.8. Construction of the pipeline in the area of Clear lake could remove roosting snags required for wintering bald eagles. As there are very few snags on the eastern side of Clear Lake available for wintering bald eagles and no snags present at the lake diversion pump station and pipeline site, this would not be a significant impact.

No mitigation required.

Impact 5.2.3.9. Laying of the underwater intake structure and pipe from the lake shore could increase the turbidity of the water, which would be a significant impact for listed species of fish.

Clear Lake hitch, a California species of concern, inhabits shallow quiet waters along streams and reservoirs. Sacramento perch, another inhabitant of Clear Lake, forages in areas with rocky bottoms, feeding on emergent plants. The fry of both these species stay in shallow water in and around aquatic vegetation. Increased turbidity, leading to a reduction in oxygen in the water and/or clogging of gills could cause injury to these fish species.

Mitigation 5.2.3.9. Laying of the pipe should be conducted so as to avoid adult spawning and fry feeding areas.

A seine survey of the general construction area should be conducted immediately prior to placement of the pipe to determine the presence of the two fish species of concern. Plastic fencing should be placed along the shallow areas, to prevent adult fish or fry from entering the area, out past the deep water point for the species (between 50 and 100 cm). Because turbidity cannot be stopped from flowing outwards, the correct season for placing the pipe should be discussed with the CDFG and USFWS.

Implementation of Mitigation 5.2.3.9 would reduce the impact to a less than significant level.

Long-term impact of the intake on fish would be less than significant because the intake screen would prevent fish from being sucked into the pipe.

Impact 5.2.3.10. Construction of the Geysers Effluent Pipeline and one secondary distribution line could result in loss of habitat and direct loss of the seed bank of populations of six plant species that are federal candidates for listing as endangered. The impact is potentially significant, but mitigable.

Lake County dwarf flax (*Hesperolinon didymocarpum*), a federal candidate, Category 1 (FC1) and state endangered (SE) species, was identified in the corridor in serpentine grassland along Big Canyon Road at Station 89. It is an annual species.

Socrates Mine jewelflower (*Streptanthus brachiatus* ssp. *brachiatus*) (FC1) was located by BioSystems in 1992 and ESA in 1993 on the serpentine barrens paralleling the NCPA Road from Stations 130 to 133. This plant is biennial, living approximately 2 years. The plants were not

flowering in April 1993 when the route was surveyed. The plants occur in a widely spaced pattern on the barrens and are not mixed with other species.

Freed's jewelflower (*Streptanthus brachiatus* ssp. *hoffmanii*) (FC1) was found by ESA in 1993 on the disturbed area below the existing pipes at the side of the access road to the NCPA Q-Pad. Approximately 50 plants were counted along the pipeline. The plants are biennial.

Morrison's jewelflower (*Streptanthus morrisonii*) was found by BioSystems and mapped to the southeast of the NCPA E-Pad. However, the exact location as mapped by BioSystems is uncertain. In 1993, ESA did not identify these plants on the route and does not believe that they would be affected. If the BioSystems survey was accurate, then the species could be affected by construction impacts adjacent to the road.

Snow Mountain buckwheat (*Eriogonum nervulosum*) is a federal candidate (FC2) perennial plant. This plant was mapped by BioSystems near the Morrison's jewelflower (see above) and at Station 137; however, it was not observed by ESA in 1993.

Two-carpellate dwarf flax (*Hesperolinon bicarpellatum*) is a yellow flowered annual that is a federal candidate 2 for listing. Ten occurrences were recorded by BioSystems in serpentine chaparral between Childers Peak and Big Canyon Creek Road and between Harbin Springs Road and Putah Creek.

Mitigation 5.2.3.10.A. Conduct pre-construction surveys in May-June and salvage all perennial special status plants within the pipeline corridor.

Surveys should be conducted in the pre-construction period when the final pipeline route has been staked but not yet cleared and at an appropriate period of plant flowering. The surveys shall identify all individual jewelflower and buckwheat plants that could be destroyed, and their location shall be marked. If the pipeline construction cannot be demonstrated to avoid these plants, they should be salvaged and replanted at a nearby site outside of the impact area. Local CNPS members could assist in the salvage and replanting operation. The replanting should be monitored for at least 5 years. This replant is considered feasible because it involves very few plants and a large amount of apparently suitable habitat that is unoccupied. On serpentine barrens it is believed that moisture availability is the limiting factor in plant distribution. The replanted jewelflowers and buckwheat are to receive supplemental water for 2 years or until they flower and produce seed.

Mitigation 5.2.3.10.B. If spoils disposal occurs at the Childers Peak Regulating Tank site, salvage all serpentine soils and create a 6-inch- to 1-foot-thick cover of the salvaged soil over the spoils.

It would be better to create a path of serpentine soil that could be used for replanting of salvaged plants specific to that substrate than to blend it with the spoils.

If this mitigation is completed, the impact would be reduced to less than significant.

It is recommended, although not required, that the same survey and salvage method be followed for four perennial species on the CNPS List 4 that potentially are present in the ROW.

Cleveland's milk vetch, serpentine reed grass, Purdy's fritillary, and Napa lomatium.

Impact 5.2.3.11. Construction of the Geysers Effluent Pipeline would displace grassland along the entire route, woodland (Station 38 to 40, 54 to 58, 69 to 73, and 121 to 124), serpentine chaparral (Station 99 to 102, 121 to 124), serpentine grassland (Station 99 to 102), serpentine seep (Station 66 to 69 and 73 to 76 and at the Childers Peak Regulating Tank and spoils disposal site), serpentine barrens habitat (Station 66 to 69, 73 to 76 and 99 to 102 and at the Childers Peak site) and an old road bed (Station 66 to 69, 73 to 76 and 99 to 102) that has been recolonized by native annual species, including two federal candidates. This is a potentially significant, but mitigable, impact.

Lake County dwarf flax and two-carpellate dwarf flax are federal candidates for listing as rare or threatened. A third species, Jepson's milk vetch, is not listed by the federal or state resource agencies but is on CNPS List 1B. There are additionally nine species of annuals that are on the CNPS List 4.

Mitigation 5.2.3.11. Salvage the topsoil and seed bank to ensure the re-establishment of these special status species and other native species.

As trenching begins, in the areas identified by BioSystems as historic (1992) sites of the above species as well as Douglas' pogogyne, Brewer's milk vetch, four-petaled pussy-paws, serpentine collomia, serpentine bird's beak, serpentine sunflower, bare monkeyflower, and Jepson's navaretia the following shall be done: 1) stockpile the top 6 inches of soil from the construction corridor in the habitat area; 2) after pipe placement and backfilling or placement of the pipe on piers, return the stockpiled cover soil and its continued seeds to the cover over the pipe and; 3) monitor the site for at least 5 years to ensure propagation of the plants.

If this mitigation is completed the impact probably would be reduced to a less than significant level.

Impact 5.2.3.12. Construction of the Geysers Effluent Pipeline in the roadless area of Sweet Springs Creek would result in loss of riparian vegetation and temporary degradation of stream habitat. This would be a potentially significant impact. The impact would be related primarily to the construction of a permanent access road, as the pipeline would be placed on piers above ground. The impact would be permanent. It would add to the cumulative loss of riparian habitat in the region. Approximately 1.4 acres of new road (0.8 miles) would be constructed in this area.

Mitigation 5.2.3.12.A. Eliminate the creation of a new access road in Sweet Springs Creek Canyon.

Minimize impact by eliminating the access road by ferrying in all construction material by helicopter or rubber-tired vehicles and placing pre-poured supports in excavations that have been hand excavated. Transport and place the pipe sections in the same way. Only rubber-tired vehicles would be permitted in this area during construction. Long-term maintenance of this portion of the ROW would be done by rubber-tired vehicle or horseback.

This mitigation measure would reduce the impact to a less than significant level.

Mitigation 5.2.3.12.B. Reduce construction corridor impact to a minimum (estimated 15 feet in width) using special construction methods in areas where no previous road exists in Sweet Springs Creek Canyon.

Lay pipe on one side of the narrowest construction corridor possible. Only rubber-tired vehicles shall be allowed in the roadless area. All vehicles must stay within the construction corridor. The grassland and riparian areas shall not be used as parking or staging areas. Additionally:

- 1) carry out construction only during the low stream flow period between July 1st and October 30th;
- 2) flag the construction corridor and necessary turn-around and storage areas. These flags will mark the impact avoidance area and no impact or intrusion shall be permitted outside of the flagged construction corridor;
- 3) fill each narrow stream crossing with heavy timbers or gravel and cover the crossing with a mat or plate; mats or plates shall extend a minimum of two feet past the bank of the channel;
- 4) machinery shall work from only one side of the construction corridor, placing the pipe on the piers and anchoring it;

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- 5) work from lower canyon leaving timbers in stream until finished, removing all timbers or gravel and mats upon completion of the pipeline;
- 6) carry out clean-up of the stream channel and revegetate the disturbed soils and stream banks; and
- 7) the restored construction corridor should be monitored for at least 5 years. If after 3 years the grassland and riparian crossings have not revegetated to the same percent cover as areas outside of the impact zone, then the deficient areas should be scarified and re-seeded with a native grass mix, and riparian zones should be planted with appropriate species (see Valley-Foothill Riparian community description in Section 4.5).

If this mitigation is completed, the impact probably would be reduced to a less than significant level. However, no road will remain paralleling the pipeline for long term monitoring and maintenance. Monitoring and maintenance would be done by light, rubber-tired, single passenger vehicle or horseback access.

OR, as alternative mitigation to 5.2.3.12.A and B

Mitigation 5.2.3.12.C. (Alternate Mitigation) Reduce impact resulting from creation of a new permanent access road (estimated 10 feet width) using special construction techniques in areas where no previous road exists in Sweet Springs Creek Canyon.

Lay pipe on one side of the narrowest construction corridor possible. All vehicles and machinery must stay within the construction corridor. The grassland and riparian areas shall not be used as parking or staging areas. If pipe is to be placed on concrete piers and a new access road is necessary for monitoring pipeline conditions, then the following measures shall be applied:

- 1) carry out construction only during the low stream flow period between July 1st and October 30th;
- 2) flag the construction corridor and necessary turn-around and storage areas. These flags will mark the impact avoidance area and no impact or intrusion shall occur outside of the flagged corridor; establish control plots in the construction impact avoidance area;
- 3) culvert each stream crossing and place fill on top of culverts;
- 4) machinery shall work only from one side of the construction corridor, placing the pipe on the piers and anchoring it;
- 5) stockpile the top 6 inches of soil from the entire access road but do not place stockpiles under the pipeline;
- 6) after placing the pipeline, return the stockpiled soil to the surface of the access road after work is completed;
- 7) scarify and re-seed the impact area including the new access road;

- 8) the restored construction corridor should be monitored for at least 5 years. If after 3 years the grassland and riparian crossings have not re-vegetated to the same percent cover as in the established control plots, then the deficient areas should be scarified and re-seeded with a native grass mix and riparian zones should be planted with appropriate species (see Valley-Foothill Riparian community description in Section 4.5) on the upstream and downstream sides of the crossing.

If Mitigation 5.2.3.12.C is completed the impact would be reduced substantially but possibly not to below the level of significance. The action may require a permit from the U.S. Army Corps of Engineers (Corps) as discharge of fill into "waters of the U.S." A pipeline that crosses a watercourse and leaves it at the same elevation can be covered under a Nationwide Permit #9 and a pipeline that bridges a "water" does not need a permit. However, an access road that crosses a "water" and culverts it involves some fill and would require a Corps permit, probably a Nationwide #26 and a Stream Alteration Agreement with the California Department of Fish and Game. These will involve mitigating for the habitat losses along the stream bank.

Implementation of the preceding mitigation measures would substantially reduce the amount of impact; however, some loss of riparian habitat would remain.

Impact 5.2.3.13. Construction of the project pipeline could result in cumulative loss of montane hardwood woodland, montane hardwood-conifer woodland and mixed chaparral that provide habitat for special status species. The impact is a potentially significant cumulative effect.

Impacts to approximately one acre of montane hardwood woodland, six acres of montane hardwood-conifer woodland and one acre of mixed chaparral include direct removal of vegetation, removal of understory growth that provides foraging and browsing material, and acorns from oak woodlands. This woodland may provide nesting habitat for Loggerhead shrike, a federal candidate 2 species, Cooper's hawk and sharp-shinned hawk, both California species of concern and protected under CDFG code 1305.5 and habitat for Napa lomatium. Construction of Geysers Effluent Pipeline connector road from Calpine's Bear Canyon Power Plant road to NCPA's M-Pad will remove approximately 6.32 acres of montane hardwood woodland, montane hardwood-conifer woodland and a minor amount of mixed chaparral including several large pine trees up to 4 feet in diameter.

Mitigation 5.2.3.13. Please refer to Mitigation Measures 5.2.3.5 and 5.2.3.7.

Implementation of mitigations cited above would reduce but not entirely eliminate the impact.

Impact 5.2.3.14. Construction of the Geysers Effluent Pipeline connector road from the Bear Canyon Access Road to NCPA's M-Pad (Stations 121 to 124) would fill and culvert a tributary watercourse. This is a significant impact.

Approximately 180 feet of channel would be culverted and covered with fill covering 2,000 square feet of an unnamed tributary of Bear Creek. The tributary is a "water of the U.S." The fill would remove montane hardwood and montane hardwood conifer forest. The construction of the fill would contribute sediment to the tributary of Bear Creek which appears to be a perennial or intermittent stream. (See also Impact 5.2.1.1 and Impact 5.2.3.1.)

This action probably would require a permit to discharge fill into a "water of the U.S." from the Corps. This road crossing may likely be covered under a Nationwide Permit #14 that allows fill up to one-third acre and a lineal length of crossing of 200 feet when measured at the center-line.

Mitigation 5.2.3.14.A. The road fill would require a Stream Alteration Agreement to be signed with the California Department of Fish and Game (pursuant to CDFG Code 1603), and one of the conditions of this agreement would likely be mitigation for the loss of stream values and bank disturbance.

The process of negotiating the Agreement shall be initiated at the earliest possible time. A suitable mitigation would be the restoration of trees and vegetation to an equivalent distance of a nearby stream that is presently in a degraded condition. As red-legged frog habitat may be affected, a pond may be recommended as mitigation in the Agreement.

Mitigation 5.2.3.14.B. Avoidance of impacts by minor redesign of the stream crossing shall include the following actions:

- Conduct a pre-construction survey of the stream for red-legged frog adults, tadpoles, and eggs, depending on the season and if any are found construct check dams both upstream and downstream to prevent the frogs from being crushed by the fill.
- Design and construct a headwall on both the upstream and downstream sides of the road crossing. This shall be directed toward creating a limited footprint for the stream crossing fill.
- Design road construction on both sides of the stream to eliminate fill on the slope above the stream. It is better to remove the cut material to another location than to allow it to cascade down into the stream.
- By careful design, remove as few trees for the road construction as is possible. Use walls to retain soil around roots where necessary.

Mitigation 5.2.3.14.C. Compensate for unavoidable impacts. In consultation with the County and California Department of Fish and Game develop a mitigation plan including goals and objectives, success criteria, drawings, planting plan, implementation plan and monitoring plan.

The typical elements of the plan are as follows:

Goals. Identify the type of habitat to be restored, re-created or created. Consultation with the resource agencies will direct the designer/biologist toward wildlife habitats or natural communities that have been depleted or are in short supply. It is recommended that this restoration be of a stream channel in the vicinity of the tributary receiving the impact.

Objectives. Identify what will be necessary to reach the identified goals. Provide a description of the physical setting that is the habitat described in the goal. Identify what species, what size plants, and how they will be planted.

Success Criteria. Lay out a time table with each year for 10 years of the monitoring period described in detail. This detail includes the phase of the project completed, the number of trees and shrubs of various sizes that will have been planted, the percent of the forest floor that is covered with the ground cover.

Drawings. Provide topographic drawings at 1"=100' or 1"=200' showing construction, planting and mulching areas.

Planting Plan. Provide a description of the species, number, size of can or bare root, distance on center, methods of planting and fertilizing and irrigating, if necessary.

Implementation Plan. Identify who is responsible, who will do the work, how the work will be done, where plant stock will be purchased or grown. Specify how long it will take and how inspections, monitoring and reporting will be facilitated. Identify who will pay.

Monitoring - Construction. Submit a record of how all mitigations have been carried out. Specify that the contractors stayed out of areas from which they were excluded, such as the bottom of the creek. Identify whether they dumped soil downslope into creek.

Monitoring-Restoration Success or Failure. Identify what type of measures will be made, and whether sample points will be random or systematic and repeatable. Identify who should be responsible for receiving the report. Specify who will write the report and do the study. Determine how much of a bond should be posted to insure that this is carried out.

Mitigation 5.2.3.14.D. Best Engineering Practices should be followed to minimize the erosion from the newly constructed fill of the stream crossing.

The Best Engineering Practices include:

- Engineered drainage culverts with energy dissipating rip rap in appropriate areas under discharge points (included in the proposed design).
- Re-vegetation of the slopes by planting appropriate native species (see Montane Hardwood and Montane Hardwood Conifer for descriptions of the surrounding vegetation community and riparian zone in Section 4.5). Examples of tree species include: Douglas fir, California bay, Canyon oak, black oak, interior live oak, and madrone.
- Seed the fill slopes with grass and shrub species seeds. Examples of shrub species include: Toyon, poison oak, and western redbud. Examples of grass species: blue wild-rye, California fescue, purple needlegrass, and melic grass but as these are not readily available, they may be extended by red fescue, soft chess, wild oat and Italian ryegrass.
- Hydromulch or mulch with hay to prevent rain from suspending the clay particles and carrying them into the stream before the grass germinates (included in the construction plan).
- Revegetation of graded areas shall take place as quickly as possible as weather permits, but in no case later than October 15th. At a minimum, revegetation shall consist of reseeding with grass all graded areas. Straw and/or mulch shall also be used to control erosion on all graded banks and slopes over 10%. For projects with slopes of 20% or greater, or located within 100 ft. of a blue line water feature (as identified on a USGS map), the project sponsors shall also install a silt fence or straw bales with rebar around downhill perimeters or lakeward of the fill areas prior to grading activities.
- Replanting of all exposed surfaces consistent with approved revegetation and slope stabilization plans shall be accomplished within the first growing season following disturbance, unless other scheduling is approved by the Planning Department.
- The project sponsors shall retain a landscape architect, registered forester, plant ecologist or other qualified professional acceptable to the Planning Director to reevaluate the entire revegetation program during the spring following initial planting. The qualified professional shall present a written statement indicating which planting techniques were successful or unsuccessful, and what will be done to improve the revegetation program if needed, to the Planning Department no later than June 1st of that year. The written statement shall be accompanied by photos illustrating the relative success of revegetation efforts. If deemed by the Planning department to be unsuccessful, additional revegetation will be required not later than the immediately succeeding fall season. The revegetation program shall include periodic inspection and upgrading as necessary. All plantings shall be maintained or replanted for the life of the project.

If all of the above mitigation measures and the conditions of the permits and agreements are carried out, some residual loss of habitat would remain but this impact would be reduced to an insignificant level.

Impact 5.2.3.15. Construction of the Geysers Effluent Pipeline and Lake Diversion Pipeline would result in the removal of some large mature oaks and conifers. The impact is adverse but probably not significant.

Mitigation 5.2.3.15.A. Vegetation disturbance should be minimized and limited to the removal of vegetation necessary for the construction of the approved facilities.

Mitigation 5.2.3.15.B. The project sponsor should not remove trees four inches in diameter or greater (measured at thirty-six inches above natural grade) unless specifically approved by the Planning Department and shown in the project plan.

Mitigation 5.2.3.15.C. Prior to the issuance of development permits, the project sponsors should submit a tree preservation plan for review and approval of the Planning Department. This plan should include the locations of all mature trees within the construction or activity areas of the proposed use.

Mitigation 5.2.3.15.D. Unless specifically approved, no excavation, placement of fill, compaction, or irrigation should take place within the dripline of mature trees.

Mitigation 5.2.3.15.E. Vegetation beyond the construction perimeter should not be disturbed. Clearing limits for development shall be specified in the development plans, and specifications shall be submitted for approval to the Planning Department.

Mitigation 5.2.3.15.F. Critical environmental features, such as County designated riparian Environmentally Sensitive Areas along Putah, Harbin and Big Canyon Creeks, shall remain in open space. No grading, building or removal of trees over 4 inches in diameter at 3 feet in height shall occur without written authorization of the Planning Director in consultation with the California Department of Fish and Game. No side casting of dirt shall occur outside of approved areas.

Implementation of the above mitigation measures would minimize impacts and ensure that less than significant impacts would occur.

Impact 5.2.3.16. Construction of Lake Diversion Pipeline would result in the loss of approximately one-quarter acre of wet meadow. This would be a cumulative, but less than significant impact.

The withdrawal of water from Clear Lake for the project is not expected to have a significant impact on wetlands at the edge of the lake. As described in Impact 5.2.2.8 (Hydrology and Water Quality), under average withdrawal rates, a theoretical drop in lake level of 1.9 inch (with no assumed recharge or replacement inflow) is projected. Under a worst case scenario, with low water level in the lake and a maximum withdrawal of 7,950 af, the theoretical drop in lake level

would be 2.41 inches (also with no assumed recharge or replacement inflow). A drop in the lake level of this magnitude, however, is not likely because of inflow and groundwater recharge. A specific measurement of the effect on lakeside wetlands is not possible to make because existing mapping of the lake and adjacent wetlands is not available with a contour interval that could reveal such small changes. However, conceptually, the small drop in lake level would not likely be sufficient to affect the wetlands plants which require permanent or seasonal wet conditions with root zone. The natural variation induced by seasonal/climatic cycles likely is equal to/ greater than that which would be related to the project withdrawal.

The small drop in lake level related to the project is expected to have imperceptible (and unmeasurable) effect on fishes in the lake, including carp.

No mitigation is required.

Impact 5.2.3.17. Construction of the Geysers Effluent Pipeline could result in a degradation of habitat for rainbow trout (*Salmo gairdneri*) in Big Sulphur Creek. This would be a temporary adverse impact.

Although not protected, rainbow trout and their streams are carefully managed because of the involvement of sport fishing with this species. Rainbow trout were sampled along Upper Big Sulphur Creek to monitor changes in fish populations and selected habitat parameters. Sampling, conducted in 1982-1983, showed the upper limits of travel of rainbow trout along Upper Big Sulphur Creek approximately 1/8 mile from the bridge at Unit 18 (Geary, et al.1983). Sedimentation from tributaries draining into Upper Big Sulphur Creek could create impacts to the spawning areas further down the creek.

Mitigation 5.2.3.17A. Prior to and during construction, temporary sand/pea gravel damming of the tributary to Upper Big Sulphur Creek down-stream of the construction area would reduce the temporary adverse impact of sedimentation flowing downstream into Upper Big Sulphur Creek.

Mitigation 5.2.3.17B. Mitigation 5.2.3.14.A, B and D should also be employed for the crossing of the unnamed tributary of Big Sulphur Creek.

Implementation of Mitigation 5.2.3.17A and 5.2.3.17B would reduce the impact to a less than significant level.

5.2.4 AIR QUALITY

IMPACT SIGNIFICANCE CRITERIA

A project would normally have a significant effect on the environment if it would violate any ambient air quality standard, contribute substantially to an existing or projected air quality violation, or expose sensitive receptors to substantial pollutant concentrations (California Office of Planning and Research, 1992).

IMPACTS AND MITIGATION MEASURES

Impact 5.2.4.1. Construction of the proposed pipelines and related facilities would generate criteria air pollutant emissions, particularly PM₁₀ and NO_x, over the construction period. This would be a potentially significant, although temporary, effect of the project.

Construction emissions would result from combustion of fuel to power heavy construction equipment, delivery and haul trucks, and construction worker vehicle trips and from fugitive dust sources. While all of the criteria pollutants would be generated by construction emissions sources, the primary pollutants generated by construction would be NO_x (from combustion of diesel fuel) and particulate (from the fugitive sources).

Where no roads exist, bulldozers would be used to clear a strip 8 to 10 feet wide. However, most of the pipeline routes pass within or along existing roads, and clearing/grading activities would be minimal along these areas. Equipment used for excavation would include backhoes and haul trucks. The trenches would be roughly one-yard wide and two-yards deep. Total pipeline length would be approximately 154,000 feet (including the Lake Diversion pipeline to the Geysers Effluent Pipeline distribution network). The total excavated material would be about 100,000 cubic yards. Much of this material would be stockpiled immediately adjacent to the trench and used as cover once the pipe is installed. The leftover soil material would either be used as fill in the immediate area, where feasible, or transported to Eastlake Landfill.

Equipment used for placement of materials in the trench would include flat bed trucks for delivering the pipe, forklifts to unload the pipe, and dump trucks to deliver the imported bedding material. Rubber-tired loaders and mechanical compaction equipment would be used to fill and compact the trench.

Based on equipment lists provided by the project sponsors and (unmitigated) emissions factors for construction equipment from the South Coast Air Quality Management District (South Coast Air Quality Management District, 1992), construction (combustion) emissions would be approximately 300 lb/day of CO, 70 lb/day of HC, 640 lb/day of NOx, 24 lb/day of SOx, and 86 lb/day of PM10 including construction equipment, haul trucks, and construction worker commute trips. To put these emissions in perspective, combustion emissions sources would amount to approximately 5.4% of County-wide NOx emissions, 1.7% of County-wide SOx emissions, and less than one-percent of County-wide Emissions of CO, HC, and PM10 based on the ARB emissions inventory (California Air Resources Board, 1993b) for Lake County. While combustion emissions, particularly NOx, would be substantial, they would not be expected to cause violations of ambient air quality standards since they would be distributed over a wide area that is mostly rural and sparsely settled.

Fugitive dust sources would include clearing and grading activities (for temporary access roads, for the permanent road connection between the NCPA access road and Bear Canyon Road, the road in Sweet Springs Creek Valley, and for leveled areas for pump stations and surge/equalization tanks), excavation activities, vehicle movement over paved and unpaved surfaces, and wind action over disturbed surfaces. Several of the residential roads in the City of Clearlake are unpaved, and thus, vehicle movement could raise substantial amounts of dust even where grading would not be needed.

Dust emissions would vary from day to day, depending on the level and type of activity, silt content of the soil, exposure conditions, and the prevailing weather. Blasting may be required in some sections of the Geysers Effluent Pipeline and could create brief local dust impacts. Based on an EPA fugitive dust emission factor (for heavy construction operations) of 1.2 tons of particulate per acre-month (adjusted to 0.6 tons/acre-month for PM10), fugitive dust sources would generate approximately 240 lb/day of PM10.

When activities levels are high and the conditions are hot and windy, fugitive dust emissions could be substantial and could lead to violations of the state ambient air quality standard along the route in the immediate vicinity of construction activity. While violations would not be expected to occur frequently during construction, nuisance impacts from fugitive dust could be more frequent at sensitive receptor locations immediately along the route. Nuisance impacts would be more likely in the vicinity of areas where construction impacts would occur for longer periods, for example, at construction yards or staging areas. Most of the route is located in rural

areas with few nearby sensitive receptors. The chief exception is the Lake Diversion pipeline and the Geysers Effluent Pipeline in Clearlake and Lower Lake.

Mitigation 5.2.4.1.A. The project sponsors shall obtain an Authority to Construct (A/C) prior to construction and Permit to Operate (P/O) from the LCAQMD. The project sponsors shall follow the conditions of this permit. The following is a dust control program that should be followed if one is not specified in the A/C:

- The area disturbed by clearing, earth moving, or excavation activities shall be minimized at all times. Construction of new dirt surface roads shall be minimized.
- All material excavated or graded shall be sufficiently watered to prevent excessive amounts of dust. Watering shall occur at least twice a day with complete coverage, carried out preferably in the late morning and after work is done for the day. Watering shall be more frequent on hot windy days (days where ground-level wind speeds exceed 13 mph). An effective watering program can reduce uncontrolled fugitive dust emissions from excavation and grading by up to 50%.
- All active construction areas shall be sufficiently watered to prevent excessive amounts of dust.
- All material transported off-site shall be either sufficiently watered or securely covered to prevent excessive amounts of dust and sediment deposition on roads.
- Vehicle speeds shall be limited to 15 mph or less on unpaved access roads.
- All areas with vehicle traffic shall be watered periodically or shall be treated with palliatives acceptable to LCAQMD or NSCAPCD (as appropriate) for stabilization of dust emissions.
- Disturbed areas (including temporary access roads and construction yards) shall be revegetated as soon as practicable once construction activities have been completed.

Mitigation 5.2.4.1.B. The construction contracts should specify that temporary construction yards or staging areas shall not be in proximity to residential dwellings and schools, unless no other areas would be feasible.

With a substantial buffer distance between the construction yard or staging area and residences and schools, nuisance impacts would be less likely to occur.

Mitigation 5.2.4.1.C. The construction contracts should specify that the contractor shall offer wood to land owners from trees felled for construction purposes for use as firewood, and if there are no takers, then chip the trunk/branches and grind the stumps and use the resultant material as disturbed soil surface cover. With other vegetative material, the contractor shall acknowledge and follow the burn requirements set forth in the LCAQMD or NSCAPCD *Rules and Regulations*, as appropriate.

No on-site burning of trash, construction or non-vegetative materials shall be permitted.

Implementation of Mitigation Measures 5.2.4.1.A - C would reduce the potential for causing violations of ambient particulate standards or causing short-term nuisance impacts. The residual impact would be less-than-significant.

Impact 5.2.4.2. Construction of the pipelines could generate asbestos dust emissions. This would be a potentially significant effect of the project.

See discussion of this impact and related mitigation measures under Impact 5.2.10.1.

Impact 5.2.4.3. Operation of the effluent pipeline could result in odorous emissions if anaerobic conditions are allowed to develop in the pipeline itself. This would be a less-than-significant impact.

The effluent in the Effluent Pipeline would receive secondary treatment. As such, the effluent would have low organic content and measurable dissolved oxygen levels. If anaerobic conditions were allowed to develop in the pipeline, odorous emissions could escape at intermediate air release points and cause occasional local annoyance to residences in the area. (The storage reservoirs would contain effluent and would be exposed to the atmosphere; however, there would be no sensitive receptors in the vicinity of the proposed Childers Peak Tank or the Y-site Tank, and thus, no odor impacts would be expected.)

Normally, anaerobic conditions and bacterial deposits on the internal pipeline walls would not occur since the effluent pipeline is designed to maintain a steady flow of 3.6 feet per second. However, during periods when effluent flow would be slowed or stopped in the pipeline due to contingencies or maintenance, anaerobic conditions that lead to odor could develop. To reduce the potential for odor impacts at such times, the project would include periodic addition of chlorine solution at the SERWTP.

Mitigation 5.2.4.3. If acceptable to LCAQMD, LACOSAN should add sufficient chlorine to the effluent to reduce the potential for odor impacts from operation of the pipeline. The P/O from LCAQMD may include conditions that specify the amount of chlorine that would be required to be added to the effluent or may specify some other control strategy to reduce the potential for odor impacts.

The temporary addition of chlorine or other odor inhibiting agents at locations other than the SERWTP and MWTP should be considered. These substances could be used to reduce potential odors from anaerobic conditions resulting from pipeline shutdowns or startups.

Impact 5.2.4.4. Long-term operation of the project including power to operate pumps, vehicle emissions from inspection and maintenance activities, and routine maintenance activities would have an insignificant impact on air quality.

As the project would generate power derived from geothermal energy, and because it would use a portion of that power to operate the pumps, it would not be dependent on fossil fuels. Because combustion of fossil fuels would not be required, operation of the project would not generate criteria air pollutants from such sources. Routine vehicle trips for inspection and maintenance of the pipeline would produce negligible emissions.

Impact 5.2.4.5. Growth-inducing impacts of the project in the LACOSAN service area would not have a significant adverse cumulative effect on air quality, with the possible exception of PM₁₀ impacts in the City of Clearlake.

As discussed in Section 7.4 of this report, the project would accommodate an increase in residential and commercial development in the LACOSAN service area. New residents and workers would generate additional emissions within the Lake County Air Basin primarily through additional vehicle trips and vehicle miles traveled (VMT); however this increase would be more than offset by the decrease in emissions per vehicle-mile expected to occur into the future. The reasons for the decrease in emissions per vehicle mile are the natural rate of vehicle turnover which has the effect of replacing older, more polluting vehicles with newer vehicle manufactured to meet more stringent emissions standards and the change in gasoline composition beginning in 1996 (i.e. California Phase II gasoline). Between 1993 and 2005, composite motor vehicle emissions (per vehicle mile traveled) are expected to decrease by 63% for CO, 67% for HC, and 41% for NO_x based on ARB's EMFAC7F emissions factors. SO_x emissions from motor vehicles would be negligible with the conversion to Phase II (low-sulfur) gasoline.

PM₁₀ emissions from motor vehicle use would increase between 1993 and 2005 since dust entrainment (rather than exhaust) is the major component of motor-vehicle-related PM₁₀ and dust entrainment is directly proportional to VMT. For much of the County, the increase in motor-vehicle-related PM₁₀ would not be expected to cause violations of state PM₁₀ standards given the low background concentrations in the Basin (see Table 4.6.1.1). However, in the City of Clearlake, background PM₁₀ concentrations are not known and could be higher than those

measured at Lakeport, given the greater amount of traffic and greater number of dirt roads in Clearlake (relative to Lakeport). In the City of Clearlake, then, the cumulative impact of growth could potentially be significant since the corresponding increase in VMT could cause, or contribute to, violations of state PM₁₀ standards in areas adjacent to dirt roads that are heavily travelled.

5.2.5 NOISE

IMPACT SIGNIFICANCE CRITERIA

A project would normally have a significant effect on the environment if it would increase substantially the ambient noise levels for adjoining areas (California Office of Planning and Research, 1992). For purposes of this EIR, a project's long-term noise effects would be considered significant if they cause a noise-level increase of five dBA over the existing noise level or exceed 50 dBA, Ldn at the closest receptor. The significance of temporary noise impacts is evaluated with reference to existing noise levels, the duration of the impact, and the number of receptors affected.

IMPACTS AND MITIGATION MEASURES

Impact 5.2.5.1. Construction of the proposed pipelines and related facilities would result in a substantial increase in ambient noise levels along the proposed routes. The impact would be relatively brief at any one location along the routes. This would be a significant, although temporary, effect of the project.

The project would temporarily increase noise levels along the route corresponding with the sequence and pace of construction activities. At any given location along the route, with the exception of construction yards/staging areas, the duration of substantial noise would be brief, generally less than one week, as construction activities first approach and then continue past the location. While noise at construction yards/staging areas would likely be less than those associated with construction along the proposed route, the duration of the impact would be greater.

The sequence of project construction would begin with clearing/grading activities, followed by delivery and stockpiling of materials. Next, excavation and placement of bedding and pipeline would occur, followed by backfill and clean-up. The pace of construction would typically be several hundred feet per day. Of these activities, the noisiest would likely be excavation. In addition, construction truck traffic, including haul and delivery trucks, would contribute to

roadside noise levels. However, the number of truck trips per day on a given road would be relatively small and the duration that any one road would be used for construction purposes would be brief given the linear progress of construction.

Noise levels at 50 feet from the center of construction activities would likely be in the range of 85 to 90 dBA, Leq based on typical noise levels generated during excavation and foundation work (U.S. Environmental Protection Agency, 1971). Noise levels typically associated with public works projects are shown in Table 5.2.5.1. Noise at 85 to 90 dBA would not be expected to pose the risk of hearing damage to residents located nearby given the brief period of impact at any given sensitive receptor location. However, despite the short-term nature of construction noise, nuisance impacts would be likely to occur and complaints from residents may be expected.

TABLE 5.2.5.1: TYPICAL PUBLIC WORKS CONSTRUCTION NOISE LEVELS

<u>Construction Phase</u>	<u>Noise Level (dBA, L_{eq}) /a/</u>
Ground Clearing	84
Excavation	89
Bedding/Placement/Backfill/b/	88
Finishing	84

/a/ Noise levels at 50 feet from the noisiest source associated with a given phase and 200 feet from the rest of the equipment associated with that phase. These levels correspond to public works projects, including roads and highways, sewers, and trenches.

/b/ This is based on the noise associated with typical construction noise related to foundations.

SOURCE: U.S. Environmental Protection Agency, *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances*, December 1971.

Noise from construction would attenuate at a rate of six to nine dBA per doubling of distance from the construction route. Thus, at 200 feet, typical construction noise would be in the range of 67 to 78 dBA, Leq. Shielding from existing intervening structures or terrain would further reduce construction noise. The noise estimates shown in Table 5.2.5.1 do not include blasting.

5.0 Environmental Consequences & Mitigation Measures
5.2 The Geysers Effluent Pipeline Component

Project construction would be a short-term annoyance to residents located near the path of construction. Potential annoyance impacts would be limited to an area approximately 500 to 1,000 feet on either side of the proposed route. The temporary annoyance of construction noise would affect hundreds of residences in Clearlake and Lower Lake, which are urbanized, and scattered residences along Clayton Creek Road, Riata Road, and Highway 29. Two school sites, Pomo School in Clearlake and Lower Lake Elementary and High Schools, are located along the route. Since the number of residents potentially affected would be substantial and project construction noise would greatly exceed existing background noise levels (by as much as 20 to 30 dBA), noise from project construction would be a significant effect of the project.

Blasting may be required at some locations along the proposed route, including areas in Clearlake. Blasting can result in substantial noise and vibration impacts, depending upon the proximity to sensitive receptors, soil and rock characteristics of the area, and number and explosive charge of blasting events. Blasting also commonly produces a startle effect, and a large number of complaints and inquiries to service providers (police, fire, and public works departments).

Mitigation 5.2.5.1.A. The construction contracts shall specify that noisy construction activities (including heavy truck trips on local roadways, but not including highways) are to be limited to 8:00 a.m. to 6:00 p.m., Monday through Saturday.

Mitigation 5.2.5.1.B. The construction contracts shall specify that construction equipment powered by internal combustion engines must be equipped with best available mufflers.

Mitigation 5.2.5.1.C. The construction contracts shall specify that blasting should be avoided unless there is no feasible alternative. If blasting is necessary, the construction contractor should employ blasting techniques utilizing the most current technology so as to limit noise levels and vibration. The LCAQMD's *Cumulative Geothermal Noise Study* lists hole shot methods and use of blast mats as means to reduce noise from use of explosives (Lake County Air Quality Management District, 1991). In addition, the construction contractor shall be directed to notify all property owners within a 2,000-foot radius of the blasting site of the blasting schedule as soon as practicable. The blasting schedule shall also be disseminated through public service announcements on local radio stations and through notifications in the local newspaper.

Mitigation 5.2.5.1.D. The construction contractor shall coordinate with Pomo School and Lower Lake Elementary and High Schools for scheduling purposes to minimize the temporary noise impacts at those locations.

Mitigation 5.2.5.1.E. The construction plan shall identify all construction yards and staging areas. The construction yards/staging areas shall be located as far as practicable away from existing residences and schools. Other construction yards/staging areas shall not be permitted.

With a substantial buffer distance between the construction yard or staging area and residences and schools, nuisance impacts would be less likely.

Mitigation Measure 5.2.5.1.F. All vehicles and heavy equipment used on-site shall be adequately muffled to comply with Motor Vehicle Code requirements.

Mitigation Measure 5.2.5.1.G. Adjustable backup beepers (when required by law) shall be set to the lowest allowable levels.

Mitigation Measure 5.2.5.1.H. In the event substantive noise complaints are received, the project sponsors shall submit a noise control plan for review and approval by the Lake County Noise Control officer. This noise control plan may require reduced hours of construction or other noise mitigation measures.

Implementation of Mitigation Measures 5.2.5.1.A through H would reduce construction-phase noise impacts to less-than-significant, although annoyance impacts would still be likely to occur.

Impact 5.2.5.2. Operation of the proposed pumps at SERWTP would increase noise levels in the vicinity. The noise from the pumps could exceed 50 dBA, Ldn at the nearest residence if left running 24-hours per day. This would be a potentially significant impact of the project.

With the project, six (200 HP) new vertical turbine pumps would be operated at the SERWTP. Unlike the proposed lake diversion pumps at Clear Lake and the Bear Canyon pumps in the Geysers, the SERWTP pumps would not be enclosed in a structure. EPA indicates that a pump typically generates 76 dBA at 50 feet (U.S. Environmental Protection Agency, 1971). Noise measurements conducted by Environmental Science Associates (ESA) of vertical effluent pumps confirm this estimate. (ESA measured 90 dBA at sixteen feet from two vertical pumps, one 125-HP pump and one 200-HP pump, which corresponds to the EPA estimate after one adjusts for distance and the number of pumps.)

Using the EPA estimate, six pumps together would generate about 84 dBA at 50 feet. (A smaller number of larger pumps would generate essentially the same amount of noise.) Normal attenuation with distance would reduce this noise to about 56 dBA at 1,200 feet. (The lower

attenuation rate (six dBA) was used for this estimate because of the large component of low-frequency noise characteristic of pump noise and because low-frequency noise attenuates less rapidly than high-frequency noise.) Assuming that all six pumps operate simultaneously over a 24-hour period, this estimate converts to approximately 62 dBA, Ldn assuming 24-hour operation of the pumps. The nearest residences are located on Robin Lane, approximately 1,200 feet south of the proposed site for the pumps at SERWTP. The intervening low rise in topography between the pumps site and the residence would probably attenuate some of the pump noise. However, pump noise would still be noticeably higher than existing conditions and would exceed the 50 dBA, Ldn standard used by Lake County to judge noise/land use compatibility. Thus, the impact is considered significant.

Mitigation 5.2.5.2. The project design should be revised to specify that the pumps at SERWTP would be enclosed. A solid building enclosure, with ventilation provided on the side of the building away from the residence, would reduce pump noise below the 50 dBA, Ldn standard (at the nearest residence).

This measure would reduce the impact to a less-than-significant level.

Impact 5.2.5.3. Other pump stations would have less-than-significant noise impacts.

Noise from operation of the lake diversion pump station would be less than significant because the pumps would be within an enclosed building. Numerous residents are located in the immediate vicinity, but the sound of the pumps would not be noticeable. The MWTP pumps would be located outdoors. However, there are no residences within several thousand feet of the site. The Bear Canyon pumps would be enclosed in buildings. They also are located in areas distant from residences and in heavily-wooded areas.

5.2.6 CULTURAL RESOURCES

IMPACT SIGNIFICANCE CRITERIA

The following Guidelines from Appendix G of the California Environmental Quality Act (CEQA) were used to determine the significance of impacts on cultural resources due to a proposed project:

"The project will normally have a significant effect on the environment if it will:

- (a) Conflict with adopted environmental plans and goals of the community where it is located;
- (j) Disrupt or adversely affect a prehistoric or historic archaeological site or property of historic or cultural significance to a community or ethnic or social group; or a paleontological site except as part of a scientific study."

Appendix K of the CEQA Guidelines further defines criteria for assessing the significance of potential impacts to archaeological resources. The mere presence of an archaeological resource alone is not enough to establish significance. Any cultural resources found on a project site would require evaluation to determine potential effects which would require mitigation in accordance with CEQA requirements. Each site or feature must be evaluated on its own to determine its importance as defined in Section III of CEQA, Appendix K. According to CEQA, an "important archaeological resource" is one which:

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

While Appendix K of the CEQA Guidelines provides criteria for assessing archaeological "importance," CEQA lacks specific criteria for assessing the significance of historic structures which are not archaeological resources (i.e., standing structures). There are no established local criteria for assessing historic significance. Instead, criteria used for assessing historic significance are those developed and used by the U.S. Department of the Interior for the National Register of Historic Places pursuant to 36CFR Part 800:

- The quality of significance in American history, archaeology, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:
 - A. that are associated with events that have made a significant contribution to the broad patterns of our history; or
 - B. that are associated with the lives of persons significant in our past; or
 - C. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
 - D. that have yielded, or may be likely to yield, information important in prehistory or history.”

In addition to the provisions of CEQA and the eligibility criteria for the National Register of Historic Places, there are laws, acts, and regulations specific for the protection of Native American resources. These generally include Native American participation if Native American resources are affected or if human remains are encountered, and consultation with the Native American Heritage Commission.

For this project, an impact on cultural resources would be considered potentially significant if cultural resource features are identified in the Project Area, and the identified features or sites meet any of the criteria for the National Register of Historic Places or CEQA. A significant impact would result if the project as proposed would result in the degradation or destruction of an important archaeological or historic resource, or if human activity resulting from project development had the potential to disrupt the integrity of an identified resource.

IMPACTS AND MITIGATION MEASURES

Impact 5.2.6.1. The Geysers Effluent Pipeline Project component could destroy or damage important historic and prehistoric cultural resources. This is a potentially significant impact. If the project were implemented as proposed, the impact is unavoidable but partially mitigable through resource recovery.

The Sonoma State University Anthropological Studies Center, Cultural Resources Facility has studied the corridor and immediate vicinity of the Lake Diversion Pipeline, Geysers Effluent Pipeline and the secondary distribution pipelines in the Geysers and all related facilities sites. Potentially significant cultural resources were identified at sites along the proposed alignment of

the Lake Diversion Pipeline and the Geysers Effluent Pipeline. Potentially significant cultural resources were not identified for any parts of the project in the Southeast Geysers, including the Unocal project area.

The general nature of the resources identified along the pipeline alignments and ancillary facility sites are presented in Section 4.8. The investigators identified 29 archaeological sites. Of these, 23 contain only prehistoric materials, one contains only a historic component and five have both prehistoric and historic resources. Identification of these resources were based on a review of the literature, including studies conducted in conjunction with previous detailed investigations and resource recovery efforts, as well as a walk-over survey of the routes and facility sites using standard survey protocols. The walk-over surveys did not include subsurface testing to determine the extent and "Significance" of the identified resources (Significance in this usage is not equivalent to significance as normally used for CEQA and NEPA compliance) nor exploration of subsurface resources. As noted in Section 4.8, cultural resources may be present in the soils up to depths of several meters.

All of the identified cultural resource sites are considered to be potentially significant since they contain materials that, when analyzed, have the ability to yield information important to archaeological research. Some of the sites may prove to be far more important than others. At this time, it appears that some of the important sites could not be avoided without a major rerouting of the pipeline in some segments.

Ground clearing and excavation activities would damage cultural resources as well as destroy their physical arrangement in the soil. Such arrangements are important to determine the nature of the resources and the site of their occurrence as well as chronological arrangements through time (as revealed by the depth sequences of the materials).

Mitigation 5.2.6.1.A. The project sponsors should seek to avoid archaeological sites to the extent feasible. To establish the site boundary, the areal extent of resource deposits shall be identified in field studies by a qualified professional archaeologist.

The studies shall encompass the spatial extent of the cultural resources. Shallow test pits may be required for this purpose. The archaeologist shall submit a map and findings to the project sponsors and County of Lake Planning Department. Where feasible, the proposed route shall be altered to avoid crossing any area within identified cultural resource deposits. It appears that at least four sites, and possibly more, could not be avoided without significant alteration of the

alignment. (Locations of these sites may not be revealed in a public disclosure document.)

Where avoidance is not feasible, the following mitigation measures shall be employed.

Mitigation 5.2.6.1.B. The project sponsors should retain a qualified professional archaeologist to conduct subsurface studies to determine the Cultural Resource Significance (CRS) of the sites. Results of the CRS determination shall include appropriate mitigation plans.

The CRS determination may entail deep test pits and detailed mapping of resource deposits. The purpose is to determine the nature and importance of the resources, their spatial extent and depth, their sequence of occurrence and overall sensitivity to impact at that site.

Mitigation 5.2.6.1.C. In all cases, if potentially significant archaeological materials are found, a program of resource recovery shall be developed and implemented at the site. Additionally, sites with significant cultural resources may be eligible for inclusion in the National Register of Historic Places.

Resource recovery must be conducted under the supervision of qualified professional archaeologists. Materials recovery must be carried out following established professional practices and recordation of findings. Recovered materials shall be cataloged and properly curated at an approved facility.

Mitigation 5.2.6.1.D. In the event that burials, associated or unassociated funerary objects, or items of cultural patrimony are encountered, the archaeologist should contact the County Coroner, and if the burial is a Native American, consult with Native American groups of the region to determine their preference for final internment of the remains.

Under the Native American Graves Protection and Repatriation Act, Native American prehistoric human remains may be moved only once. The choice for the final interment should be made by Native Americans who are the likely tribal or cultural group descendants of the people whose remains are disturbed by the project construction.

Mitigation 5.2.6.1.E. In all cases of identified archaeological or historic sites, a qualified observer should be present on site at all times during site clearing and excavation. The observer should be given the authority to halt construction in the event that cultural resources are encountered in order to evaluate the resource and carry out appropriate recovery.

Implementation of Mitigation Measures 5.2.6.1.A through E would reduce the impact to a less than significant level.

5.2.7 VISUAL AND AESTHETIC RESOURCES

IMPACT SIGNIFICANCE CRITERIA

CEQA Guidelines indicate that a project would have a significant effect on the visual and aesthetic environment if it would:

- have a substantial, demonstrable negative aesthetic effect and/or
- conflict with established recreational, education, religious or scientific uses of the area (which may include aesthetic considerations, as in the case of a park).

Additionally, a significant visual or aesthetic impact would occur if the project would:

- conflict with plans and policies of the area for which visual/aesthetic considerations may have an important role (for example, maintenance of visual quality to support goals promoting tourism).

Visual and aesthetic impacts are uniquely subjective in nature because of the wide variability in viewer attitudes about their environment and the differences in perception of the degree to which visible changes in the environment are considered acceptable or unacceptable. Rather than being based on an assessment of viewer attitudes, this impact assessment focuses solely on (1) the amount of contrast that the proposed project would present in the existing landscape, (2) the relative degree of visibility of those changes in the visual landscape based on viewing distance, and (3) the relative amount of opportunity for the public to see the change (that is, opportunity for many viewers or few viewers passing through the landscape, and permanent views from existing residences. These, in turn, are considered in relation to established policies relating to the visual environment to determine if a conflict potentially exists.

Visual impacts are considered significant only if they are long-term impacts. It is recognized that most viewers likely regard the disruptions of the landscape created by construction activity as "unsightly". Such impacts are unavoidable but generally regarded as nuisance effects rather than substantial negative effects on the visual/aesthetic environment.

IMPACTS AND MITIGATION MEASURES

Impact 5.2.7.1. The Geysers Effluent Pipeline Project component would have a less than significant impact on the visual/aesthetic environment.

Most of the Lake Diversion Pipeline and main Geysers Effluent Pipeline would be buried and therefore present little visible evidence in the landscape. Most of the Lake Diversion Pipeline and much of the Geysers Effluent Pipeline would be buried in streets or in the road shoulder and, therefore have no visible impact in those segments. In some areas of both pipelines, the alignment would cross pasture lands, and the ROW would have no visible contrast from the surrounding uses. The parts of the Geysers Effluent Pipeline that are above ground are located in areas seldom seen, and therefore, the impact would be insignificant. The proposed road widening for the Unocal project site would create a permanent visual feature, but it would not be in the line of sight, and therefore, it would not have a significant effect. The secondary pipelines for injection of effluent in the Southeast Geysers also would be located in roads or in areas already having substantial visual landscape alteration.

Buildings and facilities for this component of the project includes a variety of structures which could produce minor visual contrast. Facilities at the SERWTP and MWTP would be seldom seen. The Childers Peak Regulating Tank would be located in a seldom seen area. The Bear Canyon pump stations would be located in a seldom seen area and BC-1, BC-2 and BC-3 would be largely hidden from distant views by the existing forest. BC-4 and BC-5 would be located in an area already substantially altered by structures and pipe systems of the geothermal field in the Southeast Geysers and would be visible only as distant features in the background of views from residences on the south-facing slopes above and north of Anderson Springs and for south-bound travelers on SR175.

No mitigation is required for the visual impacts of the preceding facilities. Mitigation measures already presented for ROW revegetation would ensure that visual contrasts would be minimized.

There are four sites which are of some concern with regard to alteration of visual conditions. None qualifies as a substantial alteration of the visual landscape, and, therefore, their impact is less than significant. However, in the interest of minimizing visual impacts, these are discussed below in greater detail, and mitigation is recommended.

Impact 5.2.7.2. Station 101.5 to 102.5 of the main Geysers Effluent Pipeline would create a permanent strong visual contrast of relatively high visibility although primarily in the background of the viewers' landscape. This would be a less than significant impact. The impact is mitigable.

The segment with visual impact includes Station 101.5 to 102.5, located on the south-facing slope above Putah Creek in the Collayomi Valley. The proposed pipeline would be buried underground in the areas of visual impact. The existing vegetation cover would be removed for pipeline construction. The ROW would be replanted with vegetation that would consist primarily of grasses and herbaceous plants in order to maintain ease of access for inspection and maintenance. The revegetated corridor would contrast noticeably with the surrounding vegetation for both segments.

At Station 101.5 to 102.5, the corridor would descend the steep brush covered hillside that forms the northern valley slopes of the Collayomi Valley. The key observation points would be from SR175 with travelers in both directions on the highways having views of the impact area. The site would be visible from approximately 3,000 feet of SR175, although the view would be broken by trees along the northern edge of the road and in the foreground of viewers. The pipeline corridor would be visible as a background visual element, relatively distant from the travelers on the highway. There would be a moderate degree of color contrast created by the corridor, but the chief contrast would be created by differences in texture between the corridor and the adjacent brush-covered hillslope. The pipeline corridor would appear as a narrow, relatively straight lineament on the hillslope, running perpendicular to the ridgeline. The visual landscape in this area is dominated by strongly horizontal elements of the background ridges, middleground canopy of trees and foreground pastures. No existing similar alterations of the landscape are present on this hillslope, although parts of a road are visible on the same valley slope somewhat to east of the pipeline corridor site. Views of the lower part of the pipeline corridor just above Putah Creek would be blocked by large trees visible in the distant middleground.

SR175 in this area is acknowledged in the General Plan and zoned as a County Scenic Corridor Combining District by the County of Lake. SR175 obtains relatively high usage, and therefore, presents high viewer opportunity to see the noted landscape changes. Additionally, the route probably is used frequently for scenic driving by residents and tourists traveling between Middletown and the Cobb Mountain area. Scenic driving consistently is rated as one of the most popular forms of recreation in California.

Mitigation 5.2.7.2. (Recommended) The Project Sponsors should revegetate the ROW to minimize textural contrasts with the surrounding hill slopes.

Besides use of grasses to stabilize the relatively steep slope in this segment, revegetation shall include low-growing shrubs using species typical of this area. This would allow a minimum amount of contrast in color and, to some extent, texture contrast with the surrounding slopes. ROW inspections in this area could be accomplished by walk-overs, or on horseback, or using rubber-tired vehicles to prevent the necessity of keeping the area cleared to allow passage of vehicles.

Implementation of Mitigation Measure 5.2.7.2 would ensure that the impact is minimized and kept below the level of significance.

Impact 5.2.7.3. Station 121 to 122 of the main Geysers Effluent Pipeline would create a permanent strong visual contrast of relatively high visibility although primarily in the background of the viewers' landscape. This would be a less than significant impact. The impact is mitigable.

Station 121 to 122 is a portion of the alignment of the proposed connector road between the Bear Canyon Access Road and the M-Pad. The visual contrast created by the proposed new road would result from the combination of tree removal and grading. The key observation points of the impact site are located on Highway 175, but for viewers located only in the south-bound direction, and from scattered residences on the south-facing hills above and north of Anderson Springs. (The site would not be visible from the community of Anderson Springs because of the forest canopy and slope configuration.) The views of the site for south-bound travelers would be relatively brief, as SR175 drops at a relatively steep grade in this area and then enters an area with forest canopy that blocks the view to the site. The road and its associated cuts and fills would present substantial visible contrasts of color (due to reddish soils), line and texture to the immediate surroundings. These contrasts, however, would be broken by the trees in the forest between the viewpoints and the roads.

As noted previously, SR175 is highly traveled and has recognized scenic qualities, and zoning as a County designated scenic route.

Mitigation 5.2.7.3. (Recommended) The cut and fill slopes should be revegetated using grasses and planted shrubs and trees typical of the surrounding hills. The project sponsors shall submit a landscaping plan for approval by the Lake County Planning Department. Monitoring of revegetation success shall occur for a period of no less than five years.

Benching of cuts and placement of soil shall be carried out to achieve a more natural look when planted. Grasses and shrubs should be planted on the cut slopes. Pockets of deeper soil could be developed to accommodate tree growth. Trees shall be planted on fill slopes. The revegetated slope shall be maintained to ensure its success. The County of Lake shall monitor the success of the revegetation plan at least once yearly for a minimum of five years.

Implementation of this mitigation would help to minimize the visual impacts of this landscape feature. Even with the mitigation, the features would remain as permanent elements of the visual landscape.

Impact 5.2.7.4. The proposed cut and fill and Y-Pad Injection Fluid Storage Tank would create a permanent strong visual contrast of relatively high visibility although entirely in the background of the viewers' landscape. This would be a less than significant impact. The impact is mitigable.

The visual contrast created by the tank at its pad would result from the grading to create a pad for the tank and by the tank itself. The key observation points of the impact site are located on Highway 175, but for viewers located only in the south-bound direction, and from scattered residences on the south-facing hills above and north of Anderson Springs. The views of the site for south-bound travelers would be relatively brief, as SR175 drops at a relatively steep grade in this area and then enters an area with forest canopy that blocks the view to the site. The cut and the tank would present visible contrasts of color, line and texture to the immediate surroundings. The tank would be painted marine green but would nonetheless be easily discernible in the landscape by virtue of its form. The cut would contrast with the surrounding densely vegetated slopes. These contrasts, however, would blend with facilities created by geothermal development already in the immediate vicinity.

The cut and the tank would be entirely background landscape features to viewers. They would be visible as small features viewed at a distance. As noted previously, SR175 is highly traveled and has recognized scenic qualities, although it is not an officially designated scenic route.

Mitigation 5.2.7.4. (Recommended) Mitigation by revegetation would be the same as Mitigation 5.2.7.3, but with reference to the Y-Pad Injection Fluid Storage Tank and pad. Additionally, all above-ground facilities would be painted with appropriate colors.

Implementation of this mitigation would help to minimize the visual impacts of this landscape feature. Even with the mitigation, the features would remain as permanent, although less than significant, elements of the visual landscape.

Impact 5.2.7.5. The pump house for the Lake Diversion Pipeline on the lakeshore would be visible in the foreground to nearby residences. A tree may be removed for the pipeline. However, this is an urban area and the amount of visual contrast created by this structure and tree removal would not be significant.

The pump house would be consistent with the developed character of the lake shore in this part of Clear Lake. The structure would be visible in close range views from two nearby residences as well as from buildings on the opposite side of Lakeshore Drive. The pump house would be visible to drivers on Lakeshore Drive, although it would not likely attract much attention. A tree on the property near the pump house also may be removed for the project. Night lighting also may be provided at the site.

Because the pump house would be located in an area subject to Clear Lake Conservation and Development Policy, it would be subject to policies intended to enhance the aesthetic quality of the lake shore. No design has been proposed for the pump house at this time. A simple industrial-type structure may not promote a visually pleasing environment at the site.

Mitigation 5.2.7.5. (Recommended) The pump house and surrounding landscaping should be designed to provide aesthetically compatible features with the lake shore environment. The final plan shall be approved by the Lake County and City of Clearlake Planning Departments.

The design of the pump house could include a variety of materials and forms that would provide visual amenities to offset the functional nature of the building. For example, such materials could include use of natural wood and stone facings. Building form could be kept simple but interesting using a pitched roof with overhanging eaves, timber supports and wood joists, and shingles. This design approach would create a structure analogous to that used commonly in parks and would create an attractive landscape feature.

A somewhat less interesting design would include wood construction with a pitched roof and shingles. It could be painted white like many of the buildings on the lakeshore to create a cottage-like landscape feature.

Either of the above designs should be accompanied by modest landscaping using grass, shrubs and trees.

Cement block, plywood or metal construction would be less likely to be visually compatible with the lakeshore landscape. Such a structure could be constructed if liberal use were made of shrubs in landscaping to mask the structure.

Implementation of Mitigation 5.2.7.5 would ensure that visual and aesthetic impacts are kept to a minimum and possibly would enhance the visual character of the landscape in the area.

5.2.8 LAND USE

IMPACT SIGNIFICANCE CRITERIA

Because the pipeline would be placed underground through developed areas, it would not have any land use impacts related to long-term operation and maintenance. Potential impacts on land use could occur during construction, but these would be short-term. It is not anticipated that construction of the pipeline would have a significant, adverse impact on residences. No buildings would be removed because of the project.

IMPACTS AND MITIGATION MEASURES

Impact 5.2.8.1. The Geysers Effluent Pipeline Project component would occupy a total of approximately 11 acres. This is not a significant impact.

The proposed routes of the Geysers Effluent Pipeline and the Lake Diversion Pipeline do not place them in any areas of concentrated business activity. As noted in Table 4.10-1, the only businesses that could potentially be affected are at the intersection of Acacia and Arrowhead Roads in the City of Clearlake, the intersection of Lake and 2nd Streets in the Lower Lake area, Pine Avenue near Cedar Avenue and Spruce Grove near Highway 24. In each case, construction would take place in the adjacent roadway. The effects would be very short-term, as construction progress would average between 200 and 600 feet per day, and a normal procedure would be to backfill the pipeline trench at the end of each working day. In other words, customer access to any particular business would not be affected notably for more than one or two days, at most. This is not considered a significant impact.

5.0 Environmental Consequences & Mitigation Measures
5.2 The Geysers Effluent Pipeline Component

The proposed pipeline is consistent with Lake County, Sonoma County, and City of Clearlake general plans and policies.

No agricultural lands would be removed from production as a result of the operation and maintenance of the pipeline. Construction impacts on land use would be minimal because the pipeline has been routed along public rights-of-way for the most part.

It would be necessary to procure permanent and construction easements for the pipeline alignment on approximately 11 acres in total. An easement is a right secured from the landowner to allow use/access by the county for a defined period of time (for example, 99 years). By obtaining an easement, there is not a purchase of the property or change in title. It has been estimated that the total cost of these easements would be \$750,000, and altogether 64 parcels along the alignment would be affected (Lake County, 1993). Fair market value would be paid for the easements.

Easements are a legal instrument relative to real property and generally independent of General Plan and Zoning Ordinances (Dyett, 1993). The project sponsor does not anticipate needing and has not applied for any General Plan or zoning changes (Allen, 1993). Property purchase or easement acquisition from private owners for the purpose of extending the pipeline would require an agreement between the owner of the property and the pipeline operator. Any agreement would specify limitations on the use of the property easement, such as the growing of crops, working area versus permanent use area or placement of any structures. These agreements would be worked out on a parcel-by-parcel basis. Easement acquisitions or property purchases are not considered to be direct impacts provided structures would not have to be demolished or moved. As no existing buildings would be removed, no direct impact would occur.

All parts of the project from Station 110 to the terminus in the Southeast Geysers and all secondary distribution lines would be located in lands leased by the project sponsors for geothermal operations.

The agreements would probably prohibit some land uses, since access to repair the pipeline would be necessary. This would not be considered a significant adverse impact since property owners would already have been compensated for prohibitions on the use of their land through the purchase, acquisition or granting of easement rights.

5.2.9 SOCIOECONOMICS AND PUBLIC SERVICES

IMPACT SIGNIFICANCE CRITERIA

The construction of a pipeline to convey effluent into The Geysers steamfield would result in the creation of short-term employment in construction jobs and long-term employment in jobs to operate and maintain the pipeline. All short-term and long-term employment related to a project is considered beneficial. This includes both retention effects on employment as well as the creation of new jobs either directly or indirectly (through the lifting of the existing moratorium on development).

For the construction phase of the project, impacts would be considered significant and adverse if the project disrupts normal business activities to the extent that the owner suffers economic hardship, defined as a 50 percent decline in sales for a period exceeding one week.

Executive Order 12898, signed by President Clinton on February 11, 1994, requires that Environmental Justice impacts be considered in NEPA analysis. Since the project would create job opportunities and would not disrupt any existing business activities, there would be no effect on low income or predominantly minority areas, and no Environmental Justice impacts would occur.

IMPACTS AND MITIGATION MEASURES

Impact 5.2.9.1. The project would create employment opportunity in the short term for construction and in the long term. The impact is considered beneficial.

It has been estimated that construction of the 26-mile pipeline would take up to 18 months and generate approximately 42 primary jobs, 18 indirect and 89 induced jobs (Allen, 1993). Indirect jobs are those which are not directly involved in the construction effort, but have some relationship to the project. Additional employment created in firms that supply equipment and maintenance for the construction effort would be considered indirect jobs, for example, while the operation of equipment at the construction site would be considered direct, or primary, jobs. Induced employment is created when the primary and indirect workers spend their money in the local economy on items unrelated to the project, e.g., entertainment, clothing, dry cleaning, etc. The total primary, indirect and induced jobs that are estimated to be associated with the construction phase of the project, then, are 149. This represents an implicit construction multiplier of about 2.5, which is a reasonable multiplier for the construction industry.

5.0 Environmental Consequences & Mitigation Measures

5.2 The Geysers Effluent Pipeline Component

Additionally, it has been estimated that six new permanent jobs would be generated for the operations phase of the project. These would involve operation and maintenance of the pipeline. Most likely these jobs would be for employees of LACOSAN, depending on the final agreements reached among the project sponsors on funding and responsibilities.

Given the current rate of unemployment in Lake County, it is reasonable to assume that almost all jobs created either directly or indirectly by the project could be filled by local residents. For instance, there is an estimated pool of 126 unemployed construction workers, and the total number of unemployed persons in the County was 2,750 in September of this year. There is no reason to expect that a significant number of out-of-County residents would relocate to Lake County to apply for the jobs created by the project. Therefore, there should be no significant impacts on the local housing market or on public services due to immigrating workers. The most notable impact of the project would be the positive effect of putting local unemployed people back to work. Under the current construction schedule, most of the construction labor force would be employed in two periods (August 1994 to November 1994 and April 1995 to November 1995) totaling about 11 months. To achieve the maximum economic and employment benefits, it would be necessary to hire as many workers as possible from the local labor force.

Additionally, the project would provide a new source of water to the Southeast Geysers steamfield, with the result that steamfield activities and jobs could be maintained at (or slightly increased from) their current levels. See discussion of long-term effects in Section 5.3.7. Without the injection of effluent from this project, the existing steam source would continue to be depleted possibly within 18 years (Smith, 1993). This poses a threat of a loss of up to 112 existing jobs over a 25-year period. While there is no precise way to determine how many jobs would be lost, steamfield operators feel that the numbers would be a significant percentage of current employment by those operators (Smith, 1993). An indirect impact of the proposed project, then, is that up to 112 existing steamfield and power plant jobs held by the Calpine, Unocal, NCPA and PG&E operators would be retained.

The proposed project would result in the lifting of the moratorium on development created by the CVRWQCB Cease and Desist Order. To the extent that the project would remove the obstacle to growth in the SERWTP service area, it would contribute to potentially significant new development in the long-term. This growth could result in significant changes in economics for the County, increases in employment, more housing and greater demand for public services and facilities.

Mitigation 5.2.9.1 (Recommended). The project sponsors should prepare a local hiring and training program for approval by the Planning Department. It shall be the goal of this program to maximize employment of Lake County residents, thereby reducing socio-economic impacts on housing and transportation, while increasing benefits to the local community. The program shall be prepared in consultation with the Labor Management Committee for Lake County and be approved prior to issuance of grading permits.

Impact 5.2.9.2. The project would have an insignificant impact on public services for short-term construction.

Construction of the pipeline would normally not cause long-term impacts to such basic services as fire, police, schools, libraries and emergency medical services. There could, however, be short-term impacts on utilities.

Construction activities include excavating, laying pipe and backfilling in 200- to 500-foot increments daily. The intent of the project sponsor is to proceed with a level of care that would avoid disruption of normal utility services. The project sponsor would ensure that these specifications are part of the construction contract. During construction there may be brief periods when it would be necessary to shut off water, power or sewer service when the construction contractor is working in segments of the alignment containing existing underground pipe.

In order to complete construction of the pipeline, access restrictions to individual parcel owners would occur. The project sponsor anticipates that these access restrictions would range from a few minutes up to several hours. The construction contract would contain the requirement that the contractor notify property owners two weeks in advance of the time of restriction, and that during the time of construction the contractor would assist any emergency services that needed to gain access to individual parcels.

Additionally, it is the intent of the project sponsor to minimize any disruption to traffic including vehicles of public service provided, on any given street, that might occur when work is proceeding in a public right-of-way. On smaller roads, at least one lane would always be open, and flagmen would be available to assist in traffic control (see Section 5.2.11).

While acquisition of some easements or purchase of property for the pipeline would occur, the project would not have an impact on property values along the pipeline alignment or other facility sites. The project does not require the expansion of LACOSAN-owned land at the SERWTP, and likely would not affect land values of adjacent properties.

Long-term use of lakewater for the project would not create a sufficient drawdown in the lake to have an impact on recreation, tourism or fishing industries. The proposed underwater pipeline would not be visible from the surface and, therefore, would be unlikely to affect recreation or tourism values and related income.

The conclusion is that there are no significant adverse impacts in the area of socioeconomics and public facilities that would accompany the approval and implementation of this project.

5.2.10 ENVIRONMENTAL CONTAMINATION HAZARDS

IMPACT SIGNIFICANCE CRITERIA

Based on the CEQA Guidelines, the project would be considered to cause a significant impact if the project would:

- Create a potential public health hazard;
- Involve the use, production, or disposal of materials that pose a hazard to people, animal, or plant populations in the area affected; or
- Expose site workers to hazardous substances in excess of current recommended worker health and safety standards.

IMPACTS AND MITIGATION MEASURES

Impact 5.2.10.1. Pipeline construction would require excavation of asbestos-containing serpentine rock that would result in the release of asbestos fibers, and possibly would expose workers to mercury or other heavy metals associated with the serpentine. This would be a potentially significant impact. The impact is mitigable.

Between Stations 75 to 83, and 98 to 102, and in The Geysers (including the proposed Unocal access road and pipeline route), the proposed effluent pipeline and associated project components pass through areas of serpentine rock outcroppings. Excavation of this material without the proper dust control and work safety measures would result in the release of asbestos fibers and possibly heavy metal-containing dust into the air and expose workers to a health hazard. As there are no residents living in the immediate vicinity of these serpentine areas on the alignments, exposure to the public would be insignificant.

Mitigation 5.2.10.1.A. The construction contractors shall comply with LCAQMD regulations for the excavation of serpentine rock in Lake County and meet the LCAQMD performance goals while excavating in Sonoma County.

LCAQMD Regulations for the excavation of serpentine material are contained in LCAQMD Regulations Section 467. The regulations require that serpentine material be analyzed for asbestos and that dust mitigation and construction management plans be developed and approved by the LCAQMD prior to excavation. There is a performance goal of "no visible emissions" and requirement of not exceeding a visible opacity of greater than 5%. Water or other control measures may be used to meet the dust mitigation requirements. The North Sonoma AQMD does not have specific serpentine regulations.

Mitigation 5.2.10.1.B. The construction contractors shall comply with OSHA and Cal/OSHA asbestos removal worker requirements whenever serpentine rock containing over one percent asbestos is being excavated.

OSHA asbestos worker safety regulations are found in 29 CFR 1910. Cal/OSHA regulations are found in 8 CCR. The regulations require monitoring airborne asbestos fiber levels, worker safety training and the use of personal protective equipment by workers when asbestos levels exceed 0.2 asbestos fibers per cubic centimeter of ambient air.

Mitigation 5.2.10.1.C. Any serpentine material encountered in disturbance areas prior to or during construction shall be analyzed for heavy metals. If the levels of the metals exceed the state CCR Title 22, Section 66261 limits, the construction contractor shall comply with the hazardous waste worker safety requirements.

Any serpentine soil excavated that contains both asbestos and heavy metals in excess to the state Title 22, Section 66261 limits shall not be disposed as side cast. The material should be handled and disposed of in a manner to minimize to potential for short-term and long-term dust generation. The appropriate air quality management district and the appropriate County Department of Environmental Health shall approve the method of disposal.

Hazardous substance worker safety regulations are found in 40 CFR 262, 29 CFR 1910, and other federal and state Title 22 regulations. In general, the regulations require safety training for workers, the use of engineering controls to reduce worker exposure to hazardous materials, and the use of appropriate personal protective equipment to reduce worker exposure.

The compliance with the measures recommend by Mitigation Measures 5.2.10.1.A and B when excavating serpentine material containing more than state Title 22, Section 66261 limits (even if the level of asbestos is below one percent) combined with additional worker safety training on the hazards of mercury-containing material would provide adequate worker protection.

Implementation of Mitigation Measures 5.2.10.1.A, B, and C would reduce the potential impact to a less-than-significant level.

Impact 5.2.10.2. Construction of pipelines could expose workers to agricultural chemicals in the Burns Valley Area. This is a potentially significant, but mitigable, impact.

During construction, the application of restricted use (i.e., regulated) pesticides (such as Malathion) adjacent to pipeline construction activity would expose construction workers to hazardous chemicals. Depending on wind conditions, there is usually some degree of drift of pesticide vapor from most pesticide applications, particularly when spraying occurs. Construction workers working in or immediately adjacent to a field or orchard during a pesticide application could inhale drifting pesticide vapors or have direct skin contact.

The soil in and around orchards may contain organochlorine pesticide residuals, i.e., substances no longer permitted for agricultural use. Workers could be exposed to these residuals through inhalation of dust during excavation and other dirt-moving processes. The levels of residuals are probably well below legal hazardous threshold levels. However, since these chemicals accumulate in the body, unnecessary exposures should be avoided whenever practical.

Agricultural chemicals are also utilized for roadside weed abatement by Cal Trans and County Public Road Department.

Mitigation Measure 5.2.10.2.A. The construction contractors shall consult the Lake County Agricultural Commissioner to determine when the permitted application of restricted use pesticides to field or orchards is occurring, and the construction contractor shall amend the construction schedule to avoid exposures as necessary.

The mitigation measure is primarily a matter of obtaining information from farmers about their spraying activities. The construction contractor may negotiate with the farmer to delay pesticide application if that is acceptable to the farmers. If the farmer does not choose to alter the program for application, the construction contractor shall alter the construction schedule accordingly.

Mitigation Measure 5.2.10.2.B. The construction contractor shall use dust control practices as required by the LCAQMD (see Mitigation 5.2.4.1.A).

Because of air quality and dust nuisance concerns (see Section 5.2.4), the construction contractor would be required to use dust control measures which include the use of water. Reducing dust would also reduce the potential for worker exposure to organochlorine pesticide residual in the disturbed soils.

Implementation of Mitigation Measure 5.2.10.2.A and B would reduce the potential impact to a less-than-significant level.

Impact 5.2.10.3. If hydrocarbon contaminated soil is encountered, project construction could expose workers to hydrocarbon vapors, generate hazardous wastes, and would limit future site clean-up options. The impact is potentially significant, but mitigable.

The pipelines would be constructed near fuel storage tanks in the Burns Valley and Lower Lake areas. Leaks or spills from either surface or underground fuel storage tanks cause hydrocarbon contamination of the soil. When the soil is excavated it would release hydrocarbon vapors. If the level of hydrocarbon contamination is above the regulatory threshold, the excavated soil would have to be treated and disposed of as a hazardous waste. Placement of the pipeline in a contaminated area could make it difficult to eventually clean-up the contaminated area because the effluent pipe would be in the way.

Mitigation Measure 5.2.10.3.A. If petroleum vapors are detected or petroleum stained soil is encountered along the route, the soil to be excavated shall be tested for the presence of hydrocarbons. If the levels of hydrocarbons are greater than the regulatory threshold for hazardous waste, the pipeline shall either be rerouted around the contaminated site or the contaminated soil shall be excavated and treated or disposed as a hazardous waste. Contaminated soil shall not be used as backfill.

Soil surface staining has been observed between Stations 32.4 and 32.6. A portable hydrocarbon vapor detector should be made available to the construction contractor to be used while earth work is being performed between these stations. The detector should also be used if petroleum odors are encountered during earth work near any fuel storage tank. This detector should be used to measure hydrocarbon vapors near soil that is suspected of being contaminated. If hydrocarbon vapors are detected, soil samples should be sent to a certified laboratory to determine if the level of contamination exceeds the regulatory hazardous waste threshold. If a hazardous level is

detected, the Lake County Department of Environmental Health should be contacted to discuss the need for remediation.

Mitigation Measure 5.2.10.3.B. When excavating hazardous (i.e., contaminated) soil, the construction contractor must comply with all federal, state, and local hazardous waste regulations.

The excavation and disposal of contaminated soil is regulated by: the California Regional Water Quality Control Board, and the Lake County Department of Environmental Health, and possibly the United States Environmental Protection Agency, and the California Environmental Protection Agency (Department of Toxic Substance Control). OSHA and Cal/OSHA have special hazardous material worker safety requirements as well.

Mitigation Measure 5.2.10.3.C. Prior to initiating earth work, the construction contractor shall conduct an information meeting to discuss hazard recognition (and other issues related to worker safety). All crew members shall specify in writing that they have been informed of any potentially suspected contamination hazards and their recognition.

Implementation of Mitigation Measure 5.2.10.3.A, B and C would reduce the potential impact to a less-than-significant level.

Impact 5.2.10.4. Improper use, storage, or disposal of hazardous substances used in project construction and long-term operation, such as fuel, oil, solvents, and hydraulic fluids, could expose workers to hazardous substances and cause environmental contamination. The impact is potentially significant, but mitigable.

A variety of hazardous substances are commonly used for pipeline construction machinery and vehicles and to operate and maintain the pumps. These include solvents, fuel, and motor oil. If improperly used or stored, these materials can cause environmental contamination and expose workers to health hazards.

Mitigation Measure 5.2.10.4.A. The construction contractors, LACOSAN and the geothermal operators must comply with all federal, state, and local hazardous substance regulations.

Mitigation Measure 5.2.10.4.B. The construction contractors, LACOSAN and geothermal operators shall service construction equipment only on impermeable surfaces with spill containment features.

Motor oil and hydraulic fluid are commonly spilled when heavy equipment is serviced. If the equipment is serviced in the field, spills would contaminate the soil. If the equipment is serviced on an impermeable surface, spilled substances could be cleaned up using acceptable practices without causing environmental contamination.

Mitigation Measure 5.2.10.4.C. Any fuel wagon or temporary fuel storage structure used by the construction contractor in the field shall not leak and shall not release large amounts of fuel in case of a fuel hose rupture.

Fuel wagons are not regulated as strictly as permanent fuel storage tanks. Small leaks in the tanks on a fuel wagon are common in many areas. The release of just a few gallons per day of fuel can cause environmental contamination.

Fuel wagons often are tempting targets for fuel thieves and vandals. Fuel hoses can be cut by thieves. Depending on design, unless the check valve is closed and secured, the contents of the wagon can drain through the cut hose and cause environmental contamination. A secure fuel wagon would discourage thieves and would prevent potential large fuel spills.

Mitigation Measure 5.2.10.4.D. The construction contractor, LACOSAN, and the geothermal operators shall instruct workers on the proper and safe procedures for disposal of hazardous wastes generated during project construction and long-term operation.

Documentation of the worker instruction shall be placed in the administrative file.

Implementation of Mitigation Measure 5.2.10.4.A, B, C and D would reduce the potential impact to a less-than-significant level.

Impact 5.2.10.5. The improper use of hydrocarbon wastes and some herbicides for ROW maintenance can cause environmental contamination. The impact is significant, but mitigable.

Although petroleum hydrocarbons are a major cause of environmental contamination in California, petroleum hydrocarbon-containing products, can be used for dust and weed control. The use of hydrocarbon-containing materials in this manner can cause environmental contamination if improperly applied.

Some common herbicides currently are legal for use, but recent studies have raised new safety concerns about the continued use of these chemicals. Chlorophenoxy herbicides such as

2,4-dichlorophenoxyacetic acid (2,4-D) are suspected to be carcinogenic. Additionally, use of pesticides and herbicides can be hazardous to wildlife.

Mitigation Measure 5.2.10.5.A. No used motor oil or other mostly petroleum hydrocarbon material, such as diesel, shall be used for ROW dust or weed control.

Mitigation Measure 5.2.10.5.B. Only herbicides recommended by the Lake County Agricultural Commissioner and the California Department of Fish and Game shall be used for ROW maintenance.

Implementation of Mitigation Measure 5.2.10.5.A and B would reduce the potential impact to a less-than-significant level.

Impact 5.2.10.6. Excavation of former drilling sumps could expose workers to the waste and break the clay liner of the sump.

The RWQCB requires that drilling waste be disposed of in a clay lined sump. Excavation of the sump could damage the liner and allow the waste to be released into the environment. In addition, worker could be exposed to contaminants in the waste and the inhalation of airborne dust particles.

Mitigation Measure 5.2.10.6. The pipeline and distribution pipelines shall be routed around any existing or former drilling waste sumps.

The pipeline to the terminus and the distribution pipelines should be located to avoid former drilling waste sumps. If this is not possible, the pipelines should be placed above ground.

5.2.11 TRAFFIC AND CIRCULATION

IMPACT SIGNIFICANCE CRITERIA

According to CEQA standards, a project that would cause an increase in traffic that is substantial in relation to the existing load and capacity of the street system is considered to have a significant impact on the environment. For purposes of this EIR, the project is considered to have a significant impact if construction activity would delay emergency vehicle access.

The project is considered to have a potentially significant impact where pipelines would be installed within roadways or across major and local streets which are important to local circulation. Traffic impacts to minor, local cross streets are considered less-than-significant.

Projects are also considered to have a potentially significant impact if construction activity significantly impedes general vehicular access to local streets or adjacent uses; if traffic flow would be made less safe; or if movement of heavy vehicles would cause substantial damage or wear of public roadways.

IMPACTS AND MITIGATION MEASURES

The proposed construction scenario (e.g., activity period, types of construction vehicles, duration of road disturbance), is presented in Section 4.2.5. Construction of the effluent pipeline project would not cause a substantial increase in traffic. It would cause short-term disruption of traffic flow and increased congestion. After installation, pipeline operation would have negligible impacts to traffic flow or circulation patterns. Operations may involve occasional work in streets for pipeline maintenance, which are not considered significant effects.

A short-term impact associated with the Unocal portion of the project would be a negligible and brief increase in traffic for construction. No long-term impacts would be associated with operation of the pipeline and injection. Since Unocal's roads are used solely by the geothermal industry, and the proposed pipeline would be located on a private road, traffic impacts to the general public would not occur. Additionally, the Unocal project would not generate an increased labor force, and, therefore, no increment to existing traffic.

Impact 5.2.11.1. Pipeline construction could delay emergency vehicle access on roadways along the pipeline route. This would be a potentially significant short-term impact. However, the impact is unlikely and it is mitigable.

As shown in Table 5.2.11-1, most roadways along the pipeline alignment would have detour access available while construction is occurring. Specific detour routing would not be made until final project design. Some roadways along the pipeline route, however, including Big Canyon Road, Riata Road, and various private roads, would not have alternate access available during construction hours. In these instances, construction-related materials or heavy equipment may delay emergency vehicle access to residences or other land uses on these roadways for up to 15 minutes (Dewante and Stowell, 1993). The probability of emergency vehicle activity on these roads during construction is low.

5.0 Environmental Consequences & Mitigation Measures
5.2 The Geysers Effluent Pipeline Component

TABLE 5.2.11-1: ESTIMATED IMPACTS TO ROADWAYS ALONG PIPELINE ROUTE

Roadway	Type of Roadway	Status During Construction /a/	Length of Construction	Detour Access Available
<u>Lake Diversion Line</u>				
Lakeshore Drive	Paved	Closed	6 days	√
Lower Lakeshore Drive	Paved	Closed	5 days	√
Kern Street	Paved	Closed	2 days	√
Manatee Avenue	Paved	Closed	5 days	√
Huntington Avenue	Paved	Closed	4 days	√
Arrowhead Dr./Reed Ln.	Paved	Closed	16 days	√
Private Road	Unpaved	Limited /b/	8 days	None
Smith Lane	Unpaved	Closed	5 days	None
Robin Lane	Unpaved	Limited /b/	8 days	√
<u>Geysers Effluent Pipeline</u>				
Robin Lane	Unpaved	Limited /b/	20 days	√
Brown Street	Unpaved	Limited /b/	6 days	√
Olympic Drive	Paved	Open /c/	2 days	√
Fillmore Avenue	Unpaved	Closed	7 days	√
Polk Avenue	Unpaved	Closed	4 days	√
SR 53 Crossing	Paved	Open /d/	2 days	√
Pine Avenue	Unpaved	Closed	12 days	√
Davis Avenue	Paved	Open /c/	2 days	√
Cedar Avenue	Unpaved	Closed	4 days	√
43rd Avenue	Unpaved	Closed	14 days	√
Irving Avenue	Unpaved	Closed	35 days	√
17th Avenue	Undeveloped	Closed	4 days	√
Boyles Avenue	Partly Paved	Closed	17 days	Poor
Dam Road	Paved	Open /c/	2 days	√
<u>Geysers Effluent Pipeline</u>				
Lake Street	Paved	Closed	35 days	√
2nd Street	Paved	Closed	5 days	√
Mill Street	Paved	Closed	2 days	√
Morgan Valley Road	Paved	Open /c/	12 days	√
Clayton Creek Road	Paved	Closed	15 days	√
Riata Road	Paved	Limited /b/	20 days	None
SR 29 Crossings (3)	Paved	Open /d/	6 days	√
Along Right-of-Way	Paved	Open /e/	2 months	√
Big Canyon Road	Paved	Closed /f/	5 months	√
SR 175 Crossing	Paved	Limited /f/	2 days	√
Harbin Springs Road	Paved	Limited /b/	2 days	None
Bear Canyon Road	Paved	Limited /g/	3 months	None
Ridge Road	Paved	Limited /h/	2 months	None

(Continued)

TABLE 5.2.11-1: ESTIMATED IMPACTS TO ROADWAYS ALONG PIPELINE ROUTE (Continued)

- /a/ All roads identified as "Closed" during construction would be closed to all traffic during construction hours (weekdays, 8:30 a.m. to 4:30 p.m.), and generally open to traffic during non-construction hours. Some exceptions would apply, depending on roadway type and land uses adjacent to roadway.
- /b/ Would allow access to and from homes on this roadway during construction hours; however, construction may delay access for up to 30 minutes.
- /c/ Alternate one-way traffic would be maintained during construction hours with use of flaggers.
- /d/ If open-cut construction method were used, alternate one-way traffic would be maintained during construction hours with use of flaggers; if jack-and-bore construction method were used, traffic would not be impeded.
- /e/ No traffic impeded; use of construction warning and traffic reduction signage.
- /f/ 15-minute delay maximum for emergency vehicle access during construction hours..
- /g/ Access to Bear Canyon Power Plant would be available; up to 30-minute delay for Calpine vehicles during construction hours.
- /h/ Up to 30-minute delay for Northern California Power Agency (NCPA) vehicles.

SOURCE: Dewante and Stowell Consulting Engineers, Environmental Science Associates, Inc., 1993.

Mitigation 5.2.11.1.A. The contractor should be obligated to provide for emergency vehicle access in a timely manner, i.e., as quickly as possible. To minimize disruption and delays for emergency vehicle access, LACOSAN would identify detours and require the contractor(s) to maintain steel trench plates at the construction sites to restore access across open trenches. The amount of open trench at one time would be limited to 500 feet.

Mitigation 5.2.11.1.B. Police, fire, and emergency services should be notified weekly of the timing, location, and duration of construction activities throughout the project for that week and a schedule of construction activities by area and date. Additionally, the construction contractor should monitor emergency service provider radio channels during all periods of road closure on Big Canyon Road and Riata Road so as to provide a quick response for the passage of emergency vehicles.

Implementation of Mitigation Measures 5.2.11.1.A and B would reduce the impact to a less-than-significant level.

Impact 5.2.11.2. An increase in roadway wear in the project vicinity would occur as a result of heavy truck and construction equipment movements. This would be a less-than-significant impact on major roads, but potentially significant on local roads. The impact would be short-term and is mitigable.

The use of heavy trucks to transport equipment and material to and from the construction sites could increase the rate of road wear. The degree to which this impact would occur depends on the design (pavement type and thickness) and existing condition of the road. Major arterials and collectors (identified in Section 4.13), such as SR 53, SR 29, and SR 175 are designed to accommodate a mix of vehicle types, including heavy trucks. The private roadways within the Southeast Geyser's area are also constructed to accommodate large vehicles and heavy equipment. The project's impact is assumed to be minimal on these roads.

Local residential streets are generally not built with a pavement thickness that will withstand significant heavy truck traffic volumes. Additionally, many streets are not paved and are at present in poor condition (deeply rutted, corrugated surface, etc.). Therefore, the use of local residential streets by project truck traffic could result in significant roadwear or accelerated erosion and rutting. This would occur on those local roads which are steep, dirt-surfaced, and would be heavily traveled by trucks. Similarly, detour roads would be subjected to temporary street traffic. The traffic could result in increased wear particularly where the roads have existing poor surface condition.

Mitigation 5.2.11.2.A. Conduct a preconstruction survey of the road condition on key access routes to the project sites. Monitor the pavement and/or road surface condition of local streets and designate roads judged to be in good condition for use by heavy truck traffic. Where poor quality roads must be used, document the pre-construction condition of the road.

Mitigation 5.2.11.2.B. Roads damaged by construction traffic should be repaired to a condition equal to or better than that which existed prior to construction activity.

Roads should be restored in such a way as to not result in increased deterioration.

Mitigation 5.2.11.2.C. Detour roads should be selected to use paved roads to the extent feasible to reduce damage to unpaved roads and to minimize dust.

Implementation of Mitigation Measures 5.2.11.5.A through C would reduce the impact to a less-than-significant level.

Some less-than-significant transportation impacts are discussed below. While no mitigation measures are required, this EIR identifies measures that would further reduce these less-than-significant impacts to minimum levels.

Impact 5.2.11.3. Pipeline installation within and across streets would result in the temporary closure of local roadways, and would reduce the number of, or the available width of, travel lanes on major roads. This would result in temporary disruption of traffic flows and brief increases in traffic congestion. This would be a less-than-significant impact.

Project construction would involve pipeline installation both within and across roads, ranging from major arterials to local residential streets. The main construction techniques, described in Section 2.3, are open "straight side wall" trenching or jack-and-bore. Open trenching within a roadway involves pavement removal and excavation and results in partial street closure (e.g., closure of one to two travel lanes), or full closure of a road segment, and usually there would be a detour available. Work done in paved roadways generally would progress about 200 feet per day. Much of the pipeline route would be installed in relatively undeveloped areas; work done in dirt roads and open areas generally would progress about 400 feet per day.

At this time, the Project Sponsors have identified that the jack-and-bore technique would be used for the effluent pipeline crossing at SR 53, and three crossings of the pipeline at SR 29 because this is required by Caltrans construction standards. With this technique, boring pits are located on either side of the road being crossed and the pipeline is jacked under the road. If a vacant lot or parking lot space is available, the boring operation could completely avoid traffic impacts. However, depending on the space available for locating the pits, the pits may extend into the street being crossed and/or into a connecting side street.

Table 5.2.11-1 presents the roadways along the pipeline route that would be directly affected by pipeline construction, and estimated duration of construction. The duration of traffic and access disruption, and thus traffic impacts, would be temporary. The largest single temporary public road closure would occur on Big Canyon Road. All roads involved in the construction of the effluent pipeline project west of SR 175 are private roads. The greatest impact would be on major roadways in the project area (e.g., SR 175, Olympic Drive, Davis Avenue, Dam Road); these roadways would remain open during pipeline construction hours (weekdays, 8:30 a.m. to 4:30 p.m.), allowing either unimpeded or alternate one-way traffic flow. Delays on these

roadways during peak morning and evening commute hours would cause minor lengthening of commute times.

Numerous local roadways along the pipeline route would be either partially or fully closed during construction hours; however, in most of these instances the traffic flow volumes are low and traffic congestion impacts would not be significant. In addition, detour access would be available for most of these local roadways.

Mitigation Measure 5.2.11.3. (Recommended) Special traffic control measures should be incorporated into the construction contract specification documents, as follows:

- a. Limit lane closures for construction to off-peak traffic periods on SR 53, SR 29, SR 175, Olympic Drive, Davis Avenue, and Dam Road, and as established in encroachment permits.
- b. Require the contractor to prepare traffic control plans to show specific methods for maintaining traffic flows. Examples of traffic control measures to be considered include: (1) use of flaggers to maintain alternating one-way traffic while working on one-half of the street, then placing a steel plate over the open trench during non-working hours to provide uncontrolled two-way traffic flow; (2) using a temporary additional travel lane when sufficient width exists; (3) jacking under the roadway if (1) and (2) are not possible; (4) use of advance construction signs and other public notices to alert drivers of activity in the area; and (5) use of "positive guidance" detour signing on alternate access streets to minimize inconvenience to the driving public. (Such traffic control plans will likely be required by governing jurisdictions as a condition of encroachment permit approval.)
- c. Provide advanced public notification in local newspapers of construction activity and street/access closures, including any applicable detour routing.
- d. Schedule work involving street crossings to minimize obstruction of local circulation. More than one work crew may be used to increase the rate of construction. However, since this could increase the number of street crossings under construction at any one time, pipeline construction should be scheduled such that alternate access routes to be used by affected traffic are not blocked by concurrent construction.

Impact 5.2.11.4. Construction activities would restrict access to adjacent land uses. This would be a less-than-significant impact.

Installation of pipeline within a roadway would affect vehicle access to land uses adjacent to the work zone (e.g., residences, commercial/retail businesses, schools and other public facilities). Temporary road and driveway closures would occur. Table 5.2.11-1 presents estimated duration of closure of roadways affected by pipeline construction. Vehicle access would be restored at

the end of each work day through the use of steel trench plates or trench backfilling. Access restriction constitutes a short-term impact of the project. In most areas, an alternate access is available; vehicles can detour around the closure using side streets. However, on some roadways (e.g., Big Canyon Road, Riata Road, various private roads), no detour or alternate access is available. In these instances, access to land uses on these roadways would be maintained, but delays of up to 30 minutes could occur.

Mitigation Measure 5.2.11.4. (Recommended) Require adequate public notification (using mailings or flyers, and notices in newspapers) of construction activity, including any applicable detour routing to alternate access and/or parking for affected land uses.

Impact 5.2.11.5. An increase in vehicles trips in the project vicinity would occur as a result of construction activities. This would be a less-than significant impact.

Project construction would generate additional traffic from workers commuting to and from the site; construction associated with the transport of excavated fill, pipe, and paving material to and from the construction sites would add heavy-equipment vehicles to the traffic flow during the course of the work day. Table 2.3.5-4 and 2.3.5-6 present construction truck transport and worker commute trips associated with the effluent pipeline project.

Because the effluent pipeline project encompasses a large area, the project is separated here into three segments for discussing impacts on both local and regional roadways from construction-generated trips distinct to each region. The segments identified are: the Clearlake/Lower Lake region, the area affecting SR 29 south of SR 53, and the area affecting SR 29 and SR 175 near Middletown. Because the construction schedules for various components of the effluent pipeline project overlap, a conservative approach was taken that assumed that this construction would take place concurrently. Additionally, each worker is also assumed to commute in his/her own vehicle during the peak-hour periods.

Construction Affecting Clearlake Region: Lake Diversion Pipeline and Geysers Effluent Pipeline

Roadways in the City of Clearlake and Lower Lake areas would be directly affected by an increase in vehicle trips related to construction of the lake intake and effluent pipelines within the City, as well as construction at the Lake Diversion and SERWTP Pump Stations. The overall construction period for these facilities would occur between August 1994 and December 1995. On the basis of the worst-case construction scenario outlined above, construction activities would generate up to 40 daily transport vehicle round trips, and up to 80 daily worker commute

round trips within this region. Trips would be distributed onto the local roadways within the Clearlake community, depending on the location along the pipeline alignment where construction would occur, and the easiest available access routes. The majority of these trips would access SR 53; it is estimated the vehicles associated with these trips would account for a three to five percent increase in the total daily traffic volume on this roadway in the Clearlake region. This increase would fall within the normal fluctuations of daily traffic, and would not be noticed by the average driver.

Construction Affecting SR 29 South of SR 53

The construction period for the region of south of Lower Lake and north of Big Canyon Road would be scheduled to occur between April 1994 and December 1995. Up to 42 daily transport vehicle round trips, and up to 76 daily worker commute round trips would be generated on the roadways in this region. The majority of vehicles associated with these trips would access SR 29; it is estimated these trips would account for approximately a three percent increase in the total daily traffic volume on this roadway in the construction vicinity. This increase would fall within the normal fluctuations of daily traffic, and would not be noticed by the average driver.

Construction Affecting SR 29 and SR 175 Near Middletown

The construction period for the region from Big Canyon Road to the Middletown WWTP Pump Station would be scheduled to occur between August 1994 and December 1995. Assuming construction activities related to the effluent pipeline and the WWTP would occur concurrently, up to 23 daily round trips from transport vehicles, and up to 28 daily worker commute round trips would be generated on the roadways in this region. The majority of vehicles associated with these trips would access SR 175 and some would use SR 29 to reach SR 175; it is estimated these trips would account for less than a four percent increase in the daily traffic volume on SR 175, and less than a two percent increase in the daily traffic volume on SR 29 at the intersection with SR 175.

The majority of construction-generated vehicles traveling on SR 175 and SR 29 near Middletown would be associated with construction on the segment between SR 175 and the Southeast Geysers. Construction activities on this segment are scheduled between August 1994 and November 1995; the greatest number of trips would be generated between April 1995 and October 1995. During this timeframe, up to 69 daily truck round-trips, and 204 daily worker round-trips would occur in this region. On the basis of worst-case assumptions outlined earlier,

it is estimated these trips would account for an approximately 21 percent increase in the daily traffic volume on SR 175, and up to about eight percent increase in the daily traffic volume on SR 29 at SR 175.

Although the estimated total increase in daily traffic on SR 175 from construction would be noticeable, using a maximum roadway capacity of 2,200 vehicles per hour (reduced to reflect varying physical characteristics, i.e., shoulder width, passing opportunities, etc.), the increase in traffic due to construction would result in use of less than half of usable roadway capacity by total traffic during this period. Thus, the impact on these roadways would be less than significant.

The trips associated with the Geysers Effluent Pipeline throughout the project area would be felt most during the peak traffic hours; there could be sudden surges in traffic flow as the construction workers leave the job site together at the end of the day. However, it is concluded that construction worker trips would not be expected to reduce the existing level of service on arterials and collectors in the area of any segment. The level of impact would depend on the number of crews working simultaneously and the proximity of the active construction areas.

The potential exists for short-term adverse impacts to traffic flow on local roadways caused by the slower movements and larger turning radii of the heavy trucks used in construction; however, because truck transport traffic would be dispersed throughout the day, they would have a minimal effect on peak hour traffic. Planned storage of material (e.g., pipe) at staging areas located along the construction route would reduce the total number of truck trips.

Encroachment permits would be needed for construction within roadways. These permits, issued by the governing jurisdictions, often specify the hours during which construction may occur, the haul routes used by construction vehicles, and other operational controls.

Although this impact would not be significant, it could have some adverse effect on traffic flow in the project area and the following measures are recommended to lessen the effect.

Mitigation Measure 5.2.11.5. (Recommended) Measures to plan construction travel routes should be incorporated by the Project Sponsors into contract specification documents to ensure implementation by the construction contractor(s).

- a. Limit transport of construction equipment and materials and travel of large slow-moving machinery and vehicles to off-peak traffic periods.
- b. Require the contractor to use haul routes that minimize truck traffic on local, two-lane streets (i.e., use freeway and major roadways to the extent feasible).
- c. Require contractor to locate staging areas throughout the project area so as to minimize the hauling distances for construction equipment and materials.
- d. Develop circulation and detour plans to minimize impacts to local traffic circulation.

Impact 5.2.11.6. Construction of the Bear Canyon to M-Pad Connector Road could result in a re-distribution of traffic on Bear Canyon Access Road, Socrates Mine Road and State Route 175. This would be a beneficial impact.

Currently, the Bear Canyon Access Road provides dead-end access to facilities for Calpine Corporation at the Bear Canyon Power Plant. The NCPA access road also dead-ends to the M-Pad. Both roads are steep and winding, with gated access to the facilities controlled by the respective operators. Construction of the connecting segment between these two roads would provide alternate access to each facility for emergency vehicles, a potentially important beneficial impact. Non-emergency vehicles could also have through access, although access by personnel other than those for the gate-controlling agency (and emergency and maintenance crews for the project's pipeline) is not a stated objective of the geothermal industry participants. No formal agreements have been made by Calpine and NCPA to share each other's roads for regular operations using the proposed connector road. If such an agreement were reached, the expectation is that some vehicles traveling to and from the NCPA leasehold would change routes to use the Bear Canyon Access Road instead of Socrates Mine Road. This expectation is based on the resulting shorter distance between SR 175 and the M-Pad via the Bear Canyon Access Road. Similarly, Calpine vehicles could pass through the NCPA gate and travel directly down the NCPA road to the M-Pad to reach the Bear Canyon Access Road. Such arrangements could substantially reduce the length of vehicle trips (miles traveled per day).

The effect of traffic re-distribution would not be significant on public roads, specifically SR 175. Low traffic volumes exist on SR 175 between the Bear Canyon Access Road and the Socrates Mine Road (see Table 4.12.1-2). Geometrics for both intersections with SR 175 are such that sight distance available to drivers is sufficient for safe turning movements.

No mitigation is required.

5.2.12 ENERGY AND MATERIALS

IMPACT SIGNIFICANCE CRITERIA

A project would normally have a significant effect on the environment if it would use fuel or energy in a wasteful manner, or encourage activities which result in the use of large amounts of fuel or energy (California Office of Planning and Research, 1992).

IMPACTS AND MITIGATION MEASURES

Impact 5.2.12.1. Construction of the proposed pipelines and related facilities and long-term operation of the pumps would consume substantial amounts of energy. Normally, this would be a significant impact of the project; however, when viewed in the context of the overall project, this energy consumption would be more than offset by the energy derived from injection of the effluent.

Project construction would consume substantial amounts of energy. Construction energy expenditures would consist of both direct and indirect expenditures of energy. Combustion of the refined petroleum products needed to operate construction equipment would be a direct energy expenditure. Indirect energy is consumed through sectors that provide inputs to an activity, rather than energy consumed by the activity itself. For example, the use of steel pipe in construction indirectly represents energy consumed in all of the industries that contributed to the production of the pipe (e.g., energy consumed through mining and extraction of raw materials, manufacturing, and transportation). Indirect energy typically represents about three-quarters of total construction energy, while direct energy represents about one-quarter of total energy construction (Hannon, 1978).

Based on equipment lists provided by the project sponsors, direct energy consumption for construction would be approximately 410,000 gallons of gasoline and diesel fuel. This would include the fuel consumed by heavy construction equipment, haul trucks, delivery trucks, and construction worker commute trips.

Indirect energy would be consumed in manufacturing the materials needed for this project, primarily steel, asphaltic concrete, aggregate base, and concrete. Steel would be the most energy-intensive material needed for the project. The indirect energy associated with the pipeline and tanks would be approximately 510 billion British Thermal Units (Btu) assuming that the pipelines and tanks are made of one-half inch steel. This estimate is based on an

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estimate of 51.8 million Btu needed to produce one ton of steel pipe (California Department of Transportation, 1983). Indirect energy would amount to approximately 525 billion Btu.

Together, direct and indirect energy consumption for project construction would be approximately 580 billion Btu, which would be approximately 23 billion Btu averaged over the course of a 25-year project lifetime.

Once operational, the pipeline would require energy to operate the pumps. The pumps would consume approximately 26 million kWh per year (equivalent to 270 billion Btu). This would be partially offset by the energy savings from reduced effluent irrigation at the SERWTP.

Maintenance of the proposed pipelines and pump stations would also require energy but this would be minor.

Together, annualized construction energy plus annual pump energy would be 19.1 billion Btu per year. The project is expected to generate at least 21 MW (associated with 15% recovery) of electrical-generating capacity. Over a year, 21 MW correspond to 184 million kWh, equivalent to 630 billion Btu. Comparing annualized energy requirements of the project (293 billion Btu) with annual energy production (630 billion Btu), it is clear that the project would result in a net energy benefit.

5.3 IMPACTS AND MITIGATION MEASURES RELATED TO THE SOUTHEAST GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT

5.3.1 GEOTHERMAL RESERVOIR EFFECTS

IMPACT SIGNIFICANCE CRITERIA

CEQA Guidelines do not contain any specific indications of significant effects related to geothermal energy resources. For purposes of this impact assessment, the project would be considered to have a significant impact if it would:

- substantially affect the recovery rate of steam in the geothermal reservoir
- substantially affect the chemistry or conditions of geothermal reservoir fluids and thereby affect operations of existing power plants.

IMPACTS AND MITIGATION MEASURES

Impact 5.3.1.1. The proposed injection of effluent could double the recovery rate of injection derived steam (IDS) within several years in Calpine, NCPA and Unit 18&20 of Unocal leaseholds. This is a significant beneficial impact of the project.

Calpine, NCPA and Unocal believe that a benefit can be obtained from further concentrating available injection water in favorable geothermal reservoir zones. This conclusion is based on the results of ongoing injection programs carried out since 1989 (Beall, 1993)

The current rates of injection are about 1,600 gpm in the NCPA area, 1,800 gpm in Units 13 and 16, and 1,100 gpm in Units 18 and 20 for a total of about 4,500 gpm. The proposed Geysers Effluent Pipeline flow is 5,400 gpm. Thus, the project would increase the current injection rate by a little more than twofold. The production of IDS currently is equivalent to the injection rate. It is probable that initially the doubling of injection will not lead to a doubling of recovery, at least until experimentation and/or system operation has determined the proper injection rates at the various chosen sites. Actual recovery is dependent on individual well injection rate, injection scheme and local reservoir conditions. However, as both the injection rate and scheme can be adjusted by the industry operators at any given well or pattern of wells, considerable control can be exercised to optimize effects and recovery. Assuming that complete injection can be achieved without cooling problems, it seems likely that the recovery rate will double within several years. This is considered a significant beneficial impact of the project.

No mitigation is required.

Impact 5.3.1.2. The proposed injection of effluent would slow the rate of decline in the Low Pressure Area (LPA) but would not change its spatial extent. This is a significant beneficial impact of the project.

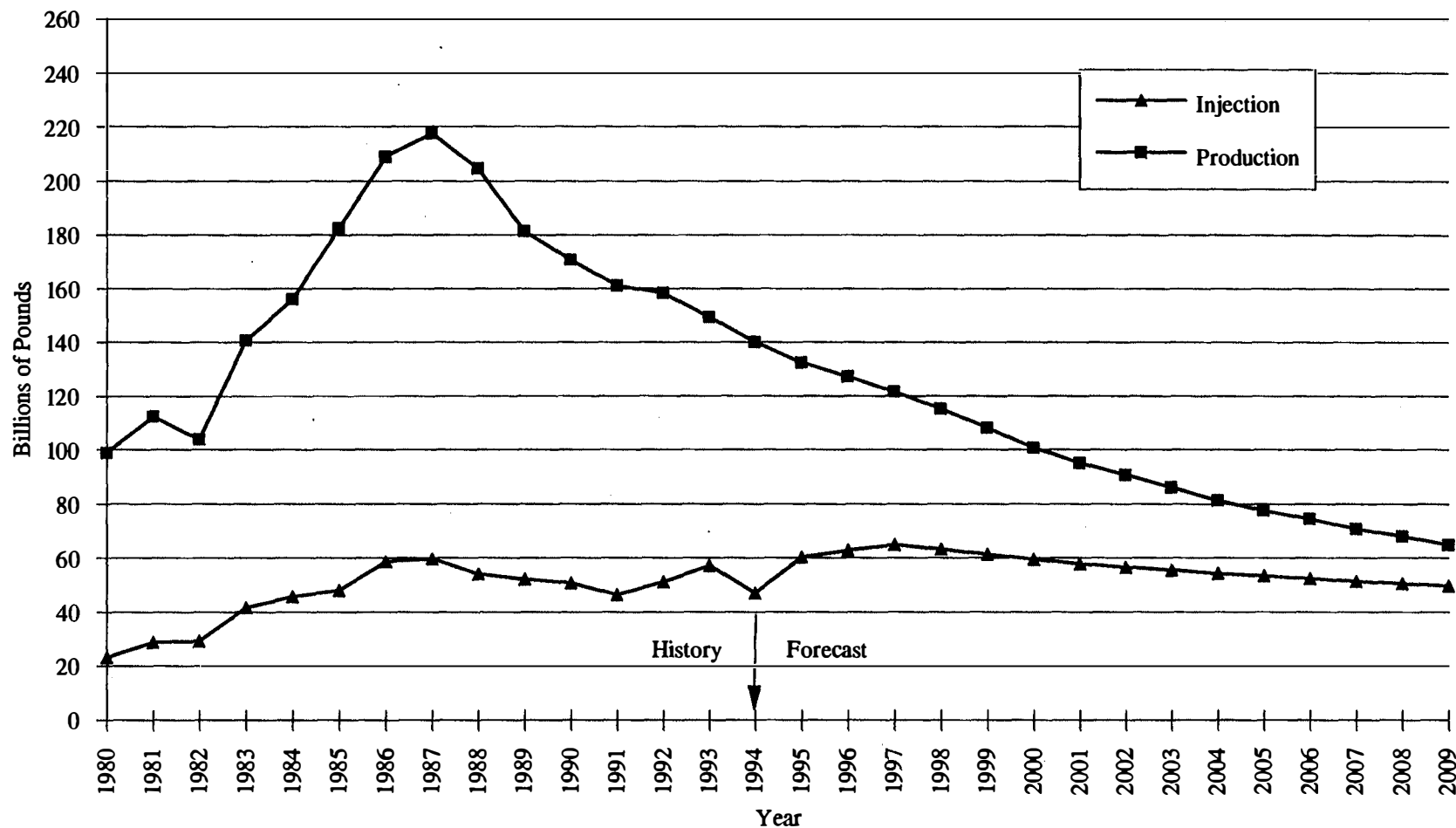
NCPA proposes to mix Lake County waste water with power plant condensate and distribute the resulting mixture to seven existing injection wells (A-1, C-11, F-1, J-6, Q-2, Y-4, and Y-5). The wells have been spaced to allow maximum flashing of injection fluids in the reservoir. The amount of water going into each injection well is determined by the operator on the basis of experience. In addition to the 7 existing wells, one E-site well and one at P-site, located in the eastern part of the lease, would be used as injection wells in the future.

In the Calpine area, power plant condensate is presently sent to four injection wells spread across Units 13 and 16. Three additional wells have been set aside for injection of Lake County wastewater. Calpine does not intend to mix the effluent water with steam condensate because of the incompatibility between the location of existing injection wells and planned future pipeline. However, in the future, Calpine may choose to construct additional pipelines and mix the Lake County waste water with steam condensate, to provide flexibility in its injection strategy.

The initial Calpine injection wells to receive project effluent are to be 956A-2, 958-5, and McKinley-3. Each of these three wells will accept approximately 600 gpm of waste water. All three effluent injection wells are located in the highly depleted segments of Units 13 and 16. As injectors, they should provide pressure support and additional injection-derived steam to the nearby production wells. Calpine has also designated McKinley-1, MLM-5, MLM-2, and MLM-1 to be used in the future as replacement effluent injection wells, although not initially.

Unocal plans to mix the effluent with steam condensate from the power plant and distribute the mixture to four injection wells (BEF42B-33, DV11, DV73-33, and GDC21). Production wells surrounding the four injection wells will be monitored, to help optimize the injection strategy. It is anticipated that the results from the monitoring program will lead to modifications of the injection program, including both the selection of the wells for injection and the rate of injection to those wells.

Figure 5.3.1-A portrays the forecast of production for the combined Calpine, NCPA, and Unocal wells associated with the project. The data indicate a continuing decline in production but at



Source: NCPA, Calpine and Unocal, 1994

Figure 5.3.1-A
History and Forecast of Production and Injection in the Southeast Geysers Effluent Pipeline Project Area
 Combine Annual Totals of NCPA, Calpine and Unocal Operations at The Geysers
 for NCPA Plants #1 and 2 and PG&E Units #13, 16, 18 and 20

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substantially diminished rate compared to conditions that would occur without the project (see Section 6, No Action Alternative). This is because injection fluids from other sources would continue to decline over the life of the project while the volume of injection fluid from the project would be constant.

Because of the large number of production wells, the area bordering the Unocal, Calpine and NCPA leases will probably continue to be the pressure sink for the Southeast Geysers. Even though the amount of water injected into this part of the reservoir will be more than doubled with the addition of Lake County wastewater, the overall production rate still will be significantly larger than the injection rate. Additionally, to avoid the potential problem of having unflashed effluent in communication with steam production wells, the injection fluid will be sent to several injection wells spread throughout the area, with each accepting only a portion of injection water. Thus it is likely that the decline rate seen in the production wells in the vicinity of injection wells will be substantially diminished, but not entirely arrested. Additionally, because the decline in pressure will not be eliminated, the LPA will remain spatially unchanged in the future.

Although the injection water would be spread throughout the reservoir, the area which will receive the most beneficial effect is the LPA. Being the lowest point in terms of reservoir pressure, this area will draw most of the injected water. Because there is a high degree of superheat in this area, most of the injectate will be flashed into steam before reaching the production wells. The area surrounding the LPA will receive some beneficial effect of the augmented injectate, but to a lesser degree, because of its higher reservoir pressure and lower level of superheat as compared to the LPA.

With the addition of injection fluids, the radius of injection influence will spread out. However, this will not occur in direct proportion to the injection rate. That is, the area influenced by injection will not be doubled when the rate of injection is doubled. The present high degree of superheat in the LPA will facilitate the flashing of injection water in the vicinity of injection wells. Also, because of the large number of production wells in the area, injection-derived steam will be extracted quickly. Thus, it is not likely that the area affected by injection will increase substantially.

No mitigation is required.

Impact 5.3.1.3. The proposed injection of effluent would be compatible with the chemistry of reservoir geothermal fluids and, therefore, would not have significant adverse impacts on geothermal field and power plant operations.

The potential chemical effects of injection, and attendant effects on the physical condition of the reservoir, can include:

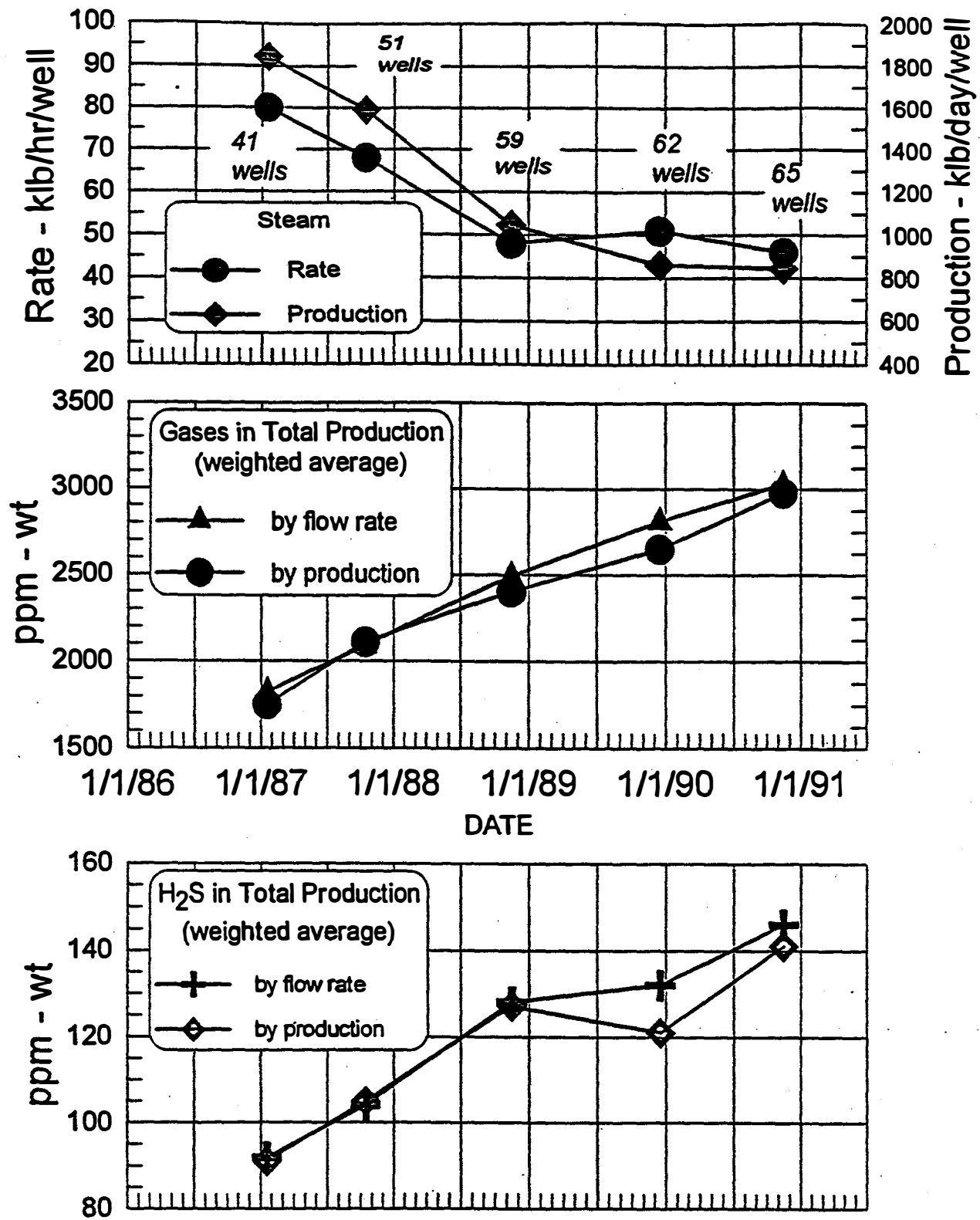
- dilution of non-condensable gases (NCG) in produced steam;
- local enhancement of reservoir porosity/permeability as a result of solution of the rock minerals by the injection fluids; and
- local loss of porosity/permeability as the injection fluids deposit scale or react with rock minerals.

Dilution of NCG

As noted in Section 4.15, tracer data indicate that the current production of steam in the Southeast Geysers now includes injection-derived steam (IDS) at a rate equivalent to the current injection rate. Because injection now totals about 30% of production, and because the injection fluid is essentially gas-free, it can be concluded that the concentration of NCG in production is now diluted on average by 30%, below what it would be if there were no IDS component in production. For example, at the end of 1990, the NCPA wellfield produced steam with an average of 3,000 ppm-wt NCG (Figure 5.3.1-B). The 1990 trend projects to about 3,300 ppm-wt early in 1993, and this value is probably 30% smaller than it would be were IDS not present. The pipeline effluent also will be essentially gas-free, and would contribute further to this dilution, at a rate approximately proportional to the percentage of injectate represented by pipeline effluent. (See also Section 5.4.4, Air Quality.)

Effects on Permeability

Creecraft and Koenig (1989) used a computer to calculate the potential for scale deposition and mineral dissolution caused by (a proposal for) injecting treated wastewater from the City of Santa Rosa into The Geysers reservoir. The Santa Rosa wastewater composition is given in Table 5.3.1-1, for comparison with the composition of the Lake County water now proposed for injection. As the composition of Lake County and Santa Rosa waters are nearly identical, the work by Creecraft and Koenig (1989) can be applied to the proposed project. They also modeled



SOURCE: GeothermEx, Inc.

Figure 5.3.1-B
NCPA wellfield, average gases in total production

TABLE 5.3.1-1: ESTIMATES OF INJECTION WATER QUALITY (a)

Water Quality Parameter	1995 Conditions			2023 Conditions			Santa Rosa Wastewater (modeled by Crecraft and Koenig, 1989; table 1)
	Lake	WWTP Effluent	Combined (Typical) (b)	Lake	WWTP Effluent	Combined (Typical) (b)	
Flow, MGC	3.38	1.84	5.22	1.75	3.61	5.36	
Temp, °C	6-28	6-26	6.26	6-28	6-26	6-26	
pH	7-9.3 (7.6)	6.5-8.5 (8.2)	7.9	7-9.3	6.5-8.5	8.1	7.5
Alkalinity, Mg/l CaCO ₃	67-170 (107)	170-240 (168)	143	67-170	170-240	175	139
Hardness, mg/l CaCO ₃	94-170 (120)	150-190 (168)	137	94-170	150-190	152	150
Spec. Cond. m mhos/cm	69-364 (270)	600-750 (653)	405	69-364	600-750	528	
TDS, mg/l	134-390 (152)	348-390 (369)	228	134-190	348-390	298	400
Total Salts, mg/l	140-260 (203)	500-600 (549)	325	140-260	500-600	436	386 (sum)
Dissolved O ₂ , mg/l	0.1-17 (7.9)	1-10 (6)	7.2	0.1-17	1-10	6.6	
Calcium, mg/l	16-33 (22)	30-40 (32)	26	16-33	30-40	29	32
Magnesium, mg/l	12-21 (16)	20-25 (21)	18	12-21	20-25	19	17
Bicarbonate, mg/l	80-210 (130.5)	210-290 (250)	173	80-210	210-290	211	170
Bod, mg/l	3-9 (6)	10-30 (20)	11	3-9	10-30	15	
SS, mg/l	5-50 (20)	10-30 (20)	20	5-50	10-30	20	4
Silica, mg/l	14	Unknown	14	14	Unknown	14	14

(a) Based on flow projections from combined sources presented on attached sheet and on existing available quality data provided by Lake County.

(b) Typical quality of blended effluent and lake water supplies proposed for injection.

SOURCE: GeothermEx, Inc.

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the injection of four Geysers steam condensate samples, local creek water, and mixtures of Santa Rosa wastewater with these other fluid types.

Their calculations considered the effect of heating the injected water in reservoir rock to 240°C without boiling, and found in all cases a net increase of porosity. This happens because the volume of quartz dissolved would exceed the volume of other mineral precipitates. The major precipitate from the wastewater would be 100 ppm-wt of dolomite ($\text{CaMg}(\text{CO}_3)_2$); 2 ppm-wt of anhydrite (CaSO_4) also would form, and mixtures of the wastewater with condensate could form additional traces of hematite (Fe_2O_3) and a hydrous magnesium silicate mineral. The majority of the carbonate deposition would occur during early heating of the liquid, whereas quartz dissolution would occur at higher temperatures. It is possible that a mixture of calcite (CaCO_3) and magnesite (MgCO_3) would form instead of dolomite.

As noted by Crecraft and Koenig (1989), their model is a highly simplified system, and did not calculate the effects of constant flow-through, boiling, and reaction rates in relation to the rate at which the injected water heats up. They considered these and other limitations in the context of a conceptual model of interaction of the injected water and the steam reservoir.

According to this conceptual model (Figure 5.3.1-C), there is no significant heating or mineral deposition in the injection wellbore. This probably is not true when injection starts, because dolomite can form very rapidly at about 100°C. However, cooling of the wellbore during injection should be rapid, and any carbonate mineral which is deposited should re-dissolve. Deposits can also be removed with acid, or by mechanical reaming of the well, although this is not anticipated for this project. In the past, mineral scale deposition in injection wells has not been a problem in The Geysers.

Leaving the wellbore, the injected liquid flows downward. The immediate vicinity of the wellbore is a zone of conductive heating. The conductive heating process initially may cause chemical interactions, but this effect decreases as the rock cools. Therefore, the zone of carbonate precipitation and quartz dissolution tends to migrate outward from the injection well over time. The further it moves, the less likely is any effect on the well's ability to transfer injection fluids, because the chemical interactions occur through a larger and larger volume of rock.

Treated Waste Water Injection

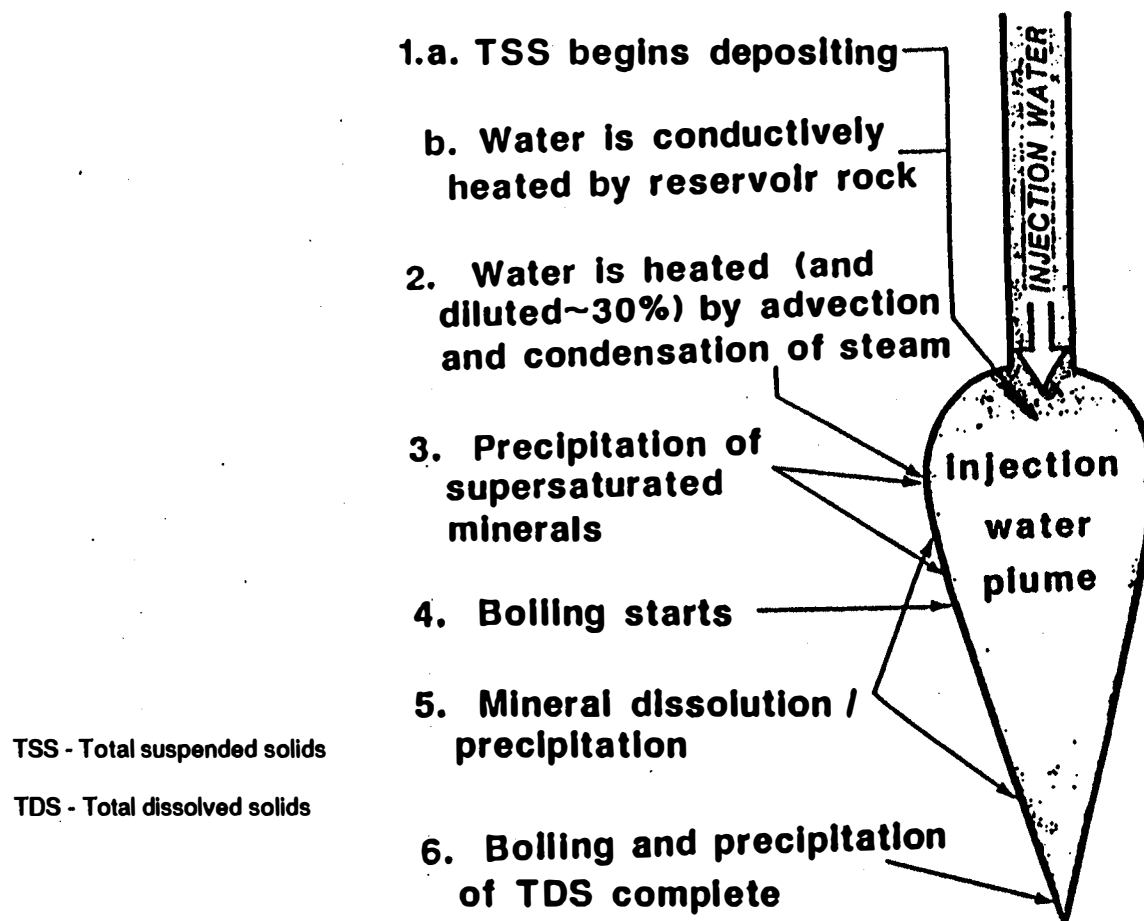


Figure 5.3.1-C: Conceptual Model of Injection Water-Stream Reservoir Interaction

Note: The stages of interaction are outlined below. Steam advection to the liquid-stream interface causes very rapid heating at the interface. Consequently, precipitation and dissolution reactions are expected to occur near the interface, possibly very close to the wellbore.

SOURCE: Graphic as reproduced by GeothermEx, Inc.

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At the liquid-steam interface of the injection fluid plume, initially cool liquid acts as a pressure sink because of its low vapor-saturation pressure. Reduced pressure draws local steam towards the plume, where it condenses. The condensation contributes to a nearly instantaneous heating of the liquid plume near the steam interface to the boiling point for local reservoir pressure. A pronounced decrease in viscosity upon heating causes hot liquid near the surface of the plume to flow downward much faster than the cooler, more-viscous liquid inside. This promotes a continuous exposure of cooler liquid to steam, with a consequent heating, vaporization, and mixing of new steam with pre-existing steam.

Boiling of the liquid at 240C requires 2.5 times the heat required to bring it to that temperature, and this additional heating must come by conduction from the reservoir rocks. As a result, boiling would seem to occur relatively slowly, and at a significant and ever-increasing distance from the wellbore. The vicinity of the plume-steam interface would be zoned roughly, with an interior region of carbonate deposition (at lower temperature), an intermediate zone of quartz dissolution (at higher temperature), and an outer zone of complete deposition of all solutes (including quartz) are deposited, because the liquid vaporizes.

These mechanisms are too complex to allow any meaningful speculation regarding the net quantitative effect on reservoir injectivity and permeability. This is particularly true when it is considered that the real reservoir, dominated by fracture permeability, is probably even more heterogeneous than envisioned above. However, there is no evidence from experience elsewhere to suggest that the wastewater injection will have a permanent detrimental effect on the reservoir, or that any effects that do occur cannot be managed. The already ongoing injection of condensate has the same potential to mobilize quartz from a zone of dissolution to a zone of deposition as that described above. Nonetheless, no problems have occurred, perhaps because the injection fluids flow mostly through fractures and actually contact a limited amount of quartz.

Carbonate deposition, and the eventual deposition (upon boiling) of all dissolved and suspended salts and solids is more problematic, because the fluid supply is continuous. Theoretically, at the scaling rate of 100 ppm-wt, the 5.36 mgd injection flow in the year 2023 (Table 5.3.1-1) will produce about 250 cubic meters per year (m^3/yr) of dolomite. The deposition of all salts at a theoretical concentration of about 400 ppm-wt will amount to roughly 1,000 m^3/yr . If the flowrate into a single injection well is assumed to be 1,000 gpm (1.44 mgd), the total deposition near that well will be about 270 m^3/yr . Injection experience to date at the Southeast Geysers

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suggests that injected water vaporizes completely within about 300 ft of the wellbore. If all vaporization occurs within a 1,000-foot-tall cylinder of 300-foot radius, having 5% porosity, the pore volume theoretically available is $4 \times 10^5 \text{ m}^3$. At a deposition rate of $270 \text{ m}^3/\text{yr}$, this pore volume would fill up in 1,500 years, assuming an unlimited supply of heat were present to vaporize the injection fluids. In reality, cooling of the entire rock mass in the cylinder probably would become significant long before 1,500 years had elapsed.

While illustrative of possible conditions in the reservoir during injection, calculations such as the above are purely theoretical. Salts deposition (including carbonate) is not likely to be uniform within the pore volume near the injection well. This is because the heating and boiling front moves outward from the well over time. As a result, the salinity of water near the boiling front should increase progressively, as the deposited salts are redissolved and mobilized forward. Similarly, the mass of salt deposited per kilogram of steam formed at the boiling front should increase steadily. At some point in time, the salt build-up is likely to interfere with liquid movement, but the timing and severity of the effect is not subject to a reliable prediction.

No mitigation is required.

Other Effects

Three other possible effects of injection are: 1) silicate deposits fed by the addition of Clear Lake diatoms to the 14 ppm-wt dissolved SiO_2 ; 2) biological growths downhole allowed by cooling and a feed of effluent organics and nutrients, and; 3) corrosion.

Data to evaluate the effects of diatoms or biological growth are not available. An evaluation probably would be highly speculative and difficult to rank in relation to the other effects discussed above. The effluent will certainly be somewhat corrosive because of dissolved oxygen (DO). DO also is present in injection fluids currently used in The Geysers. If corrosion proves to be a problem, the effluent may require treatment by addition of an oxygen scavenger to the injection fluid. This is considered an operational consideration rather than a significant source of impact on the reservoir.

The injected pipeline water is unlikely to have any significant impact on emissions to the atmosphere or on power plant operations, except that injection-derived steam will continue to dilute the NCG in the reservoir steam (see above). This will result in a trend towards lower NCG

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would be the case without the added injection. The generation of hazardous wastes (from abatement) may also be reduced, on a per megaWatt basis. These are considered beneficial impacts of the project.

Traces of organic chemicals have been reported from at least one sample of Lakeport water plant effluent (Alpha Labs, sample 89-1122-12-1, dated 26 December 1989, showing 28 gm/l chloroform and 0.8 gm/l bromodichloromethane). It is not known if such reports are reliable or representative of the wastewater from the SERWP in the future. However, proposed pipeline injection fluid would be diluted with make-up water drawn from Clear Lake and, therefore, the concentrations of chloroform and bromodichloromethane probably would be less. No information is available on the thermal stability of these substances.

No mitigation is required.

5.3.2 INDUCED SEISMICITY

IMPACT SIGNIFICANCE CRITERIA

Under Appendix G (r) of the CEQA Guidelines, a project would have a significant impact if it would expose people or structures to major geologic hazards. For purposes of the present analysis, the project would have a significant effect if injection of effluent and the resultant steam production were to result in substantially increased hazards to people or to cause damage to structures from induced earthquakes.

Impact 5.3.2.1. The project would result in increased microseismicity in the project area and vicinity, but probably would not induce larger earthquakes that pose a substantial threat to public safety and substantial damage to structures. The impact is regarded as less than significant.

The determination of the impact is based on evidence about the effects of geothermal steam production and injection in other parts of The Geysers. Available data suggest that induced seismicity at the GGF is caused both by production and injection of geothermal fluid, which perturb the natural stress regime and/or rock strength, triggering numerous small earthquakes. Production appears to be a significant cause of shallow seismicity (above a depth of around 1.2 km subsea), whereas injection appears as the main trigger for deeper events.

Studies of Induced Seismicity in The Geysers

The effects of injection and production on seismicity have been the subject of investigation for about a dozen years. Much of the best information has been developed in the Northwest and Central Geysers and is summarized here.

Bufe and Ludwin (1980) were the first investigators to document features of seismicity in the GGF over a long period of time, the eight-year period from January 1972 to April 1980. Their work related the hypocenter locations of thousands of seismic events to steam pressure conditions and to the location of production and injection wells. They examined the temporal variations and spatial clustering of seismicity, and related these to the onset of production at two power plants. They also investigated faulting mechanisms and estimated the deformation accompanying the seismic events of the GGF. Their study reached several significant conclusions:

- 1) Two clusters of seismicity persisted through the period 1975-1980. These coincided with the most heavily exploited area of the steam field (that is, the Northwest and Central Geysers). Focal depths ranged from near-surface to 5 km (16,000 feet). Steam production and seismicity are spatially correlated.
- 2) The two largest earthquakes between May 1975 and December 1978 had Mc 3.1 (22 December 1976) and 3.3 (22 September 1977) and were centered near two injection wells (DX-7 and LF-3) that were most distant from production wells. This suggested a link between fluid injection and larger seismic events (that is, events greater than microseismic events).
- 3) Initiation of steam production for Unit 15 in June 1979 was attended by an increase in seismicity within two weeks. This seismic activity appeared in a tight cluster about 0.5 km north of injection well PEC A-6. The area had previously displayed very few earthquakes. Also, a previously aseismic area became active soon after the start-up of Unit 15 in 1979.
- 4) Between 1972 and 1977, the size of the largest annual events increased from Mc 3.1 to Mc 3.8, paralleling the increase of steam production.
- 5) The data indicate great heterogeneity in the local stress field. However, the orientation of the maximum and minimum horizontal compressive stress averaged NNE and WNW, respectively, in accord with the regional pattern.

Many of these conclusions were repeated in a publication of Bufe and others (1981). In 1984, a major study was published by Eberhart-Phillips and Oppenheimer, based on data for 7,215 earthquakes recorded during May 1975-February 1982. They concluded the following:

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- 1) Based upon spatial and temporal relationships between production and injection wells and attendant mass flows, seismicity at the GGF is induced by geothermal production activities.
- 2) A significant clustering of events near production wells is apparent, but was not revealed in earlier studies. All clusters are within or below production areas, but not all wells have nearby earthquake clusters. Earthquakes are deepest in the areas of oldest production. Also, aseismic areas within the GGF correlate with the local absence of geothermal production.
- 3) The sharp southwestern boundary of seismicity appears to be structurally controlled by the northeast-dipping Mercuryville thrust fault.
- 4) With the increase of power production by some 70% in 1979-1980, seismicity has developed near the newly producing areas.
- 5) Statistical cross-correlations for several wells between monthly numbers of events and monthly volumes of steam produced and fluid injected revealed no consistent correlation between injection and seismicity. Nor was there consistent correlation between steam withdrawal and seismicity for wells in production longer than 7 years.
- 6) Seismicity occurs on rock fractures whose length is less than 1 km, and seismicity is more-or-less continuous in time. That is, seismicity is not time-clustered in "swarms".

The cross-correlations of monthly injection volumes with monthly local seismicity for seven wells, presented by Eberhart-Phillips and Oppenheimer (1984), have been reviewed by the GeothermEx for this EIR/EIS. GeothermEx found that for three of the injectors (DX8, HJ9, and GDC5313), significant correlation exists between injection and seismicity. The fact that the other four injectors do not show such correlation may be influenced by the manner in which the space volumes were defined for selecting events for correlation (that is, conceptual "cylinders" in the rock including epicenters within 1 km of wellheads and all focal depths). It now appears that the clustering of events near injection wells is more evident for depths greater than about 2 km (Stark, 1990).

Oppenheimer (1986) made some observations which are noted here. (1) For the entire GGF during the period 1976-1984, the annual numbers of events with $M_c \geq 1.2$ are well correlated with the annual mass of steam withdrawn. (2) Earthquake mechanisms are highly variable over short distances, exhibiting no spatial consistency (as had been noted by Bufe and Ludwin, 1980), and they appear to occur on small, randomly oriented, preexisting rock fractures. Nonetheless, the tectonic stress field is consistent in orientation with regional strain, with the principal extension axis oriented at an azimuth of 105 (nearly east-southeast). However, geodetic surveys

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indicate that the strain field in the GGF differs greatly in quantity from regional strain: regional strain rates are 50 times smaller than in the GGF.

Stark, of Unocal Geothermal Division, reported in 1990 a correlation between injection and some of the deeper induced microearthquakes observed in Unocal's portion of the GGF. In this work, he utilized data principally obtained by Unocal's seismographic network at the GGF. Earthquake clusters associated with injection wells form a rough three-dimensional image of the injected liquid. Very importantly, he shows that the spatial correlation is more apparent in seismicity deeper than about 4,000 feet below sea level. Temporal correlation between the onset of injection and seismicity generally is clear, and has been observed in about 10 cases. These correlations are demonstrated for several injection wells. The case of well GDC-18 is especially interesting, because the CALNET hypocenters deeper than 3,000 feet below sea level also show an excellent spatial and temporal correlation with injection rate.

Some seismicity clusters extend rather far, as much as 4,000 feet, from injection wells. Isotopic analysis shows that the flashed injectate is "heavier" than the native steam/water in the rock, and that steam wells producing a significant percentage of "heavy" steam coincide with these extended earthquake clusters. Also, some of these clusters are found in zones where reservoir pressure is higher than in the nearby injectors. Stark (1990) concluded that this seismicity occurs where the injected water flows as a liquid driven by gravity or hydraulic pressure.

Stark pointed out that not all injection is accompanied by seismicity, and that some seismicity, especially the shallower events, does not correlate with injection.

Analysis of seismic event data suggests that the induced seismicity does not produce earthquakes of a magnitude greater than about M_c 4.6 (or, more meaningfully, M_l 4.2, based on the standard seismograph). In contrast, the regional seismicity within the GGF (caused only by regional tectonic stresses) may not be magnitude-limited. However, the apparent depth-limit of 6 km seen for induced seismicity in the GGF may also serve to limit the magnitudes of earthquakes resulting from regional stress within the GGF. By being magnitude-limited, the threat to public safety would be diminished. Earthquakes of M 4.5 or less do not cause damage because the duration of the strongest groundshaking is extremely brief, usually less than one to two seconds. The frequency of M_l 4.2 in The Geysers is once or perhaps twice in a 20 year period (GeothermEx, 1994).

Induced Seismicity in The Southeast Geysers

The central earthquake epicenter cluster at West Ford Flat (see Figure 4.15.2-F), which contains well over 230 events at focal depths ≥ 2 km, is flanked by two injection wells: TH-7(RD), on the east, and MCK-5, on the south. Monthly injection data were made available for wells TH-7(RD) and MCK-5 (Ali Khan, CDOG&GR, personal communication, March 1993; J. Beall, Calpine, personal communication, May 1993). The CDOG&GR data were checked against the Calpine data. The injection volumes given by CDOG&GR for TH-7(RD) may be too small; therefore, the Calpine data were utilized (J. Beall, personal communication, May 1993 for TH-7(RD)). Beall also pointed out that wells MCK-5 and TH-7(RD) together have been used for all injection within Unit 13.

Figure 5.3.2-A compares monthly counts of earthquakes within the cluster (depth 2 km), to a distance of 3,000 feet from MCK-5, with monthly fluid mass injected in well MCK-5. The entire history of injection in MCK-5 is shown, beginning early in 1980 and running through 1992. A rough correlation between injection and seismicity may be seen for the period 1980 to 1984.

The abrupt onset of injection in early 1980 was followed by the initiation of seismicity within three months. Injection was variable but had a relatively high average through 1983, and was accompanied by low-to-moderate seismicity. The three-month cessation of injection in MCK-5 early in 1984 followed by an abrupt resumption, appears to immediately precede the largest monthly number of events (10) in the search area.

In late 1984 to early 1985, average monthly injection declined, but seismicity continued at a moderate rate into early 1986, and then ceased until late in 1987. This 1.5 year-long cessation of seismicity may possibly have been the result of declining injection. Since 1988, the low level of continuing seismicity has exhibited no correlation with injection. However, that might be explained by the fact that injection was occurring only in relatively small amounts (from zero to less than 50,000 metric tons/month).

The distribution of magnitudes for events within 3,000 feet of MCK-5 and with depths ≥ 2 km is shown in Figure 5.3.2-B. Magnitude intervals plotted on the X-axis have a width of 0.2, and the numbers shown are the lower end of each interval. The figure shows that the preponderance of microearthquakes have magnitudes from 0.7 to 1.8.

5-12
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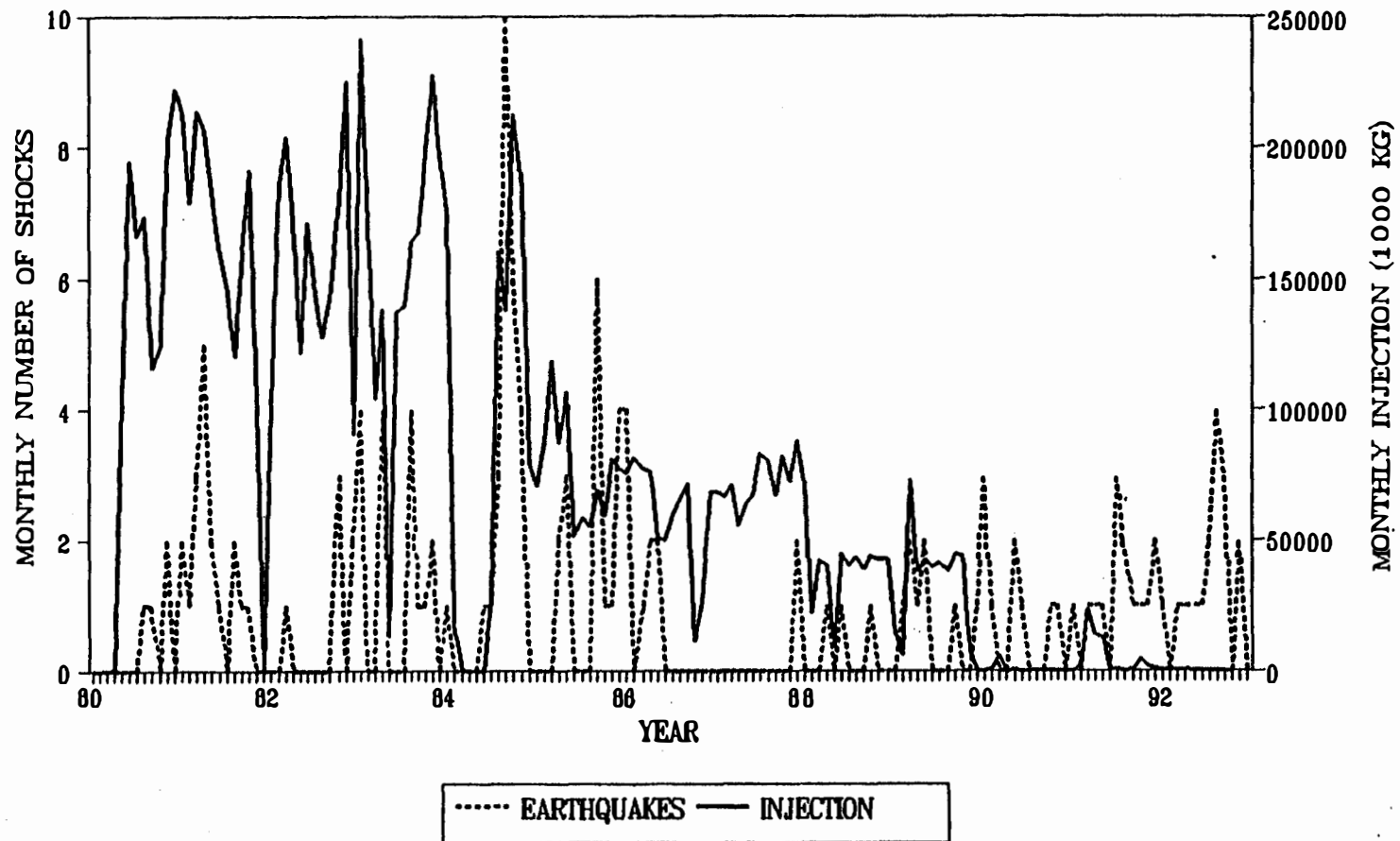


Figure 5.3.2-A: Comparison of monthly injection in well MCK-5 and earthquake frequency within 2000 feet of the well.

SOURCE: Graphics reproduced from GeothermEx, Inc.

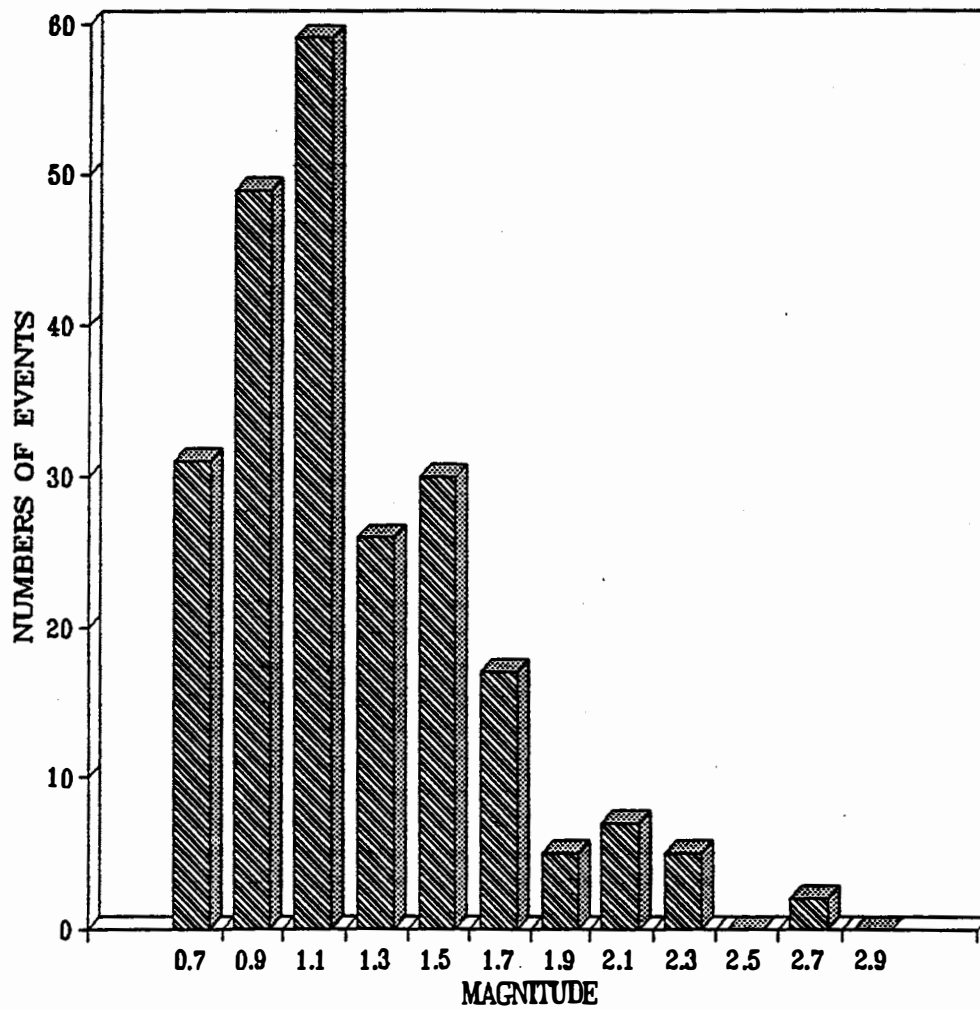


Figure 5.3.2-B: Distribution of event magnitudes, southeastern GGF, vicinity of well MCK-5. Depth $\geq$ 2km

SOURCE: Graphic as reproduced from GeothermEx, Inc.

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Figure 5.3.2-C compares injection in well TH-7(RD) with seismicity (focal depths ≥ 2 km) up to 2,000 feet to its west. No correlation is evident.

Within the area of Units 18 and 20, a distinct cluster of microseismicity may be seen to trend roughly north-south (see Figure 4.15.2-F). Unocal Geothermal Division provided data on the monthly water mass injected into four wells (GDC21, BEF42B33, DV73-33, and DV11) in proximity to this cluster, the wellbore traces of these wells, and a cross-section of earthquake hypocenters (from CALNET) in the cluster. Figure 5.3.2-D is a detailed map of epicenters of microearthquakes with depths ≥ 2 km, whose greatest magnitude was 2.0. The figure shows locations of three injection wells and their wellbore traces; also, the location of cross-section A-A' and related corridor. Well DV11 is not shown, as its documented injection extends for only three months beginning December 1993; also, the CALNET database for this study ends in March 1993. Figure 5.3.2-E is a cross-section (A-A'), provided by Unocal, showing hypocenters within the corridor shown in Figure 5.3.2-D, projected onto section line A-A'. It can be seen that hypocenters cluster rather tightly at elevations below -2,000 feet (ASL or MSL); -2,000 feet MSL is 1.4 km below land surface. Figure 5.3.2-D shows that the traces of wells GDC21 and BEF42B33 pass within 1,500 feet of the great majority of epicenters.

A comparison of microearthquake and injection data for wells GDC21 and BEF42B33 (Unit 20) is shown in Figure 5.3.2-F; well DV73-33 was not included because its wellbore is located much further from epicenters than those of the other two wells, and injection into it virtually ceased at the end of 1987. Epicenters selected for comparison lie within 3,000 feet of the wellheads of GDC21 and BEF42B33. It may be seen that microearthquake (event) frequency increased in the latter part of 1987 and continued into 1990: most months saw the occurrence of one to three events. It was in this period that the monthly mass injected into well GDC21 often exceeded 200,000 metric tons. In mid-1990, it appears that most injection was shifted from GDC21 over to BEF42B33, and event frequency dropped somewhat during late 1990. Then, after very early 1991, when monthly injection into BEF42B33 usually exceeded 200,000 metric tons, monthly event frequency rose again, peaking at 5 events in the fall of 1991.

Although a correlation of microearthquake frequency and mass injected into these two wells is suggested, it must be remembered that numerous production wells are positioned very near these injectors and the epicenter cluster. Thus, an unknown part of the correlation may be related to production. However, it may be concluded with some assurance that microearthquake frequency is correlated with geothermal production and injection combined.

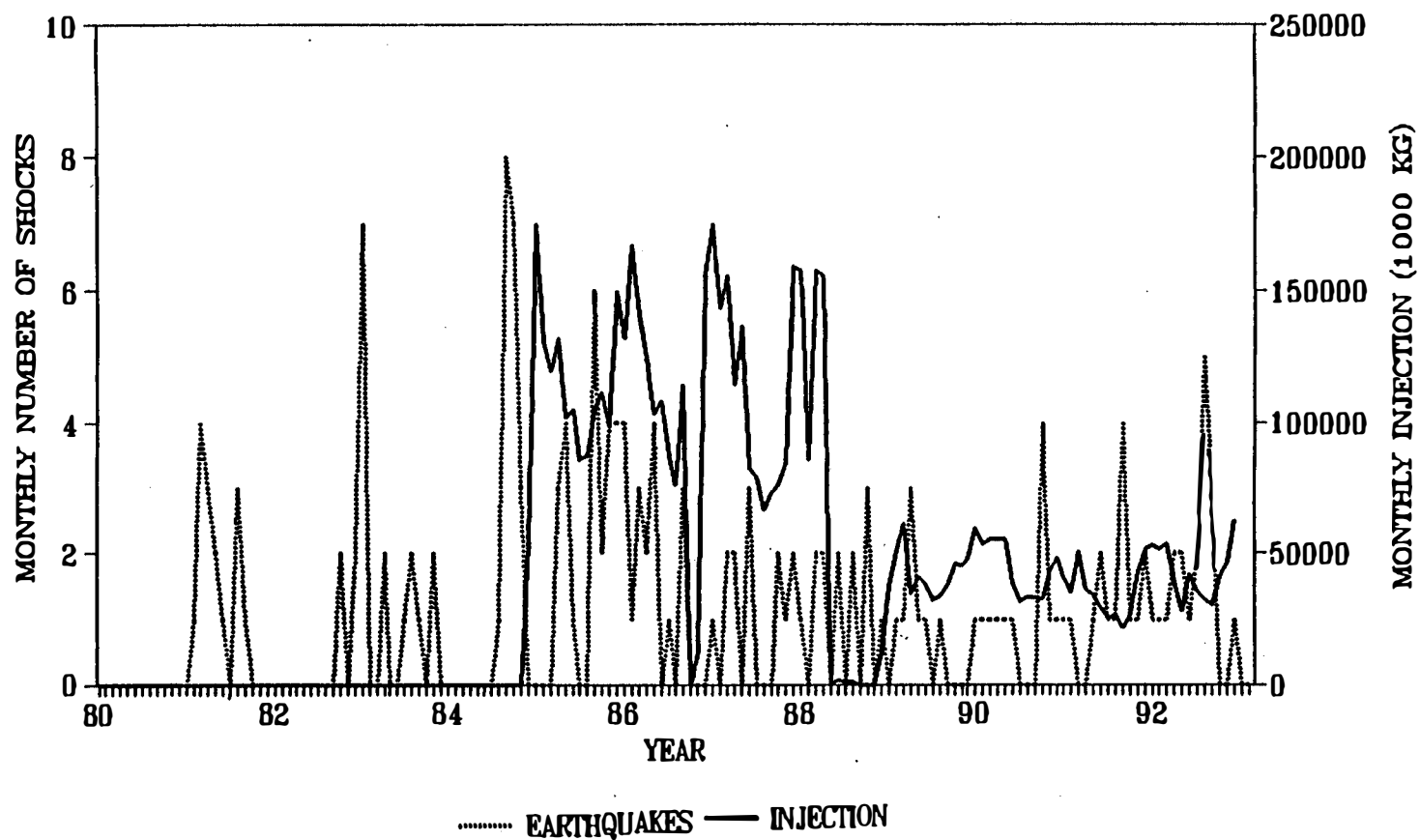
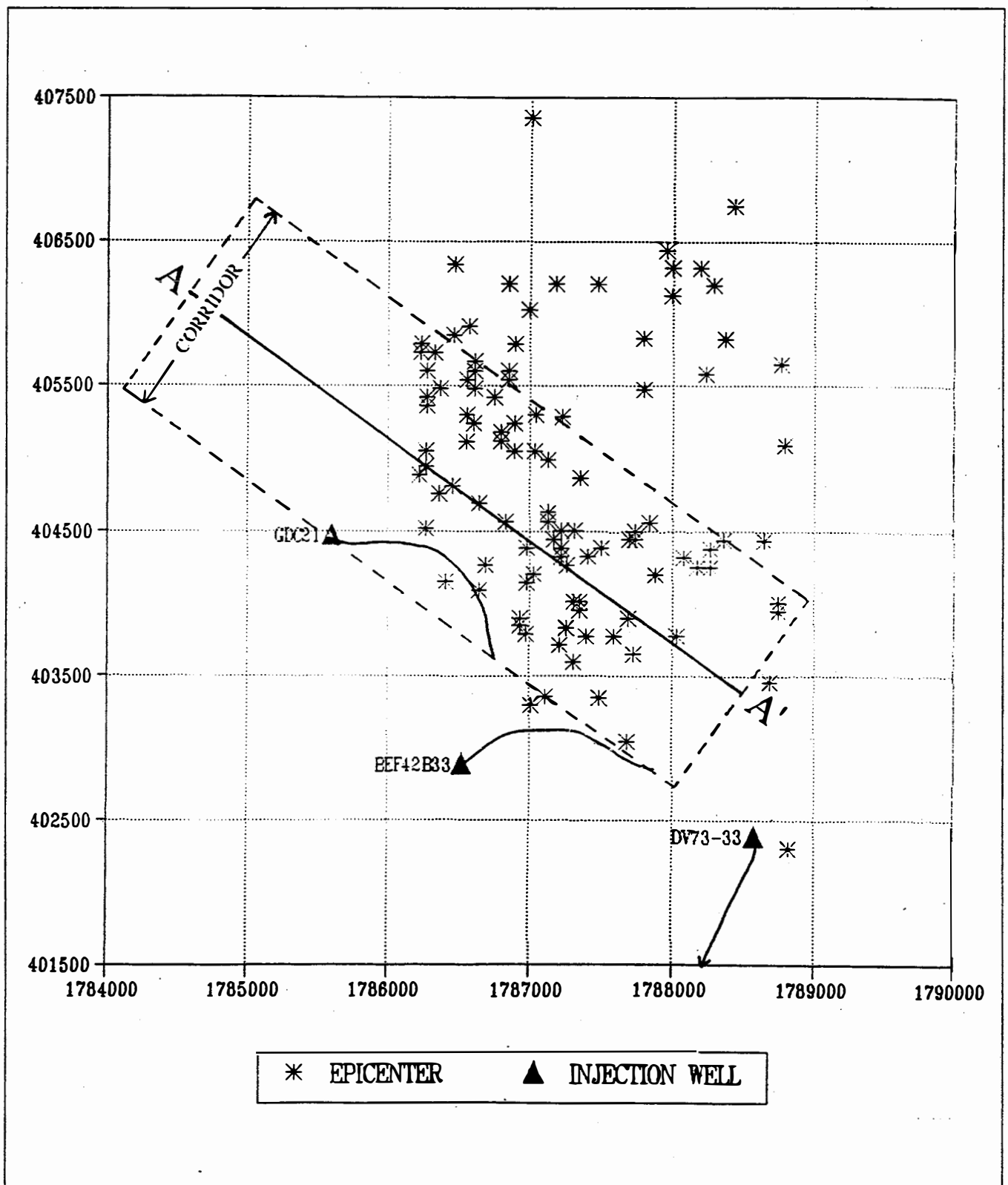


Figure 5.3.2-C: Comparison of monthly injection in well TH-7 (RD) and nearby earthquake frequency.

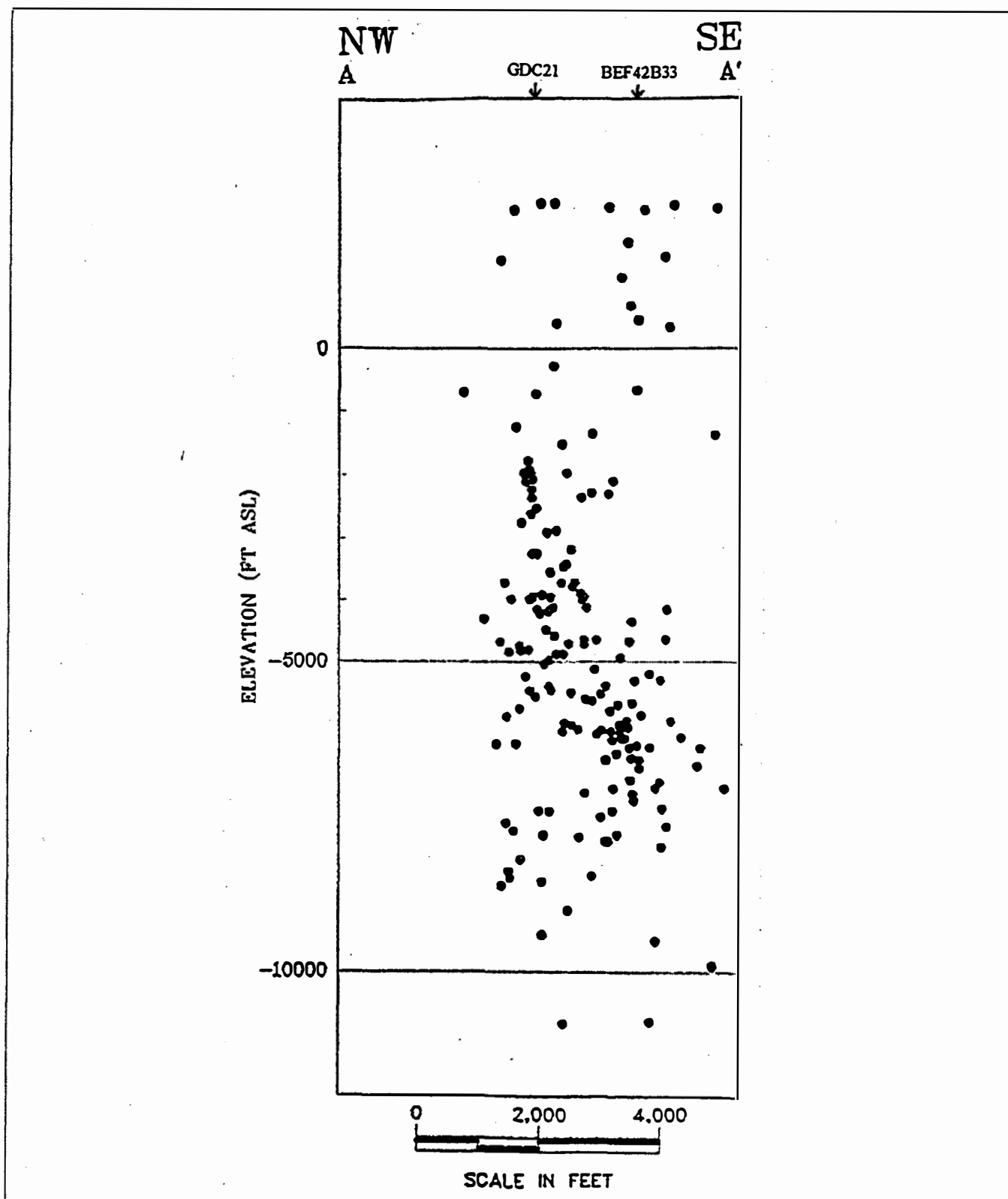
SOURCE: Graphic as reproduced from GeothennEx, Inc.



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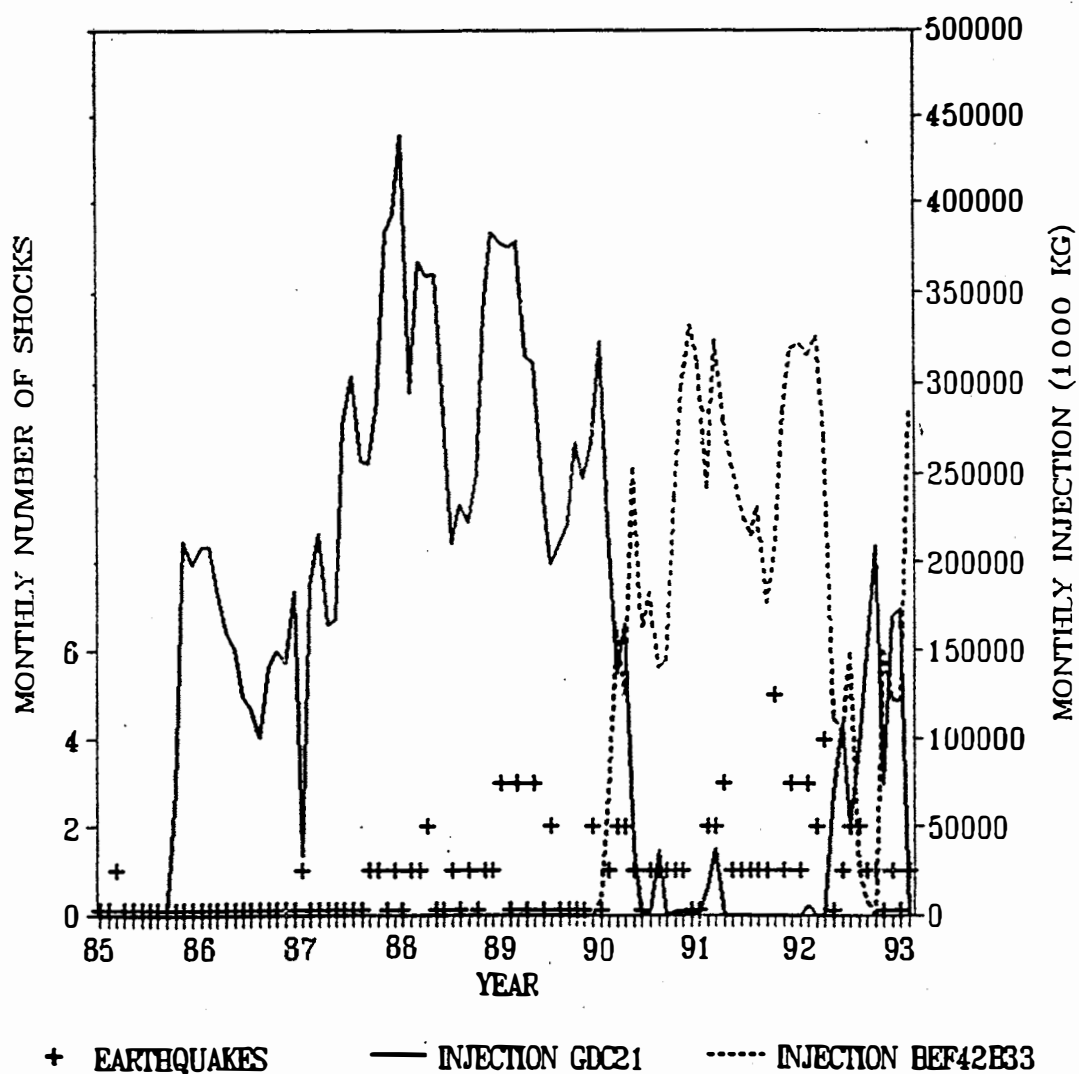
Figure 5.3.2-D
Epicenters of Microearthquakes (depth ≥ 2 km) and
Injection Wells, Area of Units 18 and 20.
(Also Shown is Location of Section A-A')



SOURCE: Graphic as reproduced from GeothermEx Inc., 1994

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Figure 5.3.2-E
 Cross-Section A-A': Microearthquake Hypocenters
 Near Well GDC21, Area of Unit 20



SOURCE: Graphic as reproduced from GeothermEx Inc., 1994

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Figure 5.3.2-F
Comparison of Monthly Injection in Wells GDC21 and BEF42B33 with Microearthquake Frequency (depth ≥ 2 km) within 3000 feet of the Wellheads

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Another injection well, 958-6, is located in the southeastern corner of Unit 16. Although large volumes have been injected into this well in every month (150,000 to over 200,000 metric tons per month) since mid-1986, only weak clustering of seismicity can be seen near it (Figure 4.15.2-F). However, it seems that seismicity in this area began to increase early in 1993 (J. Beall, Calpine, personal communication, May 1993).

Enezy and others (1993) documented the occurrence of microseismicity within NCPA operating area in the Southeast Geysers for the first six months of 1992. They noted its general spatial correlation with locations of five NCPA injection wells. They noted also that hypocenters rarely are deeper than the bottom of the wells' injection intervals. They interpreted this to mean that injectate is not migrating to greater depths within the reservoir.

The above analyses indicate that throughout The Geysers there appear to be direct relationships between increased seismicity with both production and injection, but that the details of those relationships are not necessarily consistent from area to area within the field. Smith et al. (1994) have suggested that geologic differences may help explain, at least in part, some of those differences in seismic response, such as the near absence of magnitude M_c 3.0 earthquakes in the Southeast Geysers. That near absence is in spite of the fact that for more than ten years the production and injection operations performed there have been at least as areally intensive as those being generally performed elsewhere in the field. Smith et al. (1994) also pointed out that the lower magnitudes of the seismic response in the Southeast Geysers is further illustrated by the fact that the spatial clustering of microseismic events near injection wells, quite easily observed elsewhere at The Geysers, is only distinguishable in the southern-most part of the field with the use of highly sensitive seismic arrays, those capable of detecting microseismic events of smaller magnitude than those being detected by the existing USGS network (as demonstrated by the absence of clustering in the southern half of Figure 4.15.2-D).

Mechanics of Induced Seismicity

Any attempt to draw a relationship between injection/production and seismicity in The Geysers is necessarily based on an understanding of the mechanics of induced seismicity.

A number of investigations, including those described in this EIR/EIS, have addressed the mechanics of induced seismicity in the GGF. The mechanics of induced seismicity are poorly understood at present. All proposed mechanisms involve a change in the response of reservoir

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rocks to the ambient tectonic stress and strain (deformation) fields. There is a presumption that the state of stress in reservoir rocks was quite near the failure condition, where seismicity activities can be easily triggered, prior to field development. All theories advanced address relationships between changes in effective and failure stresses across fractures, changes in reservoir pressure and temperature, and fluid volumes withdrawn or injected. These are discussed further in Appendix B.

Conclusion. Inducement of seismicity by injection of water clearly does occur in the GGF, although it is not the only mechanism. The investigations previously described indicate that production is also a cause of induced seismicity, but probably chiefly at relatively shallow depths. Stark (1990) determined that injection-related seismicity is most apparent at depths greater than about 4,000 feet below sea-level. The observations of seismicity drawn from studies in the Northwest and Central Geysers, suggest a strong relationship of injection and production activities to increased seismicity. This is revealed by a clustered pattern of seismic events in those areas. Additionally, the initiation of geothermal production has been followed by an increase in seismic events within a relatively short period. In the longer term (e.g., 8-10 years) there is a good correlation between the annual number of seismic events and the mass of steam withdrawn in production. These findings support the general observations and perceptions of local residents that more earthquakes have been occurring since geothermal development has occurred in The Geysers.

The patterns of seismicity in the Southeast Geysers are not as clear as those in the Northwest and Central Geysers. There is no apparent cluster of seismic events, although production and injection have been ongoing in the area during the same time period of the studies referenced for the Northwest and Central Geysers. Additionally, the relationship between injection and seismicity is not revealed in the consistent patterns at the wells, causing some geologists to suggest the possibility that the response of the local reservoir rocks to injection/production may be controlled by a local geology substantially different than that in the Northwest and Central Geysers.

The above considerations make it difficult to predict the effects of the project on seismicity in the Southeast Geysers. The evidence suggests that there is a good potential for the project on the whole and in the long term to increase seismic events. The evidence also suggests that if such effects do occur, they likely would become evident relatively soon after the initiation of enhanced injection. If increased seismicity may become evident, it may/may not be revealed in a well defined pattern (cluster) of seismicity in the Southeast Geysers.

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The evidence suggests that the effect of enhanced injection is likely to be primarily an increase in microseismicity, that is earthquakes below magnitude 3, which is the approximate lower limit for earthquakes felt by people. Additionally, the magnitude of earthquakes induced by the project probably would be no greater than Richter Magnitude 4.2. While larger magnitude earthquakes may occur from natural causes in the Southeast Geysers, there is no evidence at present that suggests they would be linked to injection/production activities. It is important to note that seismic events under M 4.5 do not cause damage to structures unless, perhaps, they are already in a weak condition. These felt earthquakes may contribute to general concern and feeling of unease among local residents about earthquakes. However, the frequency of earthquakes between M 3.0 and 4.2 is relatively small and assuredly many of these events are attributable to natural, regional earthquakes. A frequency of Richter Magnitude 4.2 from The Geysers source area would likely occur once or perhaps twice during the design life of the project.

As microseismicity does not pose a public safety hazard or contribute significantly to property damage, no mitigation is required.

Impact 5.3.2.2. The project probably would not result in significantly increased hazards of major earthquakes, but project-related induced seismicity potentially could contribute to minor local property damage, e.g., cosmetic cracks in plaster and stucco. The impact is regarded as being less than significant.

As noted in Impact 5.3.2.1, microseismicity impacts are likely to result from the project. However, the apparent depth-limit of 6 km seen for induced seismicity in the GGF may also serve to limit the magnitudes of earthquakes resulting from regional stress within the GGF. The effects of a given earthquake originating in The Geysers above the 6 km depth are difficult to attribute to a specific natural or induced cause. The assessment of the degree to which seismicity in The Geysers would contribute to major earthquake hazards can be approached only through statistical analyses.

Deterministic Ground Shaking

Capable regional faults and seismicity are described in Section 4.15.2.3, and fault attributes relevant to seismic hazard are summarized in Table 4.15.2-1. The faults described therein are the source of seismic hazards discussed here.

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The simplest analysis and description of earthquake hazard employs deterministic methods. In this, maximum credible earthquakes (MCE) are ascribed to capable faults. Then using well accepted, empirical ground-motion attenuation functions, the peak ground acceleration or Modified Mercalli intensity may be calculated for the site of interest (in this case, Anderson Springs). Peak ground accelerations were calculated according to Joyner and Boore (1980); intensities are according to Krinitzky and Chang (1988), for sites resting on bedrock or thin, firm, dry alluvial cover ("hard" sites).

The deterministic approach has the disadvantage that it does not discriminate between events that are more likely and ones that are less likely to occur. Therefore, the impact of nearby faults with low activity may be much greater than that of distant faults with high activity. The importance of this relationship is described next.

Table 4.15.2-1 indicates the maximum credible earthquake (MCE) on the active San Andreas fault Ms 8.25 (Ms is surface-wave magnitude). This magnitude can produce a peak ground acceleration of 0.14 g (intensity VI) at Anderson Springs. A MCE on the active Rodgers Creek-Maacama fault zone (Ms 7.5) can produce peak ground acceleration of 0.38 g (intensity low-VIII). An MCE on the Collayomi fault (Ml 6.5), which is much closer than the first two but is relatively inactive, can produce a peak ground acceleration of 0.50 g (intensity VIII).

In the next 100 years, a large earthquake (Ms 7 to 8) on the northern San Andreas fault is considered probable (better than even odds), but only somewhat likely (better than 25% chance) on the Rodgers Creek-Maacama fault. Thus, a peak ground acceleration at Anderson Springs of 0.10 g (intensity VI) is likely to occur, whereas a peak ground acceleration exceeding 0.30 g (intensity VII) has a fair chance of occurrence. A peak ground acceleration of nearly 0.50 g, accompanying a Ml 6.5 on the Collayomi fault has a low probability. Yet, the deterministic approach finds that the maximum credible earthquake ground motion at Anderson Springs is 0.50 g (intensity VIII), based upon the (improbable) occurrence of an MCE on the Collayomi fault.

The levels of ground shaking described for Anderson Springs also characterize the valley of Putah Creek running northwestward to Cobb Mountain, due to geographic positions of the faults with respect to this valley.

As noted, the maximum historic intensity experienced in the study area is estimated to be VI, for the 1906 earthquake on the San Andreas fault. Nearby, in the southern Clear Lake basin, earthquakes of $M_I \geq 4$ have produced local intensities as large as VI. Maximum intensity has not been reported for the study area arising from events located within the GGF. However, it is estimated at V, based upon maximum reported magnitudes M_I 4.0- 4.2.

Probabilistic Ground-Shaking Hazard

Probabilistic analysis of earthquake hazard for a given site incorporates the estimated activity rates of the faults that would cause damaging ground motion. Importantly, it also includes the statistical uncertainty function. Therefore, the probabilistic approach reflects reality much better than the deterministic method. The results of such an analysis, preferred by GeothermEx, Inc., are presented as probability-of-exceedance curve(s) for peak ground accelerations over given exposure-time interval(s). The user of this information may then determine a site's peak ground acceleration for a chosen risk-level. Typically, one plots a peak ground acceleration curve for a 30- or 50-year period.

Usually the analysis is completely non-historical in nature: anticipated earthquake cycles and present-day positions in those cycles (based on earthquake history) are not used. Rather, earthquakes are presumed to have completely random distributions in time and position along the fault. Hence, the exposure interval is non-historical; that is, it represents a randomly selected period with no particular position in historical time.

This approach is appropriate when seismic cycles are completely unknown for the nearest faults which produce the greatest site ground motion; such is the case in the present study. The method of analysis incorporates identifying an earthquake source (faultline or area) in terms of its magnitude-vs-frequency relationship and defining its maximum credible earthquake (MCE) magnitude. The analysis for the EIR/EIS included the San Andreas fault (in Northern California), Rodgers Creek-Maacama fault, Green Valley-Bartlett Springs fault, Collayomi fault, Knoch Bay fault and Big Valley fault. The Geysers was selected also as an area source. The geometric relationships (distances) of each source were defined with respect to Anderson Springs.

Next, the theoretical probability of exceeding each test-peak ground acceleration-level at the site for each magnitude interval is evaluated, beginning with M 4.5. An attenuation function is

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assigned in order to define for each source the probability distribution of PGA vs. magnitude at Anderson Springs. A minimum magnitude of 4.5 is used, in order to eliminate the effect of smaller nearby earthquakes which may produce site accelerations over 0.10 g but which are not capable of causing significant damage (intensity VII or more). The reason that events smaller than M 4.5 do not cause damage is that the duration of strongest shaking is extremely brief, usually less than one or two seconds.

For each source, the seismicity data together with the probability values were used to compute the annual rate of exceedance (number per year) and probability of exceedance of peak ground accelerations for Anderson Springs. These were then statistically combined to provide a summary depiction of the probability of exceedance (expressed as a percentage) for the various peak ground accelerations at Anderson Springs. These are presented in Figure 5.3.2-G.

As a general matter, earthquake hazard is nil for events with $M_l < 4.5$; but, for the GGF, information is lacking for $M_l \geq 4.2$. Seismicity for the GGF in the range $M_l 4.2-4.5$, and up to $M_l 5.25$, is based on a predicted value (the average of the two slopes [b-value] of the line shown in Figure 4.15.2-C). The frequency of $M_l 4.2$ is once or perhaps twice in 20 years. The estimated MCE in the Geysers is 5.25 (GeothermEx, 1994).

Induced seismicity in the GGF is presumed to be driven fundamentally by regional tectonic stresses, triggered by local perturbations of the stress field or changes in rock fracture strength as a result of fluid injection or withdrawal.

Three probability-of-exceedance curves for peak ground acceleration of a 30-year period are plotted for Anderson Springs in Figure 5.3.2-G. One curve shows the effect of the GGF seismic area alone; the second shows the effect of all regional faults, and the third curve shows the effect of the GGF and all regional faults (the total model). Although these results were computed specifically for Anderson Springs, the geometric distribution of faults relative to the GGF source area is such that any point in the Putah Creek valley (northward to Cobb Mountain) will be subject to much the same earthquake hazard as Anderson Springs. That is, the Modified Mercalli Intensity will vary by less than one unit, and peak ground acceleration will vary less than 0.05g, given the same site soil condition.

In Figure 5.3.2-G it can be seen that the seismic risk generated by the GGF area alone is less than one-half that of regional faults. That is, for any given peak acceleration, the probability of

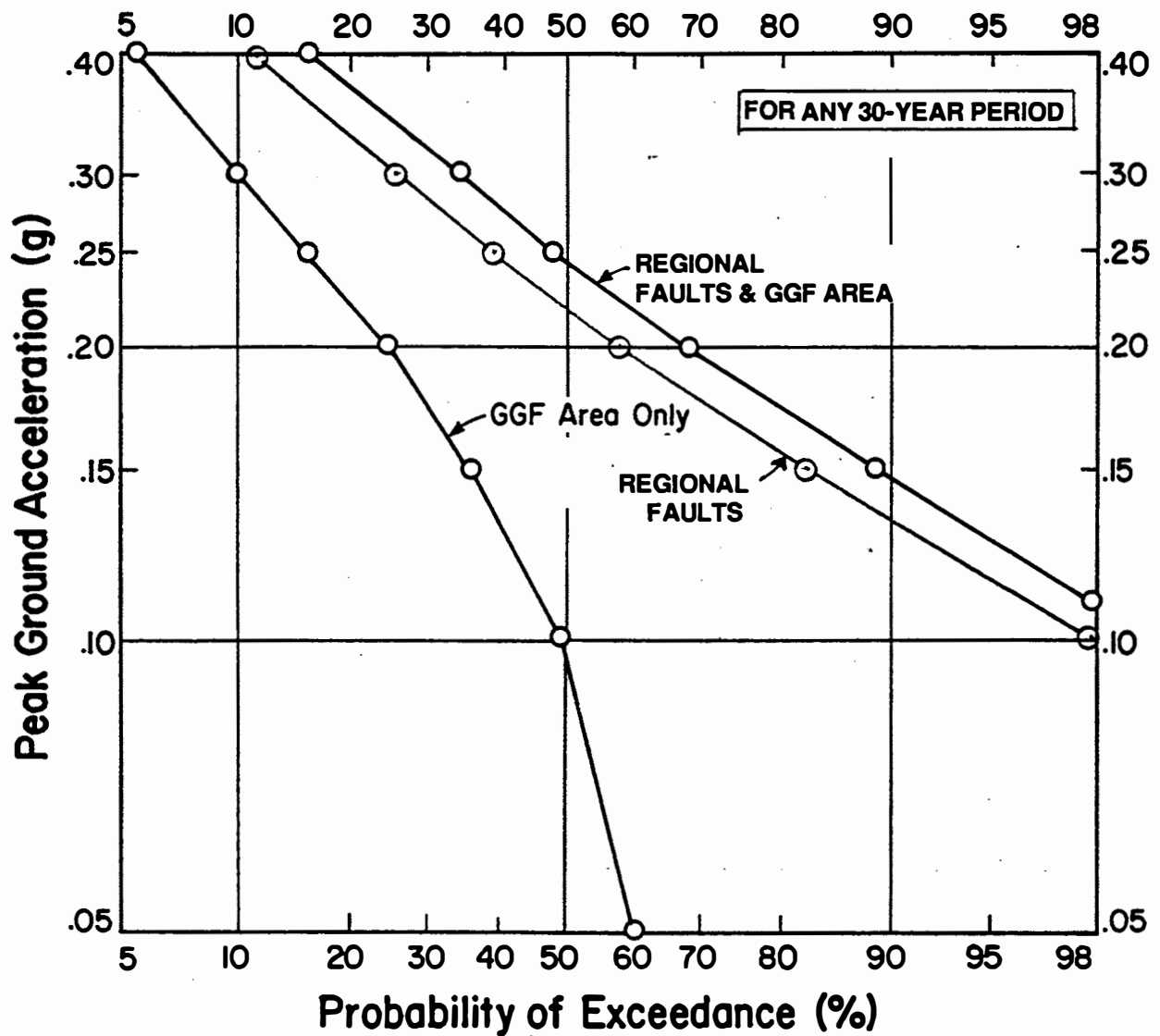


Figure 5.3.2-G: Probability of Exceedance of Peak Ground Acceleration (PGA) at Anderson Springs

SOURCE: Graphics reproduced from GeothermEx, Inc.

exceedance (the risk level) created by the seismic source in the GGF area alone is less than one-half the probability of exceedance created by regional faults. From this, it may be concluded that the GGF (as a whole) seismicity contributes somewhat less than one-third of the total earthquake risk at Anderson Springs and nearby locations flanking the GGF. Therefore, GGF seismicity can be seen as creating a minor local increase of earthquake risk. The GGF risk contribution might reasonably be termed "insignificant".

Relative impact of the GGF and Regional Active Faults Over a 30-Year Exposure Period

Figure 5.3.2-G shows that, at the 50% probability-of-exceedance level (even odds), for a 30-year exposure period, total GGF induced seismicity will produce a maximum peak ground acceleration of 0.10g, corresponding to Modified Mercalli intensity VI ("hard" or "soft" site), in the Putah Creek valley and at Anderson Springs. This intensity (VI) indicates slight damage, except perhaps cracks in plaster, stucco, or weak masonry. Many people would be frightened.

In contrast, regional faults, also at the 50% level, will generate a maximum peak ground acceleration of 0.22 g, or intensity low-VII (hard site) to low - VIII (soft site), in the same area. These intensities correspond to slight damage (low-VII) to minor/moderate damage (low-VIII) depending on construction of buildings.

The risk estimate for the GGF treated the entire geothermal field. However, seismicity to date has been much lower in the southeastern part of the GGF than in its northwestern part. If it is assumed that this pattern continues through the life of the project, then project impact would be much less than that stated for the entire field. And so, peak ground acceleration at the 50% probability-of-exceedance level for project-induced seismicity is believed to be less than 0.10g, and less than intensity VI. At most, such events possibly would result in minor cosmetic damage such as cracked plaster and overturning of unstable objects. People would notice the earthquake but few would be alarmed. Therefore, the Southeastern Geysers seismicity is seen as creating a minor, less than significant local increase of earthquake risk.

It is important to understand that induced seismicity in the GGF does not represent a change in long-term (say, 100 years or more) seismicity in the study area. Rather, it represents a hastening of release of natural tectonic stress, built up through regional plate-tectonic forces. Therefore, an increase of seismicity in coming decades (say, 10-30 years) should be followed by a decrease thereafter, with respect to a natural seismicity level unaffected by geothermal activities,

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including fluid injection. Moreover, it is not possible to distinguish naturally occurring from induced seismicity for magnitudes larger than about 3.5. This is because these larger shocks occur infrequently in the GGF (not more than once per year, on average), and are widely scattered, such that there is no possibility of testing their possible association with major changes in geothermal fluid injection or withdrawal.

Seismicity in The Geysers, and induced seismicity in particular, is poorly understood. Because of this situation, it is difficult to provide mitigation that can be used to effectively control the location, number and magnitude of induced micro-earthquakes through injection and production programs. There is a desire shared by government, the industry and the citizens to undertake a more comprehensive program of monitoring. At this point, additional seismic monitoring in the Southeast Geysers is under consideration by a number of agencies including the USGS, University of California, LBL and LLNL.

Citizen concern remains about the effects of earthquakes in The Geysers from both the natural sources and the induced sources from geothermal operations. It is important that the nearby residents be kept informed about earthquakes and it is possible to include in any monitoring program the means for citizens to obtain reduced and easily understandable information about earthquakes in the area. A response to this need possibly could be found in the form of a periodic newsletter summarizing Geysers seismicity as well as occasional presentations by the USGS, other agencies and the industry on their monitoring programs and the related seismic effects. Additionally, providing rapid information about local earthquakes, e.g., through a hot-line to the USGS or other agencies, also could provide a means of addressing these concerns. While this may not allay citizens concerns, it would provide some information to better understand what is happening in the region, thereby allowing them to better prepare for any real or perceived effects of induced earthquakes and natural earthquakes.

The project sponsors have expressed their desire to assist in information development about seismicity and its dissemination. Cooperation with other agencies would be provided and the project sponsors would assist in developing and implementing information for the public. Details of these programs remain to be worked out.

No mitigation is required.

5.3.3 HYDROLOGY AND WATER QUALITY

IMPACT SIGNIFICANCE CRITERIA

The following guidelines from Appendix G of the California Environmental Quality Act (CEQA), were used to determine the significance of impacts on hydrology and water quality:

A project will normally have a significant effect on the environment if it will:

- (f) Substantially degrade water quality;
- (g) Contaminate a public water supply;
- (h) Substantially degrade or deplete ground water resources;
- (i) Interfere substantially with ground water recharge;

For the Southeast Geysers Effluent Injection Program Plan Component, these guidelines are interpreted as follows: Groundwater contamination would be significant if effluent injection causes an increased risk of introducing hazardous materials into aquifer systems that supply nearby wells. Specific impacts would be significant if water quality was degraded so as to no longer meet Title 22 drinking water standards.

IMPACTS AND MITIGATION MEASURES

Impact 5.3.3.1. Effluent injection with the proposed project would not contaminate groundwater aquifers and/or public water supply sources. As the hazard is considered minimal, this would be a less than significant impact.

The Southeast Geysers Effluent Pipeline continuously will deliver approximately 5,400 gpm (gallons per minute) of treated effluent and raw Clear Lake Water to the Southeast Geysers Effluent Injection area. The effluent will be equally distributed to Calpine, Unocal and NCPA injection wells located within the project area for injection into the geothermal reservoir. Injection rates at individual wells are expected to range between 200 and 2,000 gpm. The effluent contribution would not exceed 1,800 gpm, but injection of effluent combined with power plant condensate and collected runoff from precipitation and stream diversion could raise injection to 4,000 gpm. Based on data provided by NCPA, Unocal and Calpine, the depth of injection will vary between 2,800 and 10,000 feet below ground surface depending on the injection well.

From the perspective of the Effluent Injection Program, any throughgoing system of near vertical fractures and/or faults could be considered a "preferential pathway" for effluent migration

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between the underground injection sites and any near surface groundwater resources. Because production in The Geysers is closely related to high steam producing fracture zones, the geothermal industry has conducted numerous studies to characterize the fracture system (Thompson, 1992; Thompson and Gunderson, 1992; Beall and Box, 1992). These reservoir studies have described the reservoir fracture system as a random or semi-random network of both localized low-angle (near horizontal) and high-angle (near vertical) fractures (Beall *et al.*, 1992). One conceptual model (Beall and Box, 1992) for the Southeast Geysers region describes a reservoir composed of vertical to high-angle fractures of varying strike (direction) defining blocks that contain low-angle fractures of limited lateral extent. The northeast and southwest lateral reservoir boundaries as well as the lower boundary are gradual in nature with the fractures more widely spaced and dominated by high angle fractures (Beall and Box, 1992). This conceptual model is consistent with the observations of Thompson and Gunderson (1992) who noted that the pattern of fracturing in the upper reservoir is random with locally controlling low-angle fractures. At increasing depths, the fractures are predominantly vertical. Evidence suggests the fractures and faults that host the reservoir do not extend through the caprock to the surface. Near surface thrust faulting, ductile flow, and fracture infilling are thought to be possible mechanisms for the truncation or closure of any vertical features between the geothermal reservoir and the surface. The persistent existence of the geothermal steam reservoir is convincing evidence that the near surface rocks have been and are, largely impermeable to steam (and presumably water) flow over long periods of time (thousands of years).

Despite the evidence of vertical fractures in the geothermal reservoir, migration of the injected effluent to groundwater aquifers and/or drinking water sources through preferential pathways is not likely due to several geometric (spatial), thermohydraulic, and hydrologic factors. These factors are discussed in detail below.

The most significant factor preventing the contamination of drinking water sources is the separation distance and the potentiometric gradient between any possible groundwater resources and depth of injection. Based on groundwater resource surveys conducted by Johnson and Treleven (1990), limited quantities of perched and unconfined groundwater exist near the surface in the injection area at depths of 300 feet or less (Figure 4.4.3-1). There are several relatively large landslide deposits in the injection area that may host small volumes of groundwater, particularly in the western portion of the injection area. Larger volumes of groundwater are found outside the injection area (e.g., Ford Flat and Cobb Mountain) but the

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distance to these areas, both vertically and laterally, make it even less likely that any project effluent could move from the geothermal reservoir to contaminate these drinking water sources.

Given that the effluent will be injected at depths more than 2,800 feet below ground surface, and typically 5,000 feet below ground surface, the minimum separation distance will be great. In addition, the impermeable "cap rock" at the top of the geothermal reservoir provides a relatively competent geologic "seal" which retards (slows) the migration of fluids (liquid or vapor) to or from the geothermal reservoir system. In effect, the geothermal reservoir is closed, isolated from the regional hydrologic system as evidenced by its under-pressured condition. To date, after 20 years of operation, the California Division of Oil and Gas and Geothermal Resources has found no evidence of injection fluid migration problems at The Geysers resulting from a lack of geologic confinement (Habel, 1990). In fact, isotopic and geochemical studies of the fluid injection program that have been performed indicate that much of the injected fluids are later recovered as steam (Crockett and Eney, 1990; Gambill, 1991; Beall, Box and Eney, 1991).

Another factor preventing the migration of injected effluent to the surface is the thermodynamics of injecting liquid effluent into a vapor dominated geothermal reservoir system. Due to the difference in density between the heavier liquid effluent and the lighter vapor present in the reservoir, any effluent injected into the reservoir will migrate below the injection level as a boiling plume of water and vapor (Pruess, 1991; Pruess and Eney, 1993; Crecraft and Koenig, 1989). Any effluent that was not immediately "boiled off" into steam would either pool in the fractures below the injection well or continue to migrate toward the "bottom" of the reservoir through the vertical system of fractures. Any lateral migration of liquid effluent would be toward the low pressure areas surrounding nearby steam production wells which will result in an increased uptake of liquid water. As discussed in Section 5.3.1, this phenomenon has been observed in steam production wells near condensate injection wells when the rate of injection has been unusually high for prolonged periods of time. This problem has been mitigated by decreasing injection rates and concentrating injection in low pressure areas where an excess in reservoir superheat increases the likelihood that the injection fluid will be flashed to steam.

Another factor preventing the migration of the injected effluent is the difference in pressure (potential) between the geothermal reservoir and any surrounding sources of groundwater. McLaughlin (1981) has characterized the steam (geothermal) reservoir as under-pressured with respect to the surrounding water dominated parts of the system. Any meteoric recharge or groundwater would migrate toward the geothermal reservoir, provided conduits into the reservoir

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are present. Goff, Donnelly, Thompson, and Hearn (1977) suggest that vents beneath Cobb Mountain could allow meteoric water to percolate deep into the Franciscan formation.

Many studies (Enedy et al., 1990, Enedy et al, 1992) have documented the general decline in reservoir pressure due the extraction of steam for geothermal power generation. Given that the production rate of steam in the area is significantly larger than the proposed injection rate, reservoir pressures will continue to decline, although at a slower rate. As a result, the geothermal reservoir will remain a hydrologic "sink" (low pressure zone) for any groundwater recharge to the system, provided the necessary pathways from the surface exist.

As proposed, the effluent would be distributed to multiple injection wells and injected at rates sufficiently low to minimize the potential for migration to groundwater resources. Hydrologic pressures will remain less than hydrostatic. As optimal production of steam is the objective of the project, injection fluid, including the effluent, will be distributed to several injection sites to minimize the likelihood for the development of pools of liquid effluent below the injection wells and/or the migration of liquid effluent to groundwater resources.

As discussed in Section 5.3.1, much, if not all of the effluent injected into the low pressure areas of the reservoir will flash to steam near the injection wells and migrate toward the surrounding steam production wells. Any evidence of pooling of liquid effluent near injection sites (indicated by an increase in pressure in the injection well) or an increased uptake of water in steam production wells will indicate that the rate of injection at a given location(s) should be decreased and/or shifted to another injection site.

As injection continues over time, the steam production rates will decrease due to removal from the system and cooling of the source. Effluent injection will not be continued when the steam production rates are insufficient to sustain power requirements. Therefore the probability of any injected effluent escaping from the reservoir and contaminating potable groundwater through saturation of underlying fractures is minimal.

While impacts to groundwater are not anticipated, monitoring of existing groundwater quality included as part of the project would provide a basis for identification of problems in the unlikely event that they should occur. Significant sources of potable groundwater near the project area would be monitored periodically to detect any potential degradation of water quality due to the migration of effluent from the project area. If baseline groundwater quality data are

unavailable for these significant sources of potable groundwater, baseline data should be collected prior to the start of effluent injection.

Impact 5.3.3.2. Leakage of effluent through damaged injection well casings could migrate to the surface and contaminate surface water. While highly unlikely, this would be a significant impact if it occurred. The impact is mitigable.

No underground sources of drinking water are known in the injection area, so leakage from damaged well casings does not represent a threat to any groundwater resources. Although small amounts of groundwater may exist in the western portion of the injection area, it is not of sufficient volume or quantity to qualify as a USDW. However, it is conceivable, although unlikely, that leakage from damaged wells could be discharged at the surface.

The California Department of Conservation, Division of Oil and Gas and Geothermal Resources (CDOG&GR) regulates both the drilling and operation of geothermal injection wells on State and private lands. The BLM regulates similar activities on federal lands. The main focus of the CDOG&GR and BLM's injection program is the protection of underground sources of drinking water. The main focus of CDOG&GR and BLM's underground injection program is the protection of the State's fresh water resources.

All geothermal wells at The Geysers (production or injection) have at least two strings of casing that provide protection of potential groundwater resources. A surface casing (generally 20 to 22 inch pipe) is installed to a depth of approximately 400 feet. This casing is cemented from the shoe to eliminate the possibility of geothermal fluids migrating or intruding into overlying aquifers. As an extra measure of safety, a second casing is installed inside the surface casing to a depth of 1,000 feet to protect the surface casing. A perforated liner is then installed to ensure that water is only injected at the desired interval in the reservoir (Crockett and Eney, 1990).

Both the BLM and CDOG&GR require injection well monitoring to ensure that injected fluid does not contaminate potential groundwater resources. Within 30 days of first injection and every two years after that, the operator is required to perform a fluid level survey, cement bond log, or a caliper log. Such injection well surveillance is required to prove that the effluent is being injected at the intended intervals (depths) and to monitor the integrity of the casing. Besides the annual inspection, injection wells are inspected during each mechanical integrity test, and again during the injection project review. If deficiencies are found, an operator is given

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written notification of the noncompliance. When corrections are made, a CDOG&GR field engineer acknowledges the corrective action(s) after first inspecting the well (Habel, 1990).

Mitigation 5.3.3.2. Effluent injection operation should be monitored in accordance with CDOG&GR and BLM requirements to detect evidence of casing failure and verify the integrity of the injection system.

Implementation of Mitigation Measures 5.3.3.2 would ensure that the hazards of groundwater contamination are reduced to an acceptable level of risk, and therefore, a less than significant level of impact.

Both the BLM and the CDOG&GR require injection well monitoring to ensure that injected fluid does not contaminate groundwater resources. Within 30 days of the first injection, and every two years thereafter, the operator is required to perform a fluid level survey, cement bond log, or a caliper log.

Impact 5.3.3.3 An accidental spill of injection fluid could result in potentially significant temporary degradation of streams in the Southeast Geysers. The impact is mitigable.

The use of injection fluids is an ongoing permitted operation of Calpine, Unocal and NCPA. At present injection fluids are derived from power plant condensate and surface water collected from precipitation events. Approximately 80% of the total volume of steam which passes through the power generation facility escapes to the atmosphere as evaporation from the cooling tower. The remaining 20% is water that is used for injection. Some condensate also is generated in the steam gathering pipeline system and is collected by drop pots and drip legs located at low elevation points along the pipeline and directed to condensate collection tanks. This pipeline condensate is also directed into injection wells.

The proposed effluent supply to The Geysers would substantially increase the amount of water directed into the pipelines and injection wells as well as the amount of water subsequently collected as cooling tower and steam pipeline condensate. A break in The Geysers Effluent Pipeline or in one of the injection fluid distribution pipelines would result in a spill of effluent and condensate, some of which would be mixed in the proposed Y-Pad Injection Fluid Storage Tank. Some of the effluent would be tapped directly from The Geysers Effluent Pipeline.

The potential for accidental spill of effluent and condensate exists at the following types of locations: The Geysers Effluent Pipeline, secondary injection fluid distribution lines, condensate collection pipeline, pipeline drop pot and dip legs, power plant cooling tower basin, condensate collection tanks, the Y-Pad Injection Fluid Storage tank, condensate sedimentation basins and at the injection system.

A spill of effluent or effluent/condensate at the above locations has the potential to discharge the fluids into streams, potentially contaminating the stream and temporarily rendering its waters unsuitable for consumption as well as diminishing its quality for other beneficial uses. As with the main pipeline to The Geysers, the effluent would be diluted by diverted lake water as well as the other sources of injection fluid and likely would not pose a serious public health hazard. Probably the greatest source of impact would be erosion of the water course (particularly in smaller channels near the source of the spill and the resulting turbidity created by the eroded silt. This could result in injury or death to fishes and other aquatic life.

Mitigation 5.3.3.3-A. Employ measures contained in the existing spill prevention control and countermeasure plans required by the Hazardous Materials Business Plan and Lake County or Sonoma County Ordinance, as appropriate.

The existing plans probably would not need to be amended in their general provisions because the project would not introduce new substantially increased hazards of contamination. These plans establish procedures to contain spills or to respond to the effects of a spill that is not fully containable. Condensate spill containment methods include controlling the source of the spill and containing the fluid with dikes; and, spreading of straw, hay or absorbents to slow the movement and to contain oil and grease or other impurities observed or known to be in spill material. Clean-up of the spill site is accomplished with vacuum trucks and the fluid (if non-hazardous) is hauled to a sedimentation basin or holding facility for disposal. If the spill is hazardous, it would be removed to a permitted contaminated water storage area. Notifications of spills also are made when a spill has occurred.

If the spill cannot be contained and could enter the watershed, procedures are established for emergency notification and possible shutdown of injection operations. Clean-up would be conducted to the extent possible. Water quality samples would be taken in the affected streams.

Mitigation 5.3.3.3-B. The operator of the leasehold in which an uncontained spill occurs should undertake clean-up of all damages to the watershed and undertake repair and restoration of the affected stream channels.

This measure would include removal of any water contaminants from the spill, repair of eroded stream channels, and restoration of biological conditions to the satisfaction of the California Department of Fish and Game.

Implementation of Mitigation 5.3.3.3.A and B would reduce the impact to a less than significant level.

5.3.4 ENERGY RESOURCE ISSUES

IMPACT SIGNIFICANCE CRITERIA

A project would normally have a significant effect on the environment if it would use fuel or energy in a wasteful manner, or encourage activities which result in the use of large amounts of fuel or energy (California Office of Planning and Research, 1992).

IMPACTS AND MITIGATION MEASURES

Impact 5.3.4.1. The project is expected to result in (at least) a net increase in electricity generation of approximately 184 million kWh. This would be a significant beneficial impact of the project.

The project would allow continued geothermal energy production in the Southeast Geysers at higher production levels than would occur if production were to rely solely on natural sources of moisture supply (precipitation and recharge). The minimum anticipated energy production related to effluent injection would be approximately 184 million kWh per year (equivalent to 630 billion Btu). This amount of energy would be substantially greater than that associated with construction and operation of the pipeline and associated pumps (estimated at 293 billion Btu per year); thus, the project would have a beneficial impact on energy resources.

5.3.5 AIR QUALITY

IMPACT SIGNIFICANCE CRITERIA

A project would normally have a significant effect on the environment if it would violate any ambient air quality standard, contribute substantially to an existing or projected air quality violation, or expose sensitive receptors to substantial pollutant concentrations (California Office of Planning and Research, 1992).

IMPACTS AND MITIGATION MEASURES

Impact 5.3.5.1. Construction of injection fluid distribution lines in The Geysers would generate criteria pollutant emissions from combustion of fuel by construction equipment and from vehicle movement over unpaved roads. Emissions of PM₁₀ could violate the state PM₁₀ standard in the immediate vicinity of construction areas; thus, this impact would be potentially significant.

The injection program would require new distribution lines in the affected steamfields in The Geysers. These lines would be buried and would follow existing roads. At the NCPA steamfield, no new injection distribution lines would be constructed initially. Disposal of effluent would be through existing piping systems. Over time, however, as much as 8,000 feet of pipeline could be constructed at the NCPA steamfield. At the Calpine steamfield, a total of approximately 8,300 feet of new distribution lines would be constructed to three injection wells. At the Unocal Steamfield, approximately 7,000 feet of new distribution lines would be constructed.

Emissions from pipeline construction have already been described under Impact 5.2.4.1. Emissions related to construction of the distribution lines would be in addition to those described for the Lake Diversion and main effluent pipelines; however, given that the extent of construction for distribution lines in The Geysers (23,300 feet of new pipeline) would be far less than for the Lake Diversion and main effluent pipelines (over 154,000 feet for new pipeline), emissions related to construction of the distribution lines would also be far less. Short-term emissions associated with construction of the new distribution lines in The Geysers would be approximately 89 lb/day of CO, 20 lb/day of HC, 192 lb/day of NO_x, 7 lb/day of SO_x, and 44 lb/day of PM₁₀ based on construction equipment lists and fuel consumption estimates for the construction of the main effluent pipeline. This PM₁₀ estimate also includes fugitive dust emissions associated with an active construction area of approximately 10,000 square feet (500 feet by 20 feet) at any one time.

However, depending upon the extent of vehicle movement over unpaved surfaces and meteorological conditions, PM₁₀ emissions on a given day could be substantially higher than 44 lb/day and could result in violations of the state PM₁₀ standard in the immediate vicinity of the distribution-line route. Annoyance-type impacts related to construction emissions in The Geysers would not be expected given the lack of receptors in the vicinity.

Mitigation 5.3.5.1. The project sponsors shall follow the same mitigation measures as those discussed under Mitigation 5.2.4.1.A and 5.2.4.1.C (which are related to construction of the Lake Diversion and main effluent pipelines).

Although Mitigation 5.2.4.1.A would be derived from a permit application with the LCAQMD, the dust control measures derived therefrom should also be applied to construction in Sonoma County.

Implementation of this measure would reduce the potential for violating the state PM₁₀ standard. The residual impact would be less-than-significant.

Impact 5.3.5.2. Construction of the distribution pipelines in the Geysers could generate asbestos dust emissions. This would be a potentially significant effect of the project.

See discussion of this impact and related mitigation measures under Impact 5.2.10.1.

Impact 5.3.5.3. Over the long-term, the increase in steam production due to the project would not substantially affect emissions (and downwind concentrations) from geothermal development in the Southeast Geysers since injection-derived steam has low concentrations of non-condensable gases (NCG), including H₂S.

Emissions from geothermal development result from the escape of gases contained in the steam, known as non-condensable gases (NCG), which include H₂S, and those that are largely from emissions control technology. The concentration of NCG increases as liquid water in the geothermal reservoir is depleted (GeothermEx Inc., 1993).

Early production at a well is a mixture of reservoir steam (with NCG) and "new" steam (without NCG). "New" steam forms when liquid water in the reservoir, trapped in the rock matrix and smaller fractures, boils in the pressure sink around the well(s) (GeothermEx, Inc., 1993). As the water near a production well vaporizes, the NCG become less diluted by the "new" steam, and the wellhead gas concentration increases (GeothermEx, Inc., 1993). However, the net result in the NCPA steamfield is a net reduction in NCG per well since, while NCG concentrations are increasing, the overall steam production is decreasing at a faster rate. There is presently no reliable quantitative reservoir model that includes NCG or that can predict future maximum NCG or H₂S averaged per well or in total steam production (GeothermEx, 1993).

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Effluent is essentially gas-free and would generate "new" steam in that it would dilute the NCG contained in reservoir steam (GeothermEx, Inc., 1993). Since the project would increase the total amount of steam in production over that which would be expected without the project, the effect of reducing NCG would be to offset the increase in emissions that would otherwise occur if the increase in steam production were from reservoir steam and not from injection-derived steam. Since emissions (and corresponding downwind concentrations) with the project would not be substantially different than they would be without the project, the effect would be less-than-significant.

Effluent distribution as cooling tower makeup water could lower power plant H₂S emissions as a partial replacement for the H₂S enriched condensate now used. Directing H₂S enriched condensate to re-injection without atmospheric exposure would likely result in an air quality benefit.

Impact 5.3.5.4. The project could result in the release to the atmosphere of toxic emissions contained in the proposed injection fluid, which would be a combination of water from Clear Lake and effluent from SERWTP and MWTP. This would be a less-than-significant impact.

Injection fluids could contain trace quantities of metals (such as zinc, lead, and mercury) and organic compounds (such as bromoform and chloroform) which, if airborne, would be considered air toxics. While the return steam from such injection fluids could contain some of these constituents, the concentrations of these constituents would be too low to be of concern based on samples taken at SERWTP and Clear Lake and that are discussed in the Surface Water Hydrology / Water Quality portion of this report. In these samples, zinc and chloroform were reported at concentrations slightly above their respective method detection limits (MDLs). All other metals and organic compounds were below their respective MDL.

Mercury in the injection fluid would probably not be emitted to the atmosphere since the mercury would react with H₂S to form cinnabars, which would tend to remain in the reservoir because of the action of the rock matrix (Kuwada, 1993). Steam, however, could contain mercury through mechanical entrainment. Mercury in particulate form would be removed from the steam through use of control equipment, such as scrubbers and rock catchers, that are commonly used at the geothermal power plants to prevent the particles from getting into the turbines (Kuwada, 1993). No change in air pollution control equipment would be required because of the project.

Virus and bacteria in the effluent likely would be destroyed following injection by the heat. It is possible that some virus and bacteria could survive in the injection derived steam (IDS), creating possible pathogens released into the atmosphere at the power plants. These releases are likely to be of low concentrations and pose minimal public health hazard.

Mitigation 5.3.5.4. (Recommended) Viral and bacterial contamination of IDS and/or effluent should be evaluated to assure absence or destruction of pathogens prior to atmospheric release.

Impact 5.3.5.5. The project could result in short-term emissions increases during the process of converting production wells to injection wells. Due to its short duration, this impact would be less-than-significant.

The process of converting production wells to injection wells could result in brief controlled releases of steam which would represent a temporary increase in emissions in the vicinity of the converted well. These emissions would be expected to be minor since the production wells that would be converted would be those with low steam pressure and the conversion process would initially involve "quenching" of the well to eliminate the steam from the well entirely. The entire process for a well conversion would occur over the course of approximately one week. This impact would not apply to the Unocal Steamfield since Unocal proposes to use only existing injection wells (i.e., none would be converted) from production use).

Mitigation 5.3.5.5. (Recommended) In consultation with LCAQMD, the steam field operators shall employ best available emissions control technology and techniques to minimize the short-term increase in emissions associated with conversion of production wells to injection wells.

Implementation of Mitigation 5.2.5.5 would minimize impacts and help to ensure that impacts remain at a less-than-significant level.

5.3.6 NOISE

IMPACT SIGNIFICANCE CRITERIA

A project would normally have a significant effect on the environment if it would increase substantially the ambient noise levels for adjoining areas (California Office of Planning and Research, 1992). For purposes of this EIR, a project's long-term noise effects would be considered significant if they cause a noise-level increase of five dBA over the existing noise

level or exceed 50 dBA, Ldn at the closest receptor. The significance of temporary noise impacts is evaluated with reference to existing noise levels, the duration of the impact, and the number of receptors affected.

IMPACT AND MITIGATION MEASURES

Impact 5.3.6.1. Conversion of production wells to effluent injection wells could result in a temporary noise impacts for the closest residents in the Southeast Geysers and in Anderson Springs.

With the project, there would be five production wells converted to effluent injection wells within approximately one-half to one-mile distance of the closest residents in the Southeast Geysers (McKinley residence and Castle Rock Springs) and in Anderson Springs. Conversion of the wells would involve a one-time, non-recurring event that could include controlled releases of steam if the wells are not properly quenched prior to retrofitting. Such releases typically are noisy events and could be audible at the nearest residences. Because well conversion generally takes only one week, the temporary noise impacts from this source would not be significant, although this noise could annoy nearby residences. This impact would not apply to the Unocal steamfield since Unocal proposes to use only existing injection wells for this project.

Mitigation 5.3.6.1. (Recommended) Employ best available (noise) control measures in consultation with LCAQMD.

Impact 5.3.6.2. With the project, steam production in the Southeast Geysers would decline more slowly than it would without the project and the occasional noise events and complaints that accompany geothermal development activity would decline more slowly as well. Since the current, cumulative noise impact of geothermal development activity in the Southeast Geysers is significant, the project's effect of continuing this activity would also have a significant noise impact on the nearest residents. This would be a significant unavoidable effect of the project.

Mitigation 5.3.6.2. The steamfield operators and power plant operators need to continue to work with LCAQMD to minimize the impacts of their activities on nearby residents. This means continuing to use best available (noise) control measures, to notify residents of scheduled noise events (where noise control is infeasible or ineffective), to take into account seasonal and meteorological factors in scheduling noisy activities, among others.

5.3.7 SOCIOECONOMICS AND PUBLIC SERVICES

IMPACT SIGNIFICANCE CRITERIA

The socioeconomics impact criteria for the Geysers Effluent Injection Program Plan Component are the same as those presented in Section 5.2.9.

Under Executive Order 12898, NEPA analyses must evaluate Environmental Justice impacts. This project would maintain the current work force in the Geysers and would not disrupt any existing business activities or residential areas. Therefore, there would be no effect on low income or predominantly minority areas.

IMPACTS AND MITIGATION MEASURES

Impact 5.3.7.1. The project would continue to provide work opportunity for approximately 112 existing positions in the geothermal industry. This is a beneficial effect of the project.

The effluent injection program would raise steam production in the steamfield and, as a result, noise power production at power plants in the Southeast Geysers closer to their installed capacity. There are approximately 112 existing jobs that are involved with steamfield and power plant operations that would be supported by the increased production. These jobs would be continued because of the project for the design life of 25 years.

Without the effluent injection program, declining production would likely result in the loss of these 112 positions.

No mitigation is required.

Impact 5.3.7.2. An economic benefit of the project would result from royalties paid to the federal, state and county governments and from tax revenues.

Royalties are derived from the electrical power generation that would be a result of the project.

As authorized under the Geothermal Steam Act of 1970 and the Code of Federal Regulations, Title 43, Chapter 11, Part 3000, the Minerals Management Service (MMS) receives royalties for electric power generated from geothermal resources in The Geysers. The federal government retains 50% of the money and 50% is returned to the State of California. Of the State's portion

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of the royalties received from the federal government 40% is returned to the county where the lease is located, that is, Lake County and Sonoma County (Lake County, 1989). Additionally, under Assembly Bill 1905, Lake County receives disbursements from the state under California Energy Commission geothermal grants provided by the State Renewable Resource Investment Fund which is supported by a portion of the State's share of the royalties.

If the project were not implemented and no effluent injection were to occur, the expected royalty from the NCPA leasehold for the period 1995 to 2028 would be \$57,047,000. If the project is approved and injection of effluent produces the expected return in electrical power generation, for the same period the royalty (with an assumed rate reduction) would be \$120,461,000. In sum, the royalty more than doubles because of the effluent injection program at NCPA. Disbursements to the federal government, state and local agencies are presented in Table 5.3.7-1. While a royalty rate reduction is not a specific element of the proposed project, it is assumed here because of the likelihood that NCPA (as well as Calpine) would request the reduction in order to proceed with the project.

TABLE 5.3.7-1: ROYALTY PAYMENTS AND DISBURSEMENTS UNDER THE NO ACTION ALTERNATIVE AND PROJECT FROM NCPA LEASEHOLD

	No Action Alternative (\$) ¹	Project (\$) ²
Federal Government	28,523,000	60,230,500
CEC /a/	8,557,050	18,069,150
RIF /b/	8,557,050	18,069,150
Lake County	5,704,700	12,046,100
Sonoma County	5,704,700	12,046,100

/a/ CEC = California Energy Commission

1 Assumed 12.5% royalty rate

/b/ RIF = State Renewable Resource Investment Fund

2 Assumed 11.25% royalty rate

SOURCE: NCPA, 1994.

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While similar figures have not been developed by Calpine Corporation or Unocal Corporation, the assumption is that these leasehold royalties also would increase substantially because of the expected increased power production. Actual royalties would be based on power generation and the rate of royalty payment.

The Lake County Assessor has projected CEC, Lake County and Sonoma County changes in income related to the project. For the total income received for the life of the project (1995-2028) from the combined NCPA and Calpine royalty is forecast at about \$26,908,000.

Assuming administrative costs of about \$226,000, the total net increase from the project would be about \$27,134,000. Of the total net increase, approximately \$11,628,900 would be disbursed to the CEC, and Lake County and Sonoma County each would receive approximately \$7,752,600 in additional income.

In addition to the above income from royalties, both Lake and Sonoma counties would receive tax payments for all geothermal properties, wells, pipelines and generating facilities. To the extent the project would forestall the removal of existing taxed facilities, it would result in a continuance of the tax base from the leaseholds. The Lake County Assessor in 1993 projected the impact of the project on property tax revenues. He assumed a net gain of 20-50 MW in production and as much as 280,000 MWh of additional power generation as a basis for the assessment. The estimated total increased revenues to the Lake County general fund would be about \$150,980 initially (assumed 1994 start-up). Over the design life of the project, the increased property tax revenue forecast for NCPA is \$2.24 million and \$2.45 million for Calpine.

The Sonoma County Assessor also forecasted the increase in property tax revenues associated with the project. Assuming that an additional 50 MW of power would be generated, he estimated that Sonoma County would receive an additional \$100,000 annually. This amount would gradually diminish over the design life of the project.

Taxes also would be generated by the purchase of materials and supplies related to operation of the project and indirect purchases of goods and materials by employees over the life of the project. Moreover, by lifting the moratorium on development, the project's growth-inducing effects likely would result in a substantial increase in the tax base of both Lake County and the City of Clearlake. Estimates of these taxes would be speculative, but over the design life of the project likely would be substantial.

5.4 IMPACTS AND MITIGATION MEASURES RELATED TO THE SERWTP FACILITIES PLAN COMPONENT

5.4.1 GEOLOGY

Impact 5.4.1.1. There are no known geologic hazards or soil limitations which would prevent construction of the proposed improvements to the existing treatment and disposal facilities.

Potential geologic hazards for the project area are discussed in general in the Geologic and Seismic Hazards Section of the Lake County General Plan, Lower Lake Area Plan, and City of Clearlake General Plan. Moderate to strong ground shaking from earthquakes is likely for the project area in the future. The most probable source for this shaking is from earthquakes on major faults, such as the San Andreas fault located about 50 miles from the project site.

Mitigation 5.4.1.1. Geologic studies should be conducted as part of the detailed design prepared for the construction of the facilities and may include test pits or borings.

If faults are located, age determinations of previous movements would be required to evaluate the possibility of future movements. Age dating is generally accomplished by geologic mapping along the fault traces, as well as several trenches excavated across the fault. Detailed examination of the soil horizons exposed in the trench sidewalls would be completed to evaluate displacements.

A geotechnical investigation should be performed to determine any special structural modifications and to evaluate the conditions which may warrant special construction and soil handling. Structures should be designed according to current seismic codes to resist strong shaking with a maximum peak) ground acceleration of approximately 0.3+g.

Implementation of the above mitigation would reduce the impact to a less than significant level.

Impact 5.4.1.2. Excavations will be as deep as 12 to 15 feet for the construction of the treatment facilities. Construction of improvements to treatment plant facilities will involve excavation of 19,000 cubic yards of earth. Excavated material will be used for backfilling, spread on-site, or hauled to the Eastlake Landfill and used as daily cover material. With appropriate mitigation measures, this impact will be less than significant.

Construction of treatment plant facilities improvements will involve excavation of 19,000 c.y. of earth. Trenches will be excavated up to 12 to 15 feet for the construction of the treatment

facilities. Excavated material will be used for backfilling, spread on-site, or hauled to the Eastlake Landfill and used as daily cover material.

There will be no construction of new roads. Portions of existing roads which are disturbed by construction will be replaced.

Mitigation 5.4.1.2.A. Detailed design plans and specifications shall be prepared for the project. They shall conform to the Lake County Grading Ordinance and be based on adequate geotechnical design investigation of the project components. For open excavations which are 5 feet or deeper, the contractor should obtain a permit from the applicable agency as required by California Labor Code 6424. Also, for all trenches 5 feet or more in depth, the contractor should prepare and submit to LACOSAN a detailed plan showing the design of shoring, bracing, and sloping or other provisions to be made for worker protection as required by California Labor Code 6422.

Mitigation 5.4.1.2.B. The project geotechnical investigation should include soils-related design criteria for use in preparation of and/or reviewing the plan. This should include such information as safe construction slopes, lateral earth pressures for sheeting and shoring design, and the effects of adjacent surcharge loads. Soil testing and profiling should be done prior to excavation. The geotechnical investigation should identify the need for dewatering and methods of dewatering which might be employed, and these recommendations should be incorporated into the project. Compaction should be obtained by mechanical means, hand tamping, or a combination of these methods.

Geologic studies should be conducted as part of the detailed design prepared for the construction of the facilities and may include test pits or borings. Soil testing and profiling should be done prior to excavation. Excavation of an open trench should be limited to 600 feet or a distance necessary to accommodate pipe installation in a single day. This distance should be collective in length and include open excavation for pipeline and appurtenances and backfilling which has not been temporarily resurfaced.

The specifications should require that all excavations be backfilled after pipe has been installed to an appropriate level as determined in accordance with ASTM 0 1557 or Test Method No. Calif. 216. Compaction should be obtained by mechanical means, hand tamping, or a combination of these methods.

There should be a routine inspection and maintenance program by a certified engineering geologist to ensure the structural integrity of the existing reservoir. The pipeline route should be inspected periodically for evidence of land movement, erosion or landslides, and appropriate

remediation implemented. Periodic inspections (bi-annually during the early fall) should be undertaken and the results of the inspection documented in a written report to the Lake County Sanitation District. Any recommended improvements or preventative measures should be noted and a formal action taken on any recommendations.

Implementation of Mitigation Measures 5.4.1.2.A and B would reduce the impact to a less than significant level.

Mitigation 5.4.1.2.C. Design plans and construction specifications for all project facilities and grading shall be prepared by a registered civil engineer subject to approval by the Lake County Public Works and Building Departments.

Mitigation 5.4.1.2.D. The project sponsors shall obtain a grading permit from the Lake County Public Works Department prior to commencement of grading activities. All grading shall be in accordance with the Lake County Grading Ordinance implementation of which is the responsibility of the Lake County Building Department.

Mitigation 5.4.1.2.E. No grading shall be conducted during the rainy season or during wet weather. Grading shall be limited to between April 10th through October 10th, unless an extension has been approved by the Public Works and Planning Departments based on dry weather, suitable soil conditions and installed erosion control measures.

Mitigation 5.4.1.2.F. All construction and grading activities shall expose as little new ground surface as possible. In all areas requiring removal of vegetation but no grading, root crowns shall be left intact so as to retard soil erosion.

Mitigation 5.4.1.2.G. Site grading shall be minimized to reduce the possible risk of future slope and/or foundation instability. In required areas to be graded, the ground surface shall be cleared and stripped of vegetation and surface soils containing organic materials. The strippings shall not be used in compacted fills, but shall be saved for reuse in landscaping, unless disposed of off-site in a location approved by the Planning Department. The estimated stripping depth will be about one foot and should be determined in the field by the project sponsors engineer, subject to the approval of the Department of Public Works.

Mitigation 5.4.1.2.H. Revegetation of graded areas shall take place as quickly as possible as weather permits, but in no case later than October 15th. At a minimum, revegetation shall consist of reseeding with grass all graded areas. Straw and/or mulch shall also be used to control erosion on all graded banks and slopes over 10%. For projects with slopes of 20% or greater, or located within 100 ft. of a blue line water feature (as identified on a USGS map), the project sponsors shall also install a silt fence or straw bales with rebar around downhill perimeters or lakeward of the fill areas prior to grading activities.

Mitigation 5.4.1.2.I. Excavated materials shall not be sidecast or pushed over the edges of slopes during construction and final grading. Cut and fill operations shall be carried out so that earthen materials (rocks, dirt strippings, etc.) shall be disposed of in manner and location approved by the Planning and Public Works Departments.

Mitigation 5.4.1.2.J. Replanting of all exposed surfaces consistent with approved revegetation and slope stabilization plans shall be accomplished within the first growing season following disturbance, unless other scheduling is approved by the Planning Department.

Mitigation 5.4.1.2.K. Loose soil mounds or surfaces shall be protected from wind and/or water erosion by being appropriately covered when construction is not in active progress or when required by the Planning Department.

Mitigation 5.4.1.2.L. The project sponsors shall retain a landscape architect, registered forester, plant ecologist or other qualified professional acceptable to the Planning Director to reevaluate the entire revegetation program during the spring following initial planting. The qualified professional shall present a written statement indicating which planting techniques were successful or unsuccessful, and what will be done to improve the revegetation program if needed, to the Planning Department no later than June 1st of that year. The written statement shall be accompanied by photos illustrating the relative success of revegetation efforts. If deemed by the Planning department to be unsuccessful, additional revegetation will be required not later than the immediately succeeding fall season. The revegetation program shall include periodic inspection and upgrading as necessary. All plantings shall be maintained or replanted for the life of the project.

Mitigation 5.4.1.2.M. Culverts, ditches, trash racks, etc. shall be regularly cleaned and maintained in order to keep these facilities operational and reduce the possibility of overflow and resultant erosion siltation impacts.

Mitigation 5.4.1.2.N. Where road alignment traverses hillsides, the road surface shall be sloped toward the hillside to prevent rilling and erosion of downslope areas and fills.

Mitigation 5.4.1.2.O. Road surfaces shall be compacted to at least 95% relative compaction, and all road fills shall be compacted to at least 90% relative compaction. Roads shall be constructed to result in minimal disturbance of soils and vegetation within the project area. Use of out-sloping and water bars shall be incorporated in the design to reduce erosion.

5.4.2 HYDROLOGY AND WATER QUALITY

Impact 5.4.2.1. Construction at the treatment plant would require extensive modifications of the site in the vicinity of the existing facilities. Care would have to be exercised to ensure that on-going operational performance is not impaired. Appropriate planning measures would reduce this impact to a less than significant level.

Mitigation 5.4.2.1. Apply Mitigations 5.4.1.2.A through O.

Impact 5.4.2.2. Interference with sludge disposal or utilization and reuse of wastewaters consists primarily of incompatible pollutants which can be concentrated in sludge or by reuse techniques such as land disposal of treated wastewater. Disposal of amounts of priority pollutants in effluent or sludge in excess of RWQCB requirements would be a significant impact.

No specific information on removals for the 129 priority pollutants is available for the SERWTP. Such information is very expensive to obtain and is not normally available for small treatment facilities. However, there have been several national studies sponsored by the U. S. Environmental Protection Agency and others to obtain such information. The range of removals which have been achieved by primary, secondary and advanced treatment processes are summarized in Table 5.4.2-1.

In general, the level of removal increases with the level of treatment. The removed constituents are either biodegraded, transformed to other compounds, volatilized, or incorporated into the sludge from the process. Often the materials are simply physically transformed to another medium, either sludge or volatilized to the air, so one must account for cross-media impacts in making a determination about the eventual environmental impacts.

Mitigation 5.4.2.2.A. Monitoring of the effluent should be continued and the program expanded to include the sampling of priority pollutants annually and monthly for metals and other inorganic constituents.

The monitoring wells should be sampled, analyzed and reported on a regular basis.

A priority pollutant sample should be taken annually of the SERWTP effluent (from the reservoir) and sludge (from a composite sample).

Mitigation 5.4.2.2.B. The project sponsor shall comply with all regulations and permit requirements of the California Regional Water Quality Board, Central Valley Region and State Department of Water Resources Division of Water Rights. No discharge of hazardous materials shall be allowed in ground or surface waters.

TABLE 5.4.2-1

REMOVAL OF PRIORITY POLLUTANTS BY DIFFERENT TREATMENT PROCESSES (% removal)

	Pollutant	Primary Treatment	Secondary Treatment	Tertiary Treatment
1.	Acenaphthene			
2.	Acrolein		95 ³	
3.	Acrylonitrile			
4.	Benzene	7 ¹	78 ¹ , 95 ³ , 99 ²	94
5.	Benzidine			
6.	Carbon tetrachloride			
7.	Chlorobenzene		90 ³	
8.	1,2,4-trichlorobenzene	12 ¹	79 ¹ , 85 ³	
9.	Hexachlorobenzene			
10.	1,2-dichloroethane		90 ³	
11.	1,1,1-trichloroethane	13 ¹	80 ¹ , 80 ³ , 91 ² , 94 ² , 95 ³	88
12.	Hexachloroethane			
13.	1,1-dichloroethane		90 ³	
14.	1,1,2-trichloroethane		95 ³	
15.	1,1,2,2-tetrachloroethane		90 ³	
16.	Chloroethane		95 ³	
17.	Bis (chloromethyl) ether			
18.	Bis (2-chloroethyl) ether		90 ³	
19.	2-chloroethyl vinyl ether			
20.	2-chloronaphthalene		95 ³	
21.	2,4,6-trichlorophenol			
22.	P-chloro-m-cresol		95 ³	
23.	Chloroform	1 ¹	56 ¹ , 62 ² , 90 ³	68
24.	2-chlorophenol		95 ³	
25.	1,2-dichlorobenzene		90 ³	87 ³
26.	1,3-dichlorobenzene			
27.	1,4-dichlorobenzene	0 ¹	88 ¹ , 90 ³ , 97 ² , 99 ²	
28.	3,3-dichlorobenzidine			
29.	1,1-dichloroethylene			
30.	1,2-trans-dichloroethylene			
31.	2,4-dichlorophenol			
32.	1,2-dichloropropane			
33.	1,2-dichloropropylene			
34.	2,4-dimethyphenol (2,4 xyleneol)		95 ³	
35.	2,4-dinitrotoluene			
36.	2,6-dinitrotoluene			
37.	1,2-diphenylhydrazine			
38.	Ethylbenzene	0 ¹	89 ¹ , 95 ³ , 99 ²	96
39.	Fluoranthene			
40.	4-chlorophenyl phenyl ether			
41.	4-bromophenyl phenyl ether			
42.	Bis (2-chloroisopropyl) ether			
43.	Bis (2-chloroethoxy) methane		10 ¹	
44.	Methylene chloride	16 ¹	47 ¹	
45.	Methyl chloride		55 ² , 56 ² , 95 ³	

TABLE 5.4.2-1 (cont'd)

	Pollutant	Primary Treatment	Secondary Treatment	Tertiary Treatment
46.	Methyl bromide			
47.	Bromoform			
48.	Dichlorobromomethane		95 ³	
49.	Trichlorofluoro-methane		95 ³	
50.	Dichlorodifluoro-methane			
51.	Chlorodibromomethane			
52.	Hexachlorobutadiene			
53.	Hexachlorocyclopentadiene			
54.	Isophorone			
55.	Naphthalene	0 ¹	92 ¹ ,95 ³ ,99 ²	
56.	Nitrobenzene		90 ³	
57.	2-nitrophenol			
58.	4-nitrophenol			
59.	2,4-dinitrophenol		90 ³	
60.	4,6-dinitro-o-cresol			
61.	N-nitrosodimethylamine		90 ³	
62.	N-nitrosodiphenylamine			
63.	N-nitrosodi-n-propylamine			
64.	Pentachlorophenol		95 ³	61
65.	Phenol		65 ⁴ ,95 ³ ,99 ²	97
66.	Bis (2-ethylhexyl) phthalate	0 ¹	77 ¹ ,90 ³ ,74	
67.	Butylbenzyl phthalate		95 ³ ,97 ² ,99 ²	
68.	Di-n-butyl phthalate	40 ¹	6 ¹ ,51 ² ,58 ² ,63 ² 63 ² ,90 ³ ,97 ²	88
69.	Di-n-octyl phthalate			
70.	Diethyl phthalate	0 ¹	36 ¹ ,96 ² ,99 ²	
71.	Dimethyl phthalate		95 ³	
72.	Benzo (a) anthracene (1,2-benzanthracene)			
73.	Benzo (a) pyrene (3,4-benzopyrene)			
74.	3,4-benzofluoranthene			
75.	Benzo (k) fluoranthene			
76.	Chrysene			
77.	Acenaphthylene		95 ³	
78.	Anthracene		95 ³	
79.	Benzo (g,h,i) perylene (1,12-benzoperylene)			
80.	Phenanthrene	0 ¹	36 ¹	
81.	Fluorene			
82.	Dibenzo (a,h) anthracene			
83.	Indeno (1,2,3-cd) pyrene			
84.	Pyrene			
85.	Tetrachloroethylene (Perchloroethylene)	25 ¹	85 ² ,87 ² ,88 ¹ ,90 ³	80
86.	Toluene	10 ¹	86 ¹ ,95 ³ ,96 ² ,97 ²	98
87.	Trichloroethylene	42 ¹	78 ¹ ,95 ³ ,97 ²	92
88.	Vinyl chloride (Chloroethylene)		95 ³	99

TABLE 5.4.2-1 (cont'd)

	Pollutant	Primary Treatment	Secondary Treatment	Tertiary Treatment
89.	Aldrin		90 ³	
90.	Dieldrin		90 ³	
91.	Chlordane			
92.	4,4'-DDT			
93.	4,4'-DDE			
94.	4,4'-DDD			
95.	a-endosulfan-Alpha			
96.	b-endosulfan-Beta			
97.	Endosulfan sulfate			
98.	Endrin		95 ³	
99.	Endrin aldehyde			
100.	Heptachlor			
101.	Heptachlor epoxide			
102.	a-BHC-Alpha			
103.	b-BHC-Beta			
104.	r-BHC-(Lindane)-Gamma			
105.	g-BHC-Delta			
106.	PCB 1242			
107.	PCB 1254			
108.	PCB 1221			
109.	PCB 1232			
110.	PCB 1248			
111.	PCB 1260			
112.	PCB 1060			
113.	Toxaphene		95 ³	
114.	Antimony (total)	25 ¹	42 ¹	
115.	Arsenic (total)		50 ³	
116.	Asbestos (fibrous)			
117.	Beryllium (total)			
118.	Cadmium (total)		6 ⁴ ,10 ⁴ ,27 ³ ,92 ² ,93 ²	87
119.	Chromium (total)	0 ¹	32 ⁴ ,52 ⁴ ,70 ³ ,76 ² ,95 ¹	79
120.	Copper (total)	21 ¹	69 ⁴ ,73 ⁴ ,75 ¹ ,82 ²	
121.	Cyanide (total)	0 ¹	15 ¹ ,40 ² ,59 ² ,90 ³	
122.	Lead (total)	12 ¹	44 ⁴ ,46 ⁴ ,69 ¹ ,81 ² 90 ³ ,97 ²	88
123.	Mercury (total)	21 ¹	22 ⁴ ,49 ⁴ ,50 ³ ,100 ¹	82
124.	Nickel (total)	0 ¹	9 ⁴ ,32 ² ,35 ² ,35 ³ ,49 ¹ ,48	
125.	Selenium (total)		18 ⁴ ,50 ³	91
126.	Silver (total)	17 ¹	82 ² ,83 ¹ ,86 ² 90 ³ ,94 ² ,95 ²	
127.	Thallium (total)			
128.	Zinc (total)	18 ¹	63 ⁴ ,70 ¹ ,71 ⁴ ,77 ³	
129.	2,3,7,8-tetrachlorodibenzo -p-dioxin (TCDD)			

Source: K.P. Lindstrom Inc. 1991 compiled from ¹ E.C. Jordan Co. (1982); ² EPA (1982); ³ EPA (1986); and ⁴ EPA (1977) As reproduced by Goddard & Goddard Engineering

Abbreviations: Ag = Silver; Cd = Cadmium; Cr = Chromium; Cu = Copper; Hg = Mercury; Ni = Nickel; Pb = Lead; Zn = Zinc

Impact 5.4.2.3. Based on the one sample of sludge analyzed, which showed that the sludge has low concentrations of chemical constituents when compared with national sludge quality data, no adverse impact on groundwater from solubilization of trace metals is expected.

Mitigation 5.4.2.3. (Recommended.) Implement measures for controlling sludge disposal including DOHS recommended practices for land spreading.

No mitigation required, however, the following measures are recommended to provide an adequate level of protection to the environment from sludge disposal practices:

- Adequate buffer zones around areas receiving stabilized sludge and to groundwater and domestic water supply wells (at least 500 feet).
- Runoff drainage and leachate should be controlled.
- Application rates should be tailored to address nitrate pollution of groundwaters and cumulative metals concentrations in soils, which should be sampled and analyzed.
- Employees should receive periodic typhoid and tetanus shots.
- Handwashing facilities are mandatory at all sludge disposal operations.
- Adequate operating records should be maintained to document how much and where sludge was applied.

Operations should comply with the provisions of the Waste Discharge Requirements issued by the CRWQCB and Permit to Operate issued by the LCAQMD.

The DOHS has prepared a "Manual of Good Practices for Land-spreading of Sewage Sludge" (DOHS, 1983). The purpose of this manual is to "present those practices in the treatment and use of sewage sludge which have been found to be effective in assuring the safe and beneficial use of the material." The manual is used as guidance by some regional water quality control boards and local health departments in recommending procedures to use in land application of sewage sludges and contains the following recommendations pertinent to the operations at the SERWTP:

Land Reclamation and Non Food-Chain Crops. The following requirements should be met for the land reclamation of sludge where applied to a non-food chain crop.

- Sludges should be stabilized prior to application.
- Sludge should be incorporated into the soil within 48 hours of application.

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- The public should not use the area for at least one year after application.
- Food chain crops should not be grown for a minimum of 3 years after the last application.
- Metals application rates should not exceed recommended application rates.

Impact 5.4.2.4. Treated wastewater effluent stored in the reservoir may indirectly recharge the groundwater basin and result in changes in local water quality. Potential impacts can be minimized by proper reservoir construction, operation and maintenance. With appropriate mitigation measures this impact would be less than significant.

The SERWTP monitors groundwater at the edge of their facilities and have had no complaints from adjacent well water users.

Mitigation 5.4.2.4. LACOSAN shall continue the existing well water monitoring program.

Impact 5.4.2.5. Effluent runoff from the land disposal areas, if not properly managed, could cause surface contamination of local drainage ways. Since drainage is controlled via the catchment basin and pumped back to the storage reservoir, no adverse impact on water quality is anticipated. This impact would be less than significant.

Operations must comply with the provisions of the Waste Discharge Requirements issued by the CRWQCB and Permit to Operate issued by the LCAQMD.

Impact 5.4.2.6. Flooding potential in the project area is minimal except in the unlikely event that the existing reservoir dam were to fail. Should such an event ever occur, water would flow down the creek through Burns Valley to Clear Lake causing minor flooding. Failure of the dam would be a significant impact.

The reservoir dam was constructed to comply with the Division of Safety of Dams requirements and specifications. LACOSAN staff periodically inspect the dam on both sides.

Mitigation 5.4.2.6. LACOSAN staff shall continue periodic dam inspections and shall maintain freeboard limits.

Impact 5.4.2.7. Nutrients contained in treated wastewater could create algal growths which could change water quality in the reservoir. The most significant potential adverse impact would be the creation of odors during reservoir drawdown. This less-than-significant impact is discussed in the air quality section (Impact 5.4.4.2).

See Impact 5.4.4.2 for mitigation measures.

Impact 5.4.2.8. Stormwater runoff from the SERWTP could potentially cause contamination of surrounding surface waters in local drainage ways and Clear Lake. New legislation requires that the SERWTP obtain a NPDES (National Pollutant Discharge Elimination System) Permit for stormwater discharges. If provisions of the NPDES Permit are adhered to, any impacts from stormwater runoff would be less than significant.

In 1972 the Federal Water Pollution Control Act [the Clean Water Act (CWA)] was amended to provide that the discharge of pollutants in stormwater to waters of the United States from any point source is unlawful, unless the discharge is in compliance with a NPDES permit. 1987 amendments to the CWA added Section 402(p) which establishes a framework for regulating municipal and industrial stormwater discharges under the NPDES program. On November 16, 1990, the U.S. EPA published final regulations establishing requirements for applications for stormwater permits. The State Water Resources Control Board (SWRCB) has issued a statewide general permit (rather than requiring individual or group permits) that will apply to all industrial stormwater discharge categories except construction, for which a separate general permit will be issued. The general permit for the project will be implemented and enforced by the Central Valley Regional Water Quality Control Board. As new permits are issued to industries that currently have a NPDES permit for discharge of treated wastewater, stormwater provisions will be included in the revised NPDES permit and supersede the general permit.

Mitigation 5.4.2.8.A. The general stormwater discharge permit will require industrial dischargers, which includes sewage treatment plants, to: (1) eliminate illicit discharges of stormwater to stormwater systems; (2) develop and implement a stormwater pollution prevention plan; and (3) perform monitoring of discharges to stormwater systems.

Permits for stormwater discharges associated with industrial activity must meet all applicable provisions of Sections 301 and 402 of the Clean Water Act, which require control of pollutant discharges that use Best Available Technology economically achievable (BAT) and Best Conventional pollutant control Technology (BCT) to reduce pollutants, and any more stringent controls necessary to meet water quality standards.

The Monitoring Program requires:

- visual monitoring for both stormwater and non-stormwater discharges;
- testing and analysis of stormwater samples for pH, total suspended solids, and specific conductance;

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5.4 Related to the SERWTP Facilities Plan

- testing and analysis for other specific pollutants under 40 CFR Subchapter N and SARA Title III Section 313 if applicable;
- testing and analysis for individual toxic pollutants known to exist at the facility, and oil, grease and total organic carbon; or these tests may be replaced with one test for acute toxicity; and
- retention of this information for a minimum three years.

This NPDES general permit also requires compliance with the California Inland Surface Water Plan and the Enclosed Bay and Estuaries Plan (Adopted April 11, 1991) in addition to the Basin Plan. The NPDES permit also requires compliance with all lawful requirements of municipalities, counties, drainage districts, and other local agencies.

A draft version of the NPDES Stormwater Pollution Prevention Plan, and Monitoring Program and Reporting Requirements, are included as suggested mitigation measures (Tables 4-18 and 19). These are in draft form as presented at the public hearing on September 3, 1991. Adoption of the proposed general permit was to be considered on September 19, 1991.

Should the site require dewatering, mitigation measures should include those normally used as part of construction on-site water management, such as desanding of water and water disposal in accordance with EPA and Regional Board guidelines.

Mitigation 5.4.2.8.B. Drainage plans shall be prepared by a registered civil engineer and submitted to the Lake County Flood Control District and Department of Public Works for approval. All drainage improvements shown on the approved plans shall be implemented into the project.

Mitigation 5.4.2.8.C. Prior to the issuance of grading permits, the LACOSAN shall submit an on-site and downstream off-site drainage plan for the approval of the Lake County Flood Control District. This plan shall include hydraulic calculations on and off-site, and shall address the existing capacity of watercourses and impacts of development using 10 year criteria. Drainage structures shall be designed with adequate capacity for full development of the project site.

Mitigation 5.4.2.8.D. Drainage plans shall distribute storm runoff and channel it to existing natural waterways only to the extent that it will not increase water head to the point of unnatural channel abrasion, nor carry excessive siltation which might adversely impact water quality. Energy dissipators and collection devices to reduce the erosion force of unnatural runoff shall be installed if required by county or state agency representatives.

5.4.3. BIOLOGICAL RESOURCES

Impact 5.4.3.1. Construction of the proposed improvements to the SERWTP facilities is not expected to significantly impact any wildlife species or its habitat within the SERWTP treatment plant boundaries.

No rare, endangered or threatened species have been identified as being present within the project area.

No mitigation is required.

Impact 5.4.3.2. Operation of the proposed improvements to the SERWTP facilities could have an adverse effect on the biotic resources in the project area if a spill occurs. The spilled effluent water would drain to Burns Valley Creek and to Clear Lake. The risk of such an event would be less with the proposed project than without it. The impact is potentially significant.

Mitigation 5.4.3.2 Nutrient loads of effluent disposed to surface waters should be minimized and the project should comply with CVRWQCB and California Department of Fish and Game requirements and recommendations regarding water quality.

Implementation of Mitigation 5.4.3.2 would reduce the impact to a less than significant level.

5.4.4. AIR QUALITY

Impact 5.4.4.1. The estimated nitrogen dioxide emissions of 235 lb NO_x/day and the 158 lb TSP/day indicate that the construction of proposed SERWTP facilities will require a LCAQMD Authority to Construct since the New Source Review limits are surpassed by nitrogen dioxide and the Total Suspended Particulate emissions as outlined in LCAQMD Rule 602. The impact is potentially significant. Impacts related to NO_x emissions are potentially significant and possibly mitigable. Both are short-term impacts.

Emissions at the SERWTP will be short-term with construction activities estimated to be on-going for 1-2 years. At the maximum estimated construction activity 19.8 lb TSP/hr will be generated over a 2.6 acre area from fugitive dust and exhaust emissions. It is estimated that 50% of the TSP will include particulates less than 10 microns in diameter (PM₁₀). The estimated 1-2 year on-going 2.6 acres of disturbance at the SERWTP includes reservoir improvements as well as the improvements to the treatment plant.

A worst case impact analysis was performed by Goddard and Goddard using a low level temperature inversion at 328 ft (100 m) and a low wind speed of 2.24 mph (1 mps). The closest residents are located 0.33 mi (1,740 ft) to the southeast and to the west-southwest of the SERWTP. An area source was estimated for the 2.6 acres of disturbance with the emissions rising 150 ft (45.7 m). The 24 hour average worst case estimated PM₁₀ impact was 15.3 ± 5.96 $\mu\text{g}/\text{m}^3$. The impact is below the CAAQS of 50 $\mu\text{g}/\text{m}^3$ as listed in Table 6-2 and below the EPA Prevention of Significant Deterioration of 18 $\mu\text{g}/\text{m}^3$. The LCAQMD has expressed concern that a possible exceed of the CAAQS could occur when background airborne particulates are added to the estimated worst case construction related SERWTP air quality impact (LCAQMD, September 4, 1991).

It is estimated that during the 2.5 year project construction period a total of 10 acres will be disturbed at the SERWTP site with no more than 2.6 acres disturbed at any one time. The rough grade civil construction will apply 0.5 gal of water twice per day per square yard on the active construction areas. This is estimated to reduce particulate emissions by 50% (EPA AP-42 Section 11.2.4, EPA-450 page 5-16). A dust palliative, equivalent to lignin sulfate, is to be used in inactive areas of the 2.6 acres resulting in an estimated 80% control of particulate emissions (EPA-42 Section 11.2.4). At the 2.6 acre area of active disturbance and using the estimated 50% dust control, the fugitive dust from the civil construction activities was estimated using EPA AP-42 Section 11.2.4, assuming 30% silt and correcting for the Potential Evapotranspiration (PE). It was estimated that 125 lb TSP/day (Total Suspended Particulates) (1.2 ton TSP-acre/month x month/30 day x 2,000 lb/ton x 60 PE/50 PE x 2.6 acres) prior to mitigation would be generated by fugitive dust from civil activities at the site.

It is estimated that the heavy equipment complement for the improvements at the SERWTP will require 2 graders, 2 bull dozers, 1 carry-all scraper, 1 trencher, 2 wheeled loaders, 2 water trucks and 7 haul trucks. Estimated hourly, daily and yearly gaseous and particulate emissions due to the fuel consumption of the construction equipment is listed in Table 5.4.4-1. The emission estimates are based upon heavy equipment emission factors from EPA AP-42 and from the EPA EFAC emissions program.

The total estimated fugitive dust for the civil construction at the SERWTP is estimated at 133 lb TSP/day. Adding the mobile particulate emissions estimate of 25.2 lb TSP/day from Table 6-4 brings the total to 158 lb TSP/day.

The estimated nitrogen dioxide emissions of 235 lb NO_x/day listed in Table 6-4 and the 158 lb TSP/day indicate that the construction will require a LCAQMD Authority to Construct since the New Source Review limits are surpassed by nitrogen dioxide and the Total Suspended Particulate emissions as outlined in LCAQMD Rule 602.

Mitigation 5.4.4.1.A. The construction contractor shall comply with dust control procedures required by the LCAQMD.

The first phase of civil construction should be removal of the top soil to a depth of 2 + inches and all vegetation within the disturbed areas, using a grader. Water should be applied for fugitive dust control. The material removed should be stockpiled for use at other locations requiring revegetation or at the fill area as needed.

The second phase should be scarification of exposed surfaces to receive fill to a depth of six inches. Water should be applied to aid in fugitive dust control and compaction. Sheepsfoot or other rollers should be used for compaction. Areas sloped greater than 20 percent should be keyed, benched and the moistened soil compacted to maintain stability, for fugitive dust control and to reduce wind erosion.

The final civil construction areas should be prepared by making a balanced cut and fill of the affected land. Scrapers, bulldozers, front end loaders, dirt transfer trucks and water trucks will be used for this work. Fill should be water treated and compacted to 95 percent within civil foundation areas and to 90 percent elsewhere to stabilize and reduce vehicular and wind erosion.

A geophysical test of the site should be performed to determine if areas to be excavated require blasting. If blasting is required, explosives should be placed in holes drilled in the rock at predetermined depth and frequency of placement, then detonated. Rock and soil disturbed by blasting should be limited to that which is required for the excavation.

Excavated soil and rock should be used as fill to bring the civil construction sites to final grade. Water should be applied to aid in compaction and for fugitive dust control. Oversize rocks should be placed at the base of fill areas or removed to an acceptable dump site.

During excavation, watering should occur on an on-going daily basis as needed for dust suppression. As previously stated, watering on a regular basis (i.e., two to four times per day) can reduce dust emissions by about 50 percent. It is recommended that dust palliatives be used

on those areas which construction has disturbed but which will await further civil work in the future. Upon completion of civil activities, affected areas should be revegetated and appropriate soil erosion structures erected.

Effective dust control should be maintained throughout the project by each of the contractors. Use of water or dust palliative should comply with standard specifications. It is recommended that the soils engineer evaluate the potential for odor generation of necessary excavations and to develop recommended mitigation measures should there be a need for control procedures.

Mitigation 5.4.4.1.B. The LACOSAN shall obtain an Authority to Construct and maintain a Permit to Operate from the Lake County Air Quality Management District (LCAQMD). All conditions of the LCAQMD Authority to Construct and Permit to Operate are herein referenced and made part of this project description.

Mitigation 5.4.4.1.C. The LACOSAN shall comply with all applicable local, state and federal laws and regulations regarding air contaminants. This requirement includes, but is not limited to, emissions of suspended particulates, carbon monoxide, hydrocarbons, odors, and toxic or obnoxious gases and fumes.

Mitigation 5.4.4.1.D. The LACOSAN shall utilize best available air emissions control technology as necessary to minimize emissions subject to the approval of the Lake County Air Quality Management District.

Implementation of Mitigation 5.4.4.1.A through D would reduce the impacts of TSP to a less than significant level. Impacts related to NO_x emissions would remain significant, but would be short-term in duration.

Impact 5.4.4.2. The long term potential impact of the sewage treatment plant is from the generation of odors. The major odor sources include the grease pits which are exposed to the air, the sludge drying beds, and the influent structure where raw wastewaters enter the plant. The proposed improvements to the facility will result in greater reliability in maintaining the sewage treatment operations within standards and will result in a reduced likelihood of odor generation. Therefore, the impact is considered beneficial.

Odor complaints have not arisen from the past disposal operations.

No mitigation required.

Impact 5.4.4.3. There is a potential for odor generation from soils upon excavation during the civil construction of proposed improvements. The impact is of undetermined significance.

Mitigation 5.4.4.3. The soils engineer should evaluate the potential for odor generation upon excavation and mitigation measures should be developed and implemented if deemed necessary by the LCAQMD.

Impact 5.4.4.4. New pumps and operation support equipment will be electrically powered, and the emissions associated with their use will be those derived from regional energy generating facilities. These emissions are considered to be minor and will not significantly impair achieving regional air quality goals.

Any major changes in plant operation which have the potential for generating an increase in air pollutant emissions should be controlled to comply with the regulations of the LCAQMD permits.

5.4.5. NOISE

Impact 5.4.5.1. Construction at the treatment plant site for the excavation of the various facilities, demolition of some existing facilities and transportation to and from the site would increase existing noise levels. The incremental increase over background noise levels created by these activities is estimated at 86 dBA at 50 ft. This is estimated to impact the closest residence, during peak construction, at 54 dBA. The impact is potentially significant short-term and partially mitigable.

Mitigation 5.4.5.1. Construction noise can be reduced by ensuring that the equipment uses proper mufflers and that the construction activities occur only during acceptable hours (not before 7:00 a.m. and no later than 7:00 p.m.) as specified in the Lake County Zoning Ordinance section 41.11. See also Mitigation in Section 5.2.5.

Implementation of Mitigation 5.4.5.1 would reduce noise during periods of particular annoyance to residents, but noise levels would remain significant at other times.

Impact 5.4.5.2. The proposed additional wastewater processing equipment at the SERWTP will generate operational noise which will add incrementally to the existing noise levels. Since the closest neighbors are 2,000 ft away, background noise levels caused by the additional equipment and activities at the site are estimated to be below 55 dBA, Ldn.

Mitigation 5.4.5.2 (Recommended) Generating equipment which creates the least noise should be considered in the selection of aeration equipment. Equipment should be selected on the basis that it should not result in noise levels greater than 45 dBA at the SERWTP boundary if it is to operate at night.

5.4.6. CULTURAL RESOURCES

Impact 5.4.6.1. Because of the extensive previous analysis at the SERWTP site, it is not anticipated that new cultural resources would be encountered during facilities construction. However, if resources are present, their disturbance would constitute a potentially significant impact. Operation of the proposed project would not have any direct adverse effects on the cultural resources in the project area.

Prehistoric archaeological materials include, but are not limited to, obsidian, chert, and basalt flakes and artifacts, groundstone (such as mortars and pestles), shell beads and pendants, midden (locally darkened soil), and human graves. Historic archaeological materials include, but are not limited to, glass bottles, privys, and ceramics.

Mitigation 5.4.6.1.A. Should archaeological materials be discovered during development, all activity should be temporarily halted in the vicinity of the finds and a qualified archaeologist shall be retained to evaluate the finds and to recommend mitigation procedures if necessary.

Mitigation 5.4.6.1.B. The LACOSAN shall contact a designated member of the Native American community acceptable to the Lake County Planning Department prior to grading, trenching or excavation.

Mitigation 5.4.6.1.C. All grading, trenching or excavation shall be conducted in the presence of a qualified archaeologist. Should any cultural or archaeological resource be discovered, all work shall halt in the vicinity of the find(s) until the archaeologist determines the significance of the resource and recommends mitigations. Mitigation measures, if necessary, shall be implemented subject to the approval of the Planning Department.

Mitigation 5.4.6.1.D. Alterations to cultural site shall be subject to the review and approval of the Lake County Cultural Resource Commission unless waived by the Planning Director consistent with Article 21-38.4 of the Lake County Zoning Ordinance.

5.4.7. VISUAL

Impact 5.4.7.1. The proposed SERWTP facilities would be constructed immediately adjacent to the existing facilities in an area previously disturbed by construction activities. Therefore, significant visual impacts are not anticipated.

It is estimated that the tallest structure would not exceed 30 feet and would not add any new profile to the existing buildings which will be visually striking.

Operation of the proposed project will not result in a changed appearance of the treatment plant site.

Mitigation 5.4.7.1.A. (Recommended) Architectural features and landscaping of the new facilities should be reviewed and approved by County and City of Clearlake Planning Departments to ensure that they are attractive and consistent with their surroundings.

Mitigation 5.4.7.1.B. (Recommended) Trees should be planted in the irrigation buffer area to help reduce drift of aerosols and improve plant area appearance, and should be protected effectively from grazing animals. There should be continued maintenance to ensure that the landscaping at the SERWTP is maintained, watered and pruned, and the attractiveness of the facilities is maintained by painting etc.

Mitigation 5.4.7.1.C. Irrigation and the placement of landscape plants within the dripline area of oaks shall be avoided.

Mitigation 5.4.7.1.D. Development of the site shall maximize the retention of existing vegetation and the protection of trees on the site. The landscape plan shall show all trees over 4 inches in diameter at 3 feet in height in the proposed development area, and indicate which will be retained and which are proposed for removal. No development or irrigation shall occur within the dripline of all remaining trees unless specifically approved in the landscape plan.

5.4.8. LAND USE

Impact 5.4.8.1. Construction at the SERWTP would convert 10 acres from other uses to facilities. This is a less than significant impact.

No mitigation is required.

Impact 5.4.8.2. Implementation of the proposed project would result in compliance with CRWQCB Waste Discharge Requirements and lifting of the building moratorium now in effect. Development may then take place in accordance with County and City planned growth, consistent with General Plan and zoning land use designations.

No mitigation is required.

5.4.9 SOCIOECONOMICS AND PUBLIC FACILITIES

Impact 5.4.9.1. Implementation of the proposed facilities improvements in combination with disposal through the effluent pipeline to The Geysers would allow lifting of the existing moratorium on new connections and permitted and planned growth. This is consistent with the Lake County and City of Clearlake General Plans.

See discussion in Section 7.2, Growth-Inducing Impacts. As a result of the new connections, the project would make possible planned economic growth with related employment opportunities. Housing construction would increase and there would be a need for increased services, including fire protection, police, health care and schools, as the population grows.

Lake County assesses the cumulative impacts on public facilities improvements and the need for capital improvements through the environmental review process. This provides for the timely development of necessary public service improvements. Planned growth made possible by the availability of new connections represents a beneficial impact of the proposed project consistent with the pertinent City of Clearlake and County General Plans, Area Plans, and area zoning.

No mitigation required.

5.4.10 ENVIRONMENTAL CONTAMINATION HAZARDS

Impact 5.4.10.1. The estimated risks on an annual basis for the existing use of chlorine at the SERWTP is considered insignificant.

The hazards of chlorine gas were summarized by Winzler & Kelly in the 1987 *Upper Lake Wastewater Facilities DEIR*. It is a highly acutely toxic chemical when inhaled and there are a number of potential hazards associated with its use for disinfection. An accidental release of chlorine could endanger treatment-plant employees, nearby residents, and anyone else in the vicinity of the plant. Livestock and wildlife could also be affected. Accidental release could also occur along the delivery route to the treatment plant. Chlorine may be dispersed from the site of an accident as a cloud at ground level because chlorine is heavier than air. Chlorine has a sharp odor which may provide warning.

Because chlorine is handled and used daily at nearly every sewage and water treatment plant in the U.S., precautions to be taken are well established and the chances of a serious accident are

low. With the precautions that are normally taken in the handling and use of chlorine gas, the risk of impact is considered insignificant.

Risks on an annual basis for the existing use of chlorine at the SERWTP were calculated by Lindstrom based on methodology contained in Hubly et al. (1985) and assuming purchase of one ton cylinders from a chemical supplier in Pittsburg, California. The study included transportation, worker exposure, and accidental and incidental chlorine releases. Lindstrom concluded that these estimated risks, listed in Table 12-2, are insignificant. The estimated risk of injuries of 10.5 in 100,000 may be compared to the national measured rate of 2,824 injuries per 100,000 workers (1970) (U.S.D.H&H.S., 1973).

Chlorine applied to wastewater in its elemental or hypochlorite form initially undergoes hydrolysis to form free available chlorine. The free available chlorine then readily reacts with ammonia to form monochloramine and dichloramine. The presence and concentration of these combined forms depend mainly on pH, temperature, and the initial chlorine to ammonia-nitrogen ratio. In chlorinated wastewaters, the predominate species and the disinfectant is monochloramine.

Mitigation 5.4.10.1.A. (Recommended) The most important precaution is the proper handling of the chemicals and the proper maintenance of equipment. Operator training in this regard is therefore very important.

Typically an operations and maintenance manual for the treatment plant would be prepared by the design engineer in which chlorine safety would be detailed.

Mitigation 5.4.10.1.B. (Recommended) The chlorination should be located as far from any residences as feasible.

A chlorine detector alarm audible from the nearby residences should be considered, in addition to telemetering the alarm to the plant operator or security person.

Mitigation 5.4.10.1.C. (Recommended) Nearby residents should be educated regarding chlorine odors and response procedures if chlorine odors or an alarm are noticed.

It is recommended that information from a chlorine leak detector be transmitted to the Fire Protection District and Sheriff's Department. Notification of the LCAQMD should be included.

Mitigation 5.4.10.1.D. Prior to storage, a chlorine leak detector shall be installed which will be transmitted by a telephone dialer to the Fire Protection District office and the Lake County Sheriff's Department. An emergency airpack for entrance into the operations room in the event of a chlorine leak shall be available on-site.

Mitigation 5.4.10.1.E. All areas designated for liquid fuel storage shall include secondary containment features equal to at least 150% of the fuel storage tank volume in compliance with Uniform Fire Code Section 79.508. No liquid fuels shall be stored on the property until these containment features have been completed and approved by the Lake County Environmental Health Department and OSHA. At no time shall liquid fuel storage take place outside of a designated and contained fuel storage area.

Mitigation 5.4.10.1.F. The permit holder shall contractually obligate all associated contractors and their subcontractors to conduct a vehicle inspection of each truck hauling toxic or hazardous materials prior to leaving the project site.

The inspection shall include brakes, vehicle connections, wheels/tires, valves, tanks, and other equipment as outlined in Title 13 CAC. After loading, a material inspection for leaks in the system shall be conducted. All inspections shall be logged for verification by agency staff.

Implementation of Mitigation Measures 5.4.10.1.A-F would ensure that risks are minimized to acceptable levels.

5.4.11 TRAFFIC AND CIRCULATION

Impact 5.4.11.1. There would be short-term increases in vehicular activity associated with the construction of the proposed facilities. There would be construction employees coming to the sites and the transport and use of heavy equipment in the form of a grader, a bulldozer, a scraper, a loader and necessary haul trucks. The impact is considered significant.

Other transportation-related impacts are those associated with hauling of construction materials to the site, and impacts associated with the labor force which is estimated at 15 workers. Since it is proposed to dispose of excavated material on-site there will not be impacts from moving this material on the highways. There may be short-term inconveniences to local residents during the construction of the project.

Construction workers and support personnel needed to work on the project (e.g., laborers, equipment operators, and a wide variety of tradespeople and engineers, inspectors, etc.) would generate an estimated 4 haul trucks and 15 worker additional vehicle trips per day.

There will be increased use of chemicals with associated trucking to the SERWTP and removal of wastes to the Eastlake Landfill via Highway 53.

Mitigation 5.4.11.1.A. (Recommended) The local residents should be notified in advance of the construction schedule of the possible inconveniences they may incur as a result of the construction activities. Proper road signs and signal personnel should be utilized to ensure that public and occupational safety is maintained during construction.

Mitigation 5.4.11.1.B. (Recommended) Movement of heavy equipment should be scheduled to avoid commute hours on Highway 53 and school bus hours.

Mitigation 5.4.11.1.C. (Recommended) Repair of any damage to roads from truck traffic or equipment should be done immediately.

Mitigation 5.4.11.1.D. All parking and access areas shall be continuously maintained in good repair throughout the life of the project.

Mitigation 5.4.11.1.E. LACOSAN shall obtain all required encroachment permits from DPW, Caltrans and the City of Clearlake.

Mitigation 5.4.11.1.F. The project sponsors shall be responsible for repair of any direct verifiable damage to public roadways resulting from construction or operation of this project.

Mitigation 5.4.11.1.G. The LACOSAN and all subcontractors operating under the authority of this project shall comply with speed limits and all other traffic laws on public roadways. Construction-related truck traffic shall avoid school busing hours.

Mitigation 5.4.11.1.H. All extra-wide and slow-moving vehicles shall be preceded by a flag car while on public roadways. The California Highway Patrol shall be notified of hazardous waste transport schedules by the permit holder.

Mitigation 5.4.11.1.I. The LACOSAN shall install necessary traffic signs and/or striping as recommended by the Department of Public Works and the City of Clearlake.

5.4.12 ENERGY AND MATERIALS

Impact 5.4.12.1. Due to the improvements to the SERWTP which will accommodate future growth, the electrical consumption is expected to increase by about 20% - 35%. This would be an insignificant increase.

No mitigation is required.

6. ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES OF THE ALTERNATIVES TO THE PROJECT

6.1 IMPACT SIGNIFICANCE CRITERIA FOR ALTERNATIVES TO THE PROJECT

The criteria for determining the significance of impacts of alternatives are the same as those identified in Chapter 5 for the proposed project. No additional criteria have been identified for the design alternatives. Under the No Action Alternative, most of the impacts related to the project would not occur. However, under the No Action Alternative, additional criteria have been identified. Under the No Action Alternative, a significant impact would occur if:

- the alternative would result in a continuation of conditions which created the Cease and Desist Order from the CRWQCB;
- the alternative would result in significant fiscal and economic impacts on citizens and public service providers in the service area;
- the alternative would result in a substantial loss of employment.

6.2 IMPACTS AND MITIGATION MEASURES RELATED TO THE NO ACTION ALTERNATIVE

The No Action Alternative encompasses the expected conditions of the environment which would occur if the project were not implemented. Because of existing regulatory requirements, it is not likely that the No Action Alternative could continue without action being forced through the court to correct the wastewater problems at the SERWTP. However, for purposes of completeness, the environmental impacts of a long-term continuation of the existing situation is presented here. Mitigation measures are not presented because in each instance conditions would continue as currently exist.

6.2.1 GEOLOGY, SOILS, AND SEISMICITY

Under the No Action Alternative, none of the impacts on geologic materials and soil resources associated with construction and operation of the Geysers Effluent Pipeline and related facilities would occur, as discussed in Sections 5.2.1. Because growth in the SERWTP service area would cease, cumulative impacts related to erosion and sedimentation from new development would

6.0 Environmental Consequences and Mitigation Measures of the Alternatives

not occur and no substantially increased population would be subject to the earthquake hazards common to the region.

In The Geysers geothermal field, seismic and microseismic events would continue to occur. Ongoing injection of fluids in the Southeast Geysers would not likely cause earthquakes above Richter Magnitude 4.2 to occur. Production effects on microearthquakes, including those generated in the project area and elsewhere in The Geysers, would continue to affect the area. As the Southeast Geysers would face continuing decline in steam production, the effects on microseismicity related to geothermal operations may also decline.

6.2.2 HYDROLOGY AND WATER QUALITY

Under the No Action Alternative, none of the impacts on water resources associated with construction and operation of the Geysers Effluent Pipeline and related facilities would occur, as discussed in Sections 5.2.2.

The long-term implication of the No Action Alternative would entail continued occasional overflows of wastewater into Burns Valley Creek, with the wastewater eventually discharging into Clear Lake. This poses a potentially significant impact on water quality in the lake, as some of the overflow could be untreated wastes from overflow through manholes. This could present a potential health hazard for direct contact water recreation as well as exposure of fish and other wildlife to hazards associated with the wastewater (disease, pathogens, etc.). Additionally, aesthetic qualities of the Burns Valley Creek and Clear Lake in the vicinity of the discharge point would be degraded.

Under the No Action Alternative, in addition to penalties levied for failure to comply with CVRWQCB orders, fines and other penalties might be ordered for individuals deemed responsible for failure to comply with the CVRWQCB order. Penalty fees could be required to be paid by all users in the SERWTP service area.

Impacts on surface hydrology related to increased runoff from development would not occur as the moratorium on development would continue in effect. No increase would occur in urban pollutants related to the curtailed development in the service area.

6.2.3 BIOLOGICAL RESOURCES

Under the No Action Alternative, none of the impacts on biological resources associated with construction and operation of the Geysers Effluent Pipeline and related facilities would occur, as discussed in Sections 5.2.3. Because none of the growth-inducing aspects of the project would occur, there would be no long-term cumulative impacts on wildlife and native plants associated with increased development in the SERWTP service area. Overflows of SERWTP effluent into Burns Valley Creek and discharge into Clear Lake could adversely affect their aquatic ecosystems, possibly significantly depending on the conditions under which such overflows would occur.

6.2.4 AIR QUALITY

Under the No Action Alternative, none of the impacts on air quality associated with construction and operation of the Geysers Effluent Pipeline and related facilities would occur, as discussed in Sections 5.2.4. Because none of the growth-inducing aspects of the project would occur, there would be no long-term cumulative impacts on air quality associated with short-term and long-term emissions from increased development in the SERWTP service area.

Air quality would continue to be good throughout Lake County and Sonoma County. Air quality in the immediate vicinity of The Geysers KGRA would continue to have relatively high concentrations of various air pollutants related to geothermal resource development. Complaints concerning odors from geothermal development processes probably would continue to be filed by residents in Anderson Springs and other communities close to The Geysers KGRA.

6.2.5 NOISE

Under the No Action Alternative, none of the impacts on the noise environment associated with construction and operation of the Geysers Effluent Pipeline and related facilities would occur, as discussed in Sections 5.2.5. Because none of the growth-inducing aspects of the project would occur, there would be no long-term cumulative impacts on noise associated with short-term construction and long-term development in the SERWTP service area. Ambient noise levels in Lake County and Sonoma County would remain low except for areas affected by geothermal development where a multitude of noise sources intrude over quiet background noise conditions.

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Noise would continue to occur in the Southeast Geysers in relation to ongoing operations in the geothermal field. Without a continued supply of water to the geothermal reservoir, production would continue to decline and eventually result in some shut-down of steam collection and power plant operations. This might occur within a 15 to 20 year period. The related noise activities similarly may be expected to decline as a result. Complaints would likely decrease with this decrease in production unless some other source of injection fluid is used as a substitute to the effluent.

6.2.6 CULTURAL RESOURCES

Under the No Action Alternative, none of the impacts on the cultural resources of the project area associated with construction and operation of the Geysers Effluent Pipeline and related facilities would occur, as discussed in Sections 5.2.6. Because, under the continued moratorium on development, none of the growth-inducing aspects of the project would occur, there would be no long-term cumulative loss of archaeological and historic resources associated with short-term construction and long-term development in the SERWTP service area. The exception would be development that was dependent on septic systems or other means of wastewater disposal.

6.2.7 VISUAL RESOURCES

Under the No Action Alternative, none of the impacts on visual resources of the project area associated with construction and operation of the Geysers Effluent Pipeline and related facilities would occur, as discussed in Sections 5.2.7. Because, under the continued moratorium on development, none of the growth-inducing aspects of the project would occur, there would be no long-term cumulative loss of open space associated with development in the SERWTP service area.

In the Southeast Geysers, the decline of the steam field would entail the eventual closure of steam collection facilities and power plants. As equipment were removed, the area would revert to a more natural type of appearance, although roads, cuts and fills would remain indefinitely.

6.2.8 LAND USE

Under the No Action Alternative, no changes in land use as related to the project would occur. The land use impact for the No Action Alternative is the same as that presented in Section 5.2.8. The moratorium on development would continue.

6.2.9 SOCIOECONOMICS AND PUBLIC FACILITIES

The No-Action Alternative would preclude the positive job-creating impacts of the proposed project. The estimated 149 construction jobs would not be created, nor the 6 full-time permanent jobs associated with pipeline operation and maintenance. Additionally, employment in the steamfields would continue to decrease, with a possible loss of 112 industry jobs. These impacts are adverse but less than significant for both Lake and Sonoma Counties as a whole.

The No Action Alternative could have a significant impact on rates for users of the SERWTP. The CRWQCB could impose fines up to \$10,000 per day for LACOSAN's failure to correct problems at the SERWTP. Assuming the fees for the fines alone, the rates to existing users could be increased by as much as \$0.53 per day per person for violations which were fined the maximum allowable amount. Assuming 60 days of violation per year in 1996, this could amount to as much as \$40 per month per household (G&GE, 1991).

Additionally, the projected decline in energy production in the Southeast Geysers would result in reduced tax revenues and royalties collected by Lake and Sonoma Counties, BLM and landowners (See discussion in Section 3.5.7). The reduced revenues would probably result in impacts on public services provided by Lake County and possibly by Sonoma County and the BLM.

In sum, the No Action alternative would have significant adverse economic and fiscal impact on residents in the service area, and possibly for the larger citizenry in both counties as a whole.

6.2.10 ENVIRONMENTAL CONTAMINATION HAZARDS

Under the No Action Alternative, none of the hazards of and impacts on the environment associated with contamination sources during construction and operation of the Geysers Effluent Pipeline and related facilities would occur, as discussed in Sections 5.2.10. Because none of the growth-inducing aspects of the project would occur, there would be no long-term cumulative impacts on environmental contamination hazards associated with short-term construction and long-term development in the SERWTP service area.

In the Southeast Geysers, environmental contamination hazards associated with steam field and power plant operations would continue, although they would decline over time. Hazardous substances currently precipitated out and collected at the power plants would decrease in volume

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as steam field operations decline. There would be a similar reduction in spill hazards and use of potentially toxic substances in normal operational activities.

6.2.11 TRAFFIC AND CIRCULATION

Under the No Action Alternative, none of the hazards of and impacts on traffic associated with construction and operation of the Geysers Effluent Pipeline and related facilities would occur, as discussed in Sections 5.2.11. Because none of the growth-inducing aspects of the project would occur, there would be no long-term cumulative impacts on traffic and roadways associated with short-term construction and long-term development in the SERWTP service area.

In the Southeast Geysers, traffic associated with steam field and power plant operations would continue, although it would decline over time. As parts of the field may be abandoned, some roads would be left in place. It is not known at this time who would have responsibility for maintaining the roads in abandoned areas of the Southeast Geysers. Responsibility may fall on the landowner.

6.2.12 ENERGY AND MATERIALS

The significant beneficial impact on energy resources would not occur under No Action Alternative.

Commercial generation of electricity at The Geysers began in September 1960 with the start-up of PG&E Unit 1, a 12 MW(gross) power plant. Since then, the growth of generation capacity has not followed a predetermined schedule. During the 1960s growth was slow, with installed capacity only rising to 82 MW (PG&E Units 1 to 4) by 1970. However, the growth rate accelerated during the 1970s when 612 MW was brought on-line, and in the 1980s when an additional 1,412 MW of generating capacity was installed.

The large increase in generating capacity that occurred from 1980 to 1985 was motivated by a continued requirement for electrical generating capacity, ever-increasing fuel prices and markets, and Federal support. One specific Federal support action was the PURPA legislation of 1978. The Public Utility Regulatory Policy Act required utilities to purchase electricity from specially qualified independent power producers at the utilities' avoided cost of new generation.

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Since 1986, development at The Geysers has slowed significantly due to a combination of problems with the performance of the developed steamfield, increasing development costs, resource risks, decreasing availability of favorable steam or power sales agreements, and declining steam price. During this period, PG&E first delayed and then canceled its plans to expand its generation by several hundred MW in response to excess capacity in power generation. This excess capacity was at least partially due to the enthusiastic response to PURPA by independent power producers of all types throughout California and the Western States. At the present time, no new power plants are scheduled for construction at The Geysers.

The growth in generation capacity in the early 1980s was matched by the growth in production rate; by 1986, the total production from the field reached a peak of approximately 30 million pounds per hour (lbs/hr). However, since 1987 the total production has dropped significantly and by June 1991 it was approximately 23 million lbs/hr.

In the late 1970s and early 1980s, production decline rates in all parts of the field were relatively low, but with the accelerated development in the 1980s it was found that there was a significant change in well decline characteristics. In most areas, the production decline increased from an exponential rate of 6% per year to 30% per year in 1985 and continued to decline at that rate, although there is evidence of a lessening in decline rate since 1990, possibly due to:

1. the reduction in overall production rate from the field which has dropped from 30 million lbs/hr to 23 million lbs/hr, a reduction of 23%, from 1987 to mid-1991;
2. local changes in injection strategy; and,
3. changes in generating strategy in some areas of the field, notably the NCPA area, by moving from base load operation to load-following.

The significant drop in production rate since 1987 may have improved the field-wide productivity decline rate but has resulted in significant under-utilization of the installed facilities and reduction in future remaining reserves. In mid-1991, it was estimated that the field-wide production was approximately 1,300 to 1,500 MW compared to an installed capacity of 2,106 MW. In 1987, when the production flow rate peaked, the installed capacity was 1,894 MW; an additional 212 MW was installed even while the overall production flow rate was declining.

With the reduction in electrical generation, the ability of The Geysers to continue to provide significant electrical generation into the future has been questioned. A field-wide numerical

6.0 Environmental Consequences and Mitigation Measures of the Alternatives

modeling simulation was undertaken to provide a basis for forecasting future field performance under different scenarios. The modeling effort was one of a number of studies being directed by the Geysers Technical Advisory Committee to investigate the methods that are available to maximize field output in the future in view of the continuing decline trend.

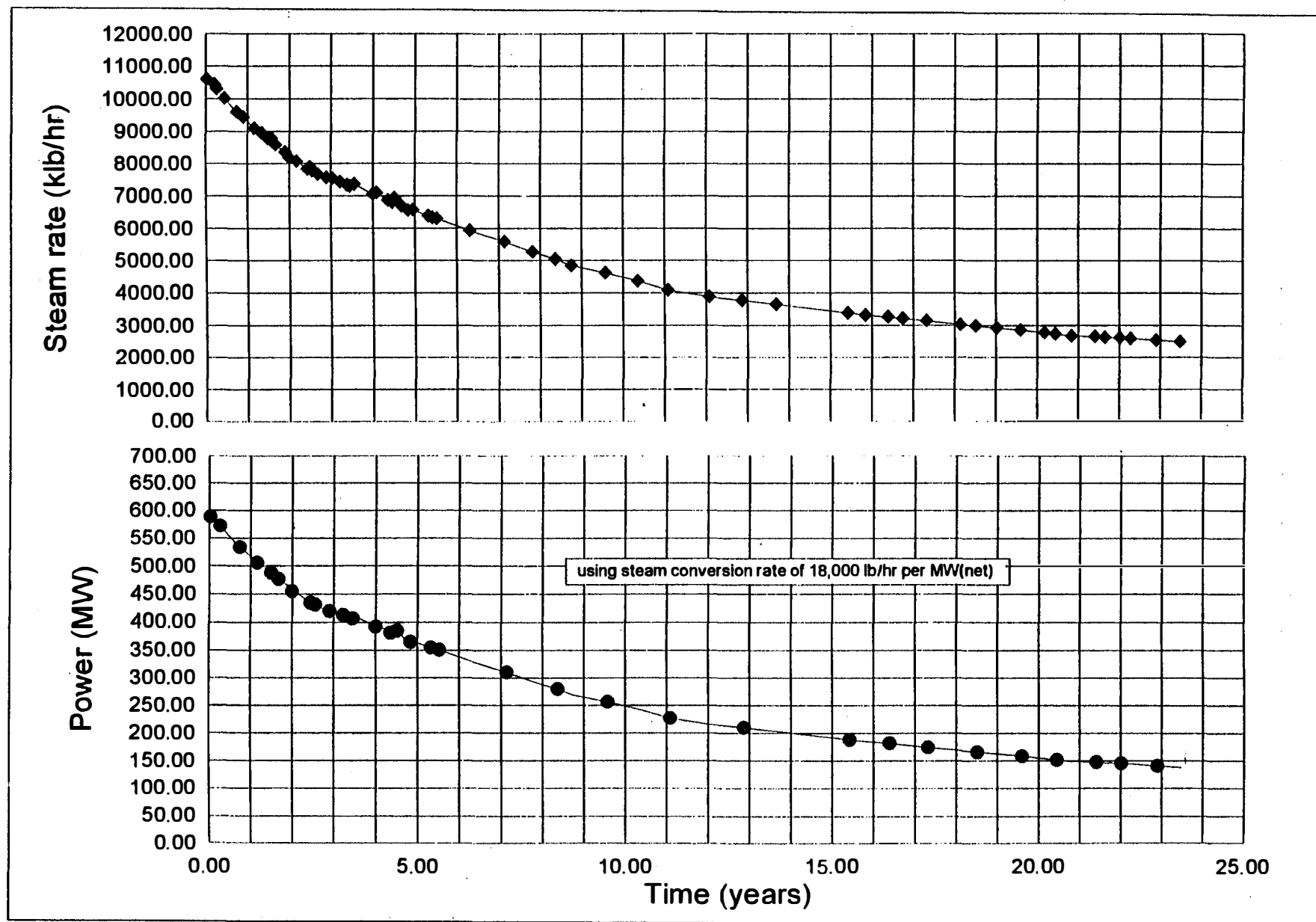
The calibrated model was used to forecast the future changes in total production flow rate from the field under various operating scenarios. One of the cases considered lowering well head pressures by a total of 40 psi generally over the subsequent five years. This scenario was designed to closely reflect the actual operating plans used by the operators in The Geysers. The ability to utilize fluid at reduced wellhead pressure will depend on retrofitting the present Geysers power plants to accept lower pressure steam at the gas ejectors. Modifications to the turbines may also be undertaken to improve efficiency at lower pressures, but this does not preclude the use of lower pressure steam.

The other main assumptions in the forecast are:

1. No infill-drilling except in the Calpine area.
2. Infill-drilling of new wells to maintain power production in the Calpine lease areas.

Figure 6.2.12-A shows the steam rate and power production forecasts for the Southeast Geysers. Results from the simulation indicate a continuing decline in production flow rate over the next 25 years. The Southeast Geysers production flow rate drops to 4.5 million lbs/hr in ten years from the fieldwide June 1991 rate of 23 million lbs/hr production then continues to decline, although at a reduced rate. By the end of the forecast, steam production from the Southeast Geysers has been reduced to 2.5 million lbs/hr. The steam flow rate forecast for the declining wellhead pressure case was converted to MW(net), assuming a constant conversion factor of 18,000 lbs/hr steam per MW(net), and the result is also plotted on the same figure. For the next 25 years power production would drop to a little over 150 MW.

For the forecast run, the percentage of produced fluid that was injected was maintained constant at 25%, slightly below the present injection percentage for the Southeast Geysers. The model did not consider the possibility that with declining production to a plant, the amount of injection water available from the cooling tower would drop below 25%.



SOURCE: Graphic as reproduced from Calpine, 1994

Southeast Geysers Effluent / 920586 ■

Figure 6.2.12-A
Numerical Simulation Steam Rate and
Power Forecasts for the Southeast Geysers

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In summary, the No Action Alternative would result in continued rapid decline in field pressure, steam production, and power output. A continued shut-down of underutilized power plants, with a commensurate loss of revenues to operators, the counties, state and federal government would be expected.

6.3 IMPACTS AND MITIGATION MEASURES RELATED TO THE PROJECT DESIGN ALTERNATIVE

6.3.1 GEOLOGY, SOILS AND SEISMICITY

Impacts for the project design alternative would be similar to those for the proposed project (see Section 5.2.1).

Lake Diversion Pumps and Pipeline on Pier

As few data are available regarding the lake bottom materials for the intake structure and underwater pipeline, it is not possible to draw a comparison with the proposed design.

Construction of the pipeline on a pier likely would present similar geologic hazards of construction on soft soil and impacts as the proposed project.

Bear Canyon Single Pump Station

As the site is flat, there would be less than significant erosion hazards. The site would be subject to potentially significant earthquake ground shaking hazard associated with the Collayomi Valley. Significant ground shaking potentially could result in a shut-down of the facility at least temporarily. If the pump station were temporarily closed, the entire pipeline system operation would be halted.

One-Way Surge Tank in The Geysers

Because the site occupies an existing engineered pad, less than significant erosion and slope instability impacts would be associated with this facility.

6.0 Environmental Consequences and Mitigation Measures of the Alternatives

By-pass Pipeline at the SERWTP

Similar geologic hazards to those described at the SERWTP would be present. Pipeline construction at the SERWTP would have an insignificant impact on erosion and sedimentation.

Alternate Route A-1 and A-2

Geologic impacts and hazards are the same as those of the preferred route in this area. Impact 5.2.1.1 also applies to this alternative. Mitigation Measures 5.2.1.1 A through J also apply.

Alternate Route B

Impact 6.3.1.1. Construction of the alternate crossing could result in significant erosion hazard and a hazard of stream erosion undermining the pipeline.

A greater amount of erosion and sediment generation would be associated with construction of this alternate than with the proposed bridge crossing of Clayton Creek. The impact would be similar to Impact 5.2.1.2. As noted, steep banks with existing gullies may require stabilization to ensure that the pipeline integrity can be maintained. Mitigation measures 5.2.1.1.A through J are the same as for the proposed project. Geotechnical studies required as mitigation shall establish a minimum setback for pier supports from the stream banks.

Alternate Route C

There are no significant geologic impacts associated with this alternative.

Alternate Route D

Impact 6.3.1.2. Construction in this alignment would likely be subject to high erosion hazards similar to those described in Impact 5.2.1.1.

As noted, the alternate route is steep and deeply eroded. Mitigation Measures 5.2.1.1.A through J also would apply to this segment. If these mitigation measures are successfully implemented, the construction of the pipeline in this segment would result in the improvement of an existing badly eroded trail.

Alternate Route E

There are no significant geologic impacts or hazards for this alternative.

Alternate Route F

Impact 6.3.1.3. Because this route ascends a steep slope with erodible soils, erosion hazards would be high, as described in Impact 5.2.1.1.

On the whole, the erosion hazard associated with Alternative Route F would be substantially less than that of the proposed project (that is, the construction of 2,300 foot long road connecting the Bear Canyon Access Road and the M-Pad). Mitigation Measures 5.2.1.1.A through J also would apply to this segment. Additionally, double debris fences shall be installed on both sides of the ridgeline. Following construction, all debris entrapped in the fences shall be collected and removed to a suitable spoil disposal site.

Alternate Route G

There are no significant geologic impacts or hazards for this alternative.

Alternate Site For Childer's Peak Regulating Tank

Construction of this site would require a greater amount of grading, including possibly blasting, as compared to the proposed site. The cut into the hillside to create a pad for the tank, would introduce some potential slope instability. As with the proposed project, at least three exploratory borings should be drilled to assess the variability of subsurface conditions. The proposed 10-foot high 1.5 : 1 slopes probably would be stable and pose minimal hazard for the proposed tank. Additional mitigation is not necessary.

6.3.2 HYDROLOGY AND WATER QUALITY

Lake Diversion Pumps and Pipeline on Pier

Impact 6.3.2.1. The driving of piles for the pier would substantially increase turbidity of water locally. The impact would be potentially significant but of short-term duration, probably on the order of about one month.

6.0 Environmental Consequences and Mitigation Measures of the Alternatives

The impacts on water quality from construction of the pier probably would be approximately similar in kind but somewhat greater than those of the proposed project. No effective mitigation is possible.

Bear Canyon Single Pump Station

The construction of the pump station would result in increased runoff. The existing grasslands and trees would be removed and replaced with the proposed facilities. Most of the surface would be dirt or gravel which would become compacted over time, reducing infiltration. Because the site is flat and lacks the presence of a watercourse on site, the overall impact on runoff would be less than significant. Because the site is flat, erosion potential would be low. As a result, impacts of silt generation on water quality would be less than significant.

One-Way Surge Tank in The Geysers

The site occupies an existing cleared pad near a ridgeline. The small size of the tank footprint would result in a less-than-significant change in runoff conditions.

By-pass Pipeline at the SERWTP

Minor impacts on erosion and sediment generation would occur. Use of best construction practices are recommended to minimize silt generation during construction.

Alternate Route A-1 and A-2

Impact 6.3.2.2. Silt generated by construction would be conveyed down the corridor to Dam Road and from there into the Clear Lake Outlet Channel (CLOC). This is a potentially significant impact.

These routes would have similar impacts to those of the proposed project route but greater because of the need to clear existing brush-covered slopes. Route A-1 would entail clearing a new corridor through the brush, resulting in a substantial alteration of runoff characteristics. The cleared corridor would be located on moderately steep slopes, raising the potential for gullying and erosion (see Section 6.3.1). The deposition of silt in the CLOC would increase turbidity in the channel as well as add to nutrients that promote algae growth. This would be a potentially significant impact. Mitigation identified in Section 6.3.1 would reduce impact on water quality to a less-than-significant level.

6.0 Environmental Consequences and Mitigation Measures of the Alternatives

Alternate Route A-2 would have a similar, but less intense impact on runoff and water quality to Route A-1. This is because Route A-2 already has a partially cleared trail or fire break that would be widened for the project. The overall change in surface runoff would be small. Construction silt generation would be potentially significant, also discharging into the CLOC. Mitigation identified in Section 6.3.1 would reduce impact on water quality to a less-than-significant level.

Alternate Route B

Impact 6.3.2.3. Construction of the pipeline at this alternate location could result in significant short term silt deposition in Clayton Creek.

Construction of the pipeline at this location would have slightly greater short-term impact on water quality in Clayton Creek than the proposed project (with a spanned crossing adjacent to the bridge). The alternate crossing with a span of the creek north of the existing bridge would require some construction along the steep banks of the channel. Some bank stabilization efforts also may be required. This would result in silt generation that would be discharged into Clayton Creek. The overall impact would diminish with time unless construction of the pipeline were to induce further instability of the steep stream banks. Mitigation measures identified for the proposed project, including Mitigation 5.2.1.2 and 5.2.2.1, should also be applied to this alternate crossing. These measures would reduce the impact to a less-than-significant level.

Alternate Route C

This alternate would have impacts similar to the proposed project. The impacts would be related to short-term construction degradation of water quality. Because of the small area involved, the impacts of this alternative would be less than significant.

Alternate Route D

Impact 6.3.2.4. Construction of the pipeline at this alternate location could result in potentially significant erosion, with silt deposition in Big Canyon Creek.

This alternate would have impacts similar to the proposed project. The impacts would be related to short-term construction degradation of water quality. The route is also steep and eroded, with gullies in the existing fire break or trail. The project would entail some widening of this trail with clearing of brush. The large area of exposed soils, combined with steep slopes, could result

6.0 Environmental Consequences and Mitigation Measures of the Alternatives

in substantial erosion. Silt would be entrained in runoff and discharged into Big Canyon Creek. The impact is potentially significant. Mitigation measures included under Section 6.3.1, and as part of the proposed project, including Mitigation 5.2.1.2 and 5.2.2.1, would reduce the impact to a less-than-significant level.

Alternate Route E

Construction of the pipeline in the existing roadways would result in a less-than-significant impact on runoff and water quality.

Alternate Route F

Impact 6.3.2.5. The impacts on runoff and water quality of this alternative would be less than significant for the portion in the Bear Canyon Access Road to the Bear Canyon Power Plant, but potentially significant for the portion between the power plant and the NCPA M-Pad.

The latter portion would require clearing of dense brush and trees on a steep hillside for the pipeline corridor. The steep slopes would be subject to erosion (see Section 6.3.1). Substantial silt would be deposited in the adjacent unnamed creek that is a tributary to Bear Creek, resulting in substantial short-term impacts during the construction period. Additionally, because of the steep slopes, the effects on silt deposition could continue for many years as gullying and erosion increases. While direct impacts on the stream channel would not occur, the close proximity of the watercourse and steep slopes raise the potential hazards to water quality to a high level of concern. On the whole, the impacts of this alternative on water quality would be substantially less than that associated with the proposed project (new connector road between the Bear Canyon Access Road and M-Pad). Careful slope stabilization methods and revegetation will be required to ensure that the erosion and silt generation would be minimized (see Section 6.3.1). These measures would reduce the impact on water quality to a less-than-significant level.

Impact 6.3.2.6. Because this alternative would have no road, thereby increasing emergency response time, a potential break or leak in the pipeline in this section could significantly affect water quality in the nearby unnamed tributary of Bear Creek.

The impact would be temporary but potentially significant. While a break in the pipeline would be unlikely, if it were to occur the effects could be significant on erosion of the natural slopes of the canyon of the unnamed tributary of Bear Creek and the engineered cut slope above the Bear Canyon Power Plant. Because these are such steep slopes, a break in the pipe would quickly

result in a flow of water and mud into the creek, similar to the likely course of events in a break in the pipeline along the proposed route. However, response time to reach the alternative route would be greater than that of the proposed project.

Mitigation 6.3.2.6A. Install check valves at the M-Pad, at the point on the ridge where the route meets the top of the cut slope above the Bear Canyon Power Plant and at the road/fill crossing of the unnamed tributary of Bear Creek.

Alternate Distribution Pipeline Route G

The impacts on hydrology and water quality would be less than significant. The southern part of this route follows an existing road and the NCPA C-Pad, which already has highly altered runoff characteristics. The northerly part follows an existing trail or fire break, requiring some enlargement for the pipeline corridor. This would occur in close proximity to an existing water course with probable good water quality. Mitigation measures for the proposed project, including Mitigation 5.2.2.1, would reduce the impact to a less-than-significant hazard.

Alternate Site For Childer's Peak Regulating Tank

The impacts on hydrology and water quality would be similar to those of the proposed project, but possibly greater in intensity because of the greater amount of grading and related silt generation. Additionally, cuts in the hillside could encounter seeps of groundwater draining from the slopes of Childer's Peak. Mitigation measures for the proposed project, including Mitigation 5.2.2.1, would reduce the impact to a less-than-significant hazard. Additionally, if seeps are encountered during grading of the site, proper drainage features should be constructed to collect the flow of groundwater and channel it in a controlled manner to the drainage system. These measures would reduce the impact to a less-than-significant level.

6.3.3 BIOLOGICAL RESOURCES

Impacts for the project design alternatives would be similar to those for the proposed project (see Section 5.2.3).

Lake Diversion Pumps and Pipeline on Pier

Impacts on biological resources would be slightly greater than associated with the proposed project, but also would remain less than significant. This includes minor loss of benthic

6.0 Environmental Consequences and Mitigation Measures of the Alternatives

organisms and vegetation in the lake. Removal of algae probably would be considered a beneficial impact of the project. No mitigation is required.

Construction of a long pier might have the beneficial impact of providing nesting and roosting sites for birds. As the pier probably would be made inaccessible to the public, it likely would attract birds for these purposes. The overall impact is likely to be minor.

Bear Canyon Single Pump Station

The primary impact would be the loss of several large trees and Valley Oak Woodland habitat similar to Impact 5.2.3.15; the related Mitigation 5.2.3.15 also would apply to the site. These trees may provide habitat for Cooper's hawk and sharp-shinned hawks, and impacts would be the same as those described for Impact 5.2.3.7 and Mitigation 5.2.3.7.A and B also would apply.

One-Way Surge Tank in The Geysers

As the site is highly disturbed, no significant biological impacts are anticipated.

By-pass Pipeline at the SERWTP

As the site is highly disturbed, no significant biological impacts are anticipated.

Alternate Route A-1 and A-2

The alternates present similar impacts to biological resources as the proposed route. A larger amount of mixed chaparral habitat, including several conifers, may be removed for construction in this area. However, as these are common to the area, the impact is considered less than significant. No mitigation is required.

Alternate Route B

Impact 6.3.3.1. Construction of the proposed alternate route potentially could affect northwestern pond turtles and habitat of the black-shouldered kite. The impact is potentially significant but of short term.

The proposed alternate crossing of Clayton Creek would result in a minor loss of grassland and a small amount of Riparian habitat. The impact on the habitat is less than significant unless northwestern pond turtles are present. If that species is present, Impact 5.2.3.2 and

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Mitigation 5.2.3.2.A through C would apply to this site. Similarly, this area may provide habitat for the black-shouldered kite, as discussed in Impact 5.2.3.6. Mitigations 5.2.3.6.A and B also would apply to this alternative. The impact and mitigation measures already apply to the proposed crossing of Clayton Creek, and are assumed to be equally applicable to this alternative.

Use of this crossing would have the beneficial impact of preserving one or two large oak trees that probably would have to be removed to accommodate the Geysers Effluent Pipeline adjacent to the bridge as part of the proposed project. This would be a beneficial, but less than significant, impact.

Alternate Route C

This alternate would have the beneficial impact of preserving several large cultivated trees adjacent to the highway on its east side. The impact is beneficial but insignificant.

Alternate Route D

The route passes through disturbed mixed chaparral. The existing trail through this area already has resulted in disturbance of the plant communities. Serpentine reedgrass was observed at the site and could be destroyed by the road construction. However, the presence of the reedgrass appears to be the result of its taking advantage of the better light conditions afforded by the clearing for the existing trail. Construction of a wider access road may also produce a similar result.

Alternate Route E

As the alternate route would be located in existing roads, there would be no impact to biological resources.

Alternate Route F

Impact 6.3.3.2. The project alternative would contribute to permanent cumulative loss of mixed chaparral and montane hardwood habitat of the Cooper's hawk and sharp-shinned hawk.

As the lower part of the alternate route to the Bear Canyon Power Plant would be located in an existing road, no biological impacts would result. From the Bear Canyon Power Plant to the M-Pad, the route would trend through thick Mixed Chaparral and Montane Hardwood habitat. Both

6.0 Environmental Consequences and Mitigation Measures of the Alternatives

are common vegetation and habitat types in the region, and their loss in and of themselves, would constitute a less than significant impact. However, as with Impact 5.2.3.13, construction of this alternate would contribute to the potentially significant cumulative impacts on these habitats of the Cooper's hawk and sharp-shinned hawk. On the whole, this alternate would result in substantially less removal of vegetation than the proposed project. Similar vegetation types are located along the proposed connector road between the Bear Canyon Access Road and the M-Pad. However, a much greater length and width of disturbed corridor would result from the proposed project. Mitigation Measure 5.2.3.7 also would apply to this alternate. Napa lomatium also may be present and lost due to construction. Preservation of the plants is recommended, but not required.

Alternate Route G

The route follows through disturbed McNab cypress and manzanita habitat at an existing pad and along an existing road. Less than significant impacts to native vegetation and habitat would result.

Alternate Site For Childer's Peak Regulating Tank

Impact 6.3.3.3. The project would result in the potential loss of two special status plant species.

The impacts to the mixed chaparral and blue oak-foothill pine communities would be the same as for the proposed project. Scarlet fritillary and thread-leaved miner's lettuce may be present and destroyed by grading and construction activities. Mitigation 5.2.3.10A and B also would apply to this alternative.

6.3.4 AIR QUALITY

The air quality impacts under this Alternative would be essentially the same as those described for the project in Section 5.2.4.

6.3.5 NOISE

Impact 6.3.5.1. Operation of one large pump station at the foot of Bear Creek Road (rather than a series of five smaller pump stations up to the Y-Pad tank) could result in a significant noise impact since this larger pump station would not be enclosed (as proposed). The nearest residence would likely experience noise levels in excess of 50 dBA, Ldn from the pumps at this station.

The nearest residence would be located approximately 2,000 feet away from the pump station. Six 600-HP pumps would likely generate approximately 88 to 89 dBA at 50 feet assuming that four 600-HP pumps would generate three times the acoustic energy of four 200-HP pumps. At 2,000 feet, assuming direct line-of-sight with the pumps, the noise level from the pumps would be approximately 56 to 57 dBA. Based on 24-hour operation of the pumps, the 24-hour weighted average noise level would be approximately 61 to 62 dBA, Ldn, which would be considerably above the County's 50 dBA, Ldn compatibility standard.

Mitigation 6.3.5.1. If this alternative design component is chosen, re-design the pump station so that the pumps would be enclosed. This would reduce the impact to less-than-significant.

Impact 6.3.5.2. Construction of the proposed pier would result in significant short-term noise related to pile driving. The impact is partially mitigable.

The impact is considered significant because of the particularly annoying noise associated with pile driving. There are many residents located in the vicinity of the pier and the noise would travel a great distance over the water surface. Pile driving could occur for up to two months.

Mitigation 6.3.5.2. Limit pile driving activities to the hours of 8:00 a.m. to 5:00 p.m., Monday through Saturday.

Implementation of Mitigation 6.3.5.2 would reduce the relative degree of annoyance of the noise but would not affect noise levels.

Other design alternatives would have the same impacts as those described for the project.

6.3.6 CULTURAL RESOURCES

There are no recorded historic or pre-historic cultural resources at any of the alternate facility sites and pipeline routes. Therefore, impacts associated with development of these sites are not expected to be significant. In the event that cultural resources are encountered, mitigation measures as proposed for the project (see Section 5.2.6) should be applied. The proposed pier for the Lake Diversion Pipeline is located in an area with unknown cultural resources under water.

6.3.7 VISUAL RESOURCES

Lake Diversion Pumps and Pipeline on Pier

Impact 6.3.7.1. The alternative pier and pumphouse would result in a significant alteration of the visual environment. The impact is unavoidable.

The proposed pier would be a highly visible feature on the shoreline from residences and roads. Although numerous piers are located in this area, the proposed pier would be considerably longer, and therefore, present substantial contrast in the landscape. Because of its length, it may be desirable to have the pier painted in light color, e.g. white, to raise the level of visibility in order to minimize safety hazards for boating. Additionally, the pier could present a noticeable lighting feature. Because of the length of the pier, it is assumed that some type of light would be needed for purposes of boating safety. The impact is unavoidable.

The pumphouse, if located on the shore, would have impacts which are the same as the proposed project. The same mitigation would apply. If located at the lakeward end of the pier, the pumphouse would be highly visible from many vantage points. Additional mitigation may be needed to make the pumphouse aesthetically acceptable with minimum intrusion. This could include design to keep the pumphouse profile low, use of wood siding painted white, and provision of visually interesting architectural details.

Bear Canyon Single Pump Station

The proposed facilities would be located immediately adjacent to a well-travelled highway. They would be visible in the foreground views of travellers in both directions on SR175. The proposed facilities would contrast strongly with the existing landscape. Several large trees would have to be removed. Because the site is located in an area without special designation for

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visual resources, the impact is considered to be less than significant. Mitigation is recommended. Mitigation would include planting of trees and shrubs to screen views of the pump station from SR175.

One-Way Surge Tank in The Geysers

The impact would be less than significant. The tank would be another industrial type feature in the landscape that already has substantial modification for facilities of the geothermal industry. The proposed site is located in a seldom-seen area for the public. The tank would be visible in distant background views of southbound travellers on SR175 and residents on the higher slopes north of Anderson Springs. Mitigation is recommended. Mitigation would include painting the tank in earth-tone colors such as marine green. The planting of trees to screen the distant views from the north would also further minimize impacts.

By-pass Pipeline at the SERWTP

The proposed pipeline would be constructed in an area with extensively modified landscape features located by SERWTP facilities. The impact would be less than significant.

Alternate Route A-1 and A-2

The impacts would be similar for both routes and, for both alternatives, greater than that of the proposed route. In both cases, the impact would be less than significant. The creation of a cleared corridor for Route A-1 and the widening of the existing fire-road or trail with removal of several pine trees would create a noticeable visual contrast. The corridor would be visible in foreground and middleground views from residences at the base of the hill along Dam Road and in middleground views of residences on the south side of the Clear Lake Outlet Channel. Limited views of the corridor would be available to travelers in either direction on Dam Road. Mitigation is not required. Recommended mitigation includes planting of the ROW with grasses and low shrubs to minimize the visual contrast, as well as to protect the slope from erosion.

Alternate Route B

The span crossing at the alternate site north of the bridge would be more visible than the proposed project. The proposed pipeline would be located immediately adjacent to the bridge and would have low visibility because it would occupy a low position in the immediate foreground of the view of travellers. By contrast, the alternate route would place the spanned

6.0 Environmental Consequences and Mitigation Measures of the Alternatives

crossing in the foreground view of travellers, particularly the westbound travellers. The channel of Clayton Creek in this area has a natural appearance. The span crossing of the creek would present a highly visible man-made feature which would contrast strongly with the landscape. Because Clayton Creek Road receives a moderate amount of vehicle traffic, it would be in the views of many people. The area does not receive any special protection under visual management policies and would not be visible from any residences; therefore the impact is considered less than significant.

Recommended mitigation includes painting the exposed pipeline an earth tone that would blend in with the color of the stream banks. Alternatively, the pipeline could be painted green. All disturbed areas immediately adjacent to the creek where the pipeline would be under ground should be revegetated with grasses.

A beneficial impact of this alternative is that it allows for the preservation of a couple of large oak trees that would be removed for the proposed construction. These are large trees that grow immediately adjacent to the bridge on the banks of Clayton Creek. Preservation of the trees enhances the riparian visual character of the creek.

Alternate Route C

This alternative would have the beneficial effect of preserving several large conifers and deciduous trees along the east side of the road. These trees do not provide a significant element of the visual landscape, but they do contribute to visual interest along the roadside. Highway 29 in this area is within a County Scenic Corridor Combining District. Preservation of the trees by selection of this alternative would support policies for preserving scenic quality in this area.

Alternate Route D

The alternate site is in a seldom seen area and is less visible than the proposed route. However, the route follows an existing fire break or trail. Following construction of the pipeline, the trail would be slightly wider than the existing trail. The impact would be less than significant.

Alternate Route E

As the pipeline would be located in roads, there are no visual impacts associated with this alternative.

Alternate Route F

The portion of the alternative route in the Bear Canyon Access Road would have no visual impact. The portion of the pipeline corridor from the Bear Canyon Power Plant to the NCPA M-Pad would create a high degree of visual contrast resulting from the clearing of dense brush and trees on the steep slopes. The contrast would be created by the linear form of the corridor, the contrast in color (reddish earth compared to the adjacent green vegetation) and the different texture created by the smoother surface of the corridor compared to the vegetation. The corridor would be visible to travellers in the southbound direction on SR175 and residents at higher elevations on the southfacing slopes north of Anderson Springs. In each case, the feature would be located in background views. The overall visual effect is cumulative and would be small in comparison to the strong visual contrast created by the existing cut in the slope above the power plant. Compared to the proposed project, this alternative probably would have a somewhat greater degree of visibility. Mitigation is recommended but not required. Mitigation would include revegetation of the slopes using grasses and low growing shrubs to minimize the visual contrast of the corridor. This measure would reduce the impact to a minimal level, but would not entirely eliminate the impact.

Alternate Distribution Pipeline Route G

The impact would be less than significant. Minimal visual contrast would be created because the pipeline would be located on existing disturbed sites which already contain geothermal facilities. Additionally, the area is seldom seen by the public.

Alternate Site For Childer's Peak Regulating Tank

The impact would be less than significant. A greater amount of visual contrast would be created because the tank would require creating a cut slope, which would be a permanent feature of the landscape. However, as the area is seldom seen by the public, the impact is considered less than significant.

6.3.8 LAND USE

There would be no significant impacts on land use associated with any of the design alternatives. Impacts would be the same as for the proposed project (see Section 5.2.8). Alternate route E has the beneficial impact of reducing the amount of easement acquisition from a private landowner

6.0 Environmental Consequences and Mitigation Measures of the Alternatives

the alternate route would be located in County roads. However, the costs for easement acquisition may be offset by the costs for a longer pipeline.

6.3.9 SOCIOECONOMICS AND PUBLIC FACILITIES

There would be no significant impacts on socioeconomics and public facilities associated with any of the design alternatives. Impacts would be the same as for the proposed project (see Section 5.2.9).

6.3.10 ENVIRONMENTAL CONTAMINATION HAZARDS

All impacts of the design alternatives would be similar in nature and significance to those of the proposed project (see Section 5.2.10).

Impacts 5.2.10.2 through 5.2.10.4 would also apply to the alternative routes.

Impact 6.3.10.1. If the alternative routes are near any of the sites listed in Table 4.11.2-2, project construction could expose workers to hydrocarbon vapors, and could interfere with ongoing clean-up activities.

Unlike the proposed route, the alternative routes may be near a site currently undergoing remediation. Excavation may interfere with current remediation efforts.

Mitigation 6.3.10.1.A Prior to excavating near a site under remediation, the Lake County Department of Environmental Health shall be consulted. Department recommendation shall be followed or the pipeline rerouted around the contaminated area.

Implementation of Mitigation Measure 6.3.10.1A would reduce the potential impact to a less-than-significant level.

6.3.11 TRAFFIC AND CIRCULATION

All impacts of the design alternatives would be similar in nature and significance to those of the proposed project (see Section 5.2.11). A minor beneficial impact on traffic circulation might accrue from Alternate Route B, as construction would avoid the temporary closure of the Clayton Creek bridge during construction. Similarly, slightly more adverse impact on traffic circulation might occur by implementation of Alternate Route E, because lane closures would have to occur

6.0 Environmental Consequences and Mitigation Measures of the Alternatives

have to occur for the segments of affected road. In both of the above cases, the impacts would be short-term and of negligible effect on traffic circulation.

Alternate Distribution Pipeline Route G would have the beneficial impact of avoiding lane closures at the busy NCPA gate. This was the primary basis for the alternative route. The NCPA gate is the sole route of ingress/egress for all operations traffic in NCPA Plants 1 and 2 leaseholds. Construction of the pipeline could result in significant short-term disruption of traffic through this area. However, as the road is a private road, this is regarded as an operational consideration for NCPA rather than an impact on publicly accessible traffic circulation.

6.3.12 ENERGY AND MATERIALS

Impacts on energy and materials for all project design alternatives would be essentially the same as for the project. The overall energy impact would be beneficial.

7.0 IMPACT OVERVIEW

7.1 UNAVOIDABLE SIGNIFICANT IMPACTS

The following impacts of the proposed project are both significant and unavoidable. Significant and unavoidable impacts are adverse environmental effects which cannot be reduced to a level less than significant through mitigation. Under CEQA, if significant unavoidable impacts are anticipated to result from a project, the lead agency must make a Statement of Overriding Considerations if approving the project. Under Section 15093, CEQA requires the decision-maker to balance the benefits of the project against its unavoidable environmental effects and risks in determining whether to approve the project. If the benefits of the project outweigh the unavoidable adverse environmental effects, the impacts may be considered acceptable. The decision-making body must state in writing for the record its reasons to support its decision. The Statement of Overriding Considerations also should be identified in the Notice of Determination under CEQA and the Record of Decision for NEPA. NEPA does not identify a Statement of Overriding considerations as a requirement in such cases. Instead, Council on Environmental Quality regulations (40 CFR 1502.14 and 1502.16) require that the federal lead agency describe alternatives and their environmental consequences, including unavoidable significant impacts. The regulations require the BLM in this case to identify the environmentally preferred alternative and enter into the Record of Decision the basis for selecting the preferred project. If the preferred project has unavoidable significant impacts, the BLM should enter its basis for selecting this alternative.

SIGNIFICANT UNAVOIDABLE IMPACTS OF THE GEYSERS EFFLUENT PIPELINE COMPONENT

Impact 5.2.1.1. Construction of the proposed pipelines, pump stations and tanks would result in significant, short-term accelerated erosion in some areas. Additionally, Impact 5.2.2.1. Construction of the Geysers Effluent Pipeline Project component would have a significant short-term impact on water quality of Sweet Springs Creek and the unnamed tributary of Bear Creek.

Significant silt generation would result from disturbance of the construction sites, particularly site clearing, access road construction, site grading and backfilling. The impact would be significant and unavoidable where slopes are relatively steep and/or soils are erodible. The

implementation of best construction practices and compliance with the County Grading Ordinance would reduce erosion and silt generation, but it is not possible to reduce the impact to a less than significant level in the Sweet Springs Creek drainage, in the drainage of the unnamed tributary to Putah Creek on the south side of Childers Peak and in the unnamed tributary to Bear Creek. Significant silt generation from construction sites would occur for at least one or two wet seasons following the completion of construction. A number of mitigation measures are possible to reduce the impact to the lowest level possible.

Impact 5.2.2.4. Underwater construction of the Lake Diversion water intake and pipeline would substantially increase local turbidity in Clear Lake at the construction site.

The impact would be short-term, ranging from approximately one week to up to a month. Effective mitigation is not possible. Selection of alternate sites likely would result in a similar impact.

Impact 5.2.3.13 Construction of the project pipeline could result in cumulative loss of montane hardwood woodland, montane hardwood-conifer woodland and mixed chaparral that provide habitat for special status species.

While some mitigation is possible to minimize impacts, the permanent loss of these habitats for three special status species of birds would occur. These include the Loggerhead shrike, a federal candidate 2 species; Coopers hawk and sharp-shinned hawk, both California species of concern and protected under CDFG Code 1305.5. Additionally, these areas provide potential habitat for the Napa lomatium, a plant species on the California Native Plant Society List 4 (species with limited distribution - a watch list). The project itself would not likely have significant impact; the impact relates to cumulative losses of these habitats in the region.

Impact 5.2.6.1. The Geysers Effluent Pipeline Project component could destroy or damage important historic and prehistoric cultural resources.

Cultural resource significance evaluation is needed to determine if the potential resources at 29 sites on the proposed construction ROW are significant as interpreted for compliance with the National Historic Preservation Act. From preliminary surveys, it appears that at least some of the sites are likely to be significant. Construction of the pipeline unavoidably would destroy the site of the resources, including both their horizontal and vertical arrangements. The primary mitigation available is resource recovery. Adequate resource recovery and artifact curation is generally considered a permissible means to reduce the impact to an acceptable level.

SIGNIFICANT UNAVOIDABLE IMPACTS OF THE SERWTP FACILITIES PLAN COMPONENT

Impact 5.4.5.1 Construction at the SERWTP site for the excavation of the various facilities, demolition of some existing facilities and transportation to and from the site would increase existing noise levels to 86 dBA at 50 feet. This is estimated to impact the closest residence, during peak construction, at 54 dBA.

The impact is short-term, but construction noise levels would continue for a 1 to 1.5 years. Some mitigation is possible to minimize impact, but full mitigation is not possible.

SIGNIFICANT UNAVOIDABLE IMPACTS OF THE SOUTHEAST GEYSERS EFFLUENT INJECTION PROGRAM PLAN COMPONENT

Impact 5.3.6.2. With the project, steam production in the Southeast Geysers would decline more slowly than it would without the project and the occasional noise events and complaints that accompany geothermal development activity likely would decline more slowly as well. Since the current, cumulative noise impact of geothermal development activity in the Southeast Geysers is significant, the project's effect of continuing this activity would also have a significant noise impact on the nearest residents. This would be a significant unavoidable effect of the project.

7.2 GROWTH INDUCING IMPACTS

7.2.1 CEQA DEFINITIONS

The CEQA Guidelines (Section 15126(g)) require that an EIR evaluate the growth inducing impacts of a proposed action. A growth inducing impact is defined by the CEQA Guidelines as the "way in which a proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment. Included in this definition are public works projects which would remove obstacles to population growth. It is not assumed that growth in an area is necessarily beneficial, detrimental, or of little significance to the environment."

CEQA Guidelines, Appendix G(s), specifically identify as potentially significant environmental effects the impacts related to the extension of a sewer trunkline with capacity to serve new development. Such impacts specifically are related to growth-inducing aspects of wastewater improvements. The proposed expansion of wastewater treatment facilities and the disposal of the treated effluent are actions that remove a primary obstacle to growth in the SERWTP service area. If implemented, the existing CRWQCB Cease and Desist Order would be removed and the

moratorium on additional hook-ups in the SERWS service area would be lifted. By so doing, new development could occur in the service area.

The environmental effects of induced growth are indirect impacts of the proposed action. These indirect impacts or secondary effects of growth may result in significant, adverse environmental impacts. Secondary effects of growth commonly include increased demand on other community and public services and infrastructure, increased traffic and noise, degradation of air and water quality, and conversion of agricultural and open space land to developed uses. These effects are summarized in Section 7.4.

Growth inducement may constitute an adverse impact if the growth is not consistent with the land use plans and growth management plans and policies for the area affected. Local land use plans provide for land use development patterns and growth policies that allow for the orderly expansion of urban development supported by adequate urban public services, such as water supply, roadway infrastructure, sewer service or solid waste service. A project that would induce "disorderly" growth in conflict with the local land use plans could indirectly cause additional adverse environmental impacts and impacts to other public services. Thus, it is important to assess the degree to which the growth induced by a project would or would not be consistent with applicable land use plans.

As the project would only affect wastewater conditions in Lake County and would result in no increase in employment at the Geysers, the following discussion applies only to Lake County. The project has no potential to affect growth in Sonoma County.

7.2.2 BACKGROUND

Wastewater treatment service is one of the chief public services needed to support community development. Lack of adequate sewer capacity is currently a constraint to planned development within the SERWTP service area. LACOSAN's SERWTP is currently operating under a Cease and Desist Order from the CRWQCB due to a lack of adequate wastewater treatment, storage and disposal facilities. There is a moratorium in place on new sewer connections. The storage reservoir at the SERWTP overflowed in 1982, 1983, 1986 and 1993 due to a lack of sufficient storage capacity. The effluent entered Burns Valley Creek, and eventually, Clear Lake. Waste Discharge Requirements adopted in 1988 did not prescribe a compliance time schedule for expansion of the plant's treatment and disposal facilities, because the District was actively

pursuing plant expansion. However, the Cease and Desist Order issued in 1991 included a compliance time schedule.

LACOSAN's proposed wastewater facility and disposal plan would increase the District's wastewater treatment and disposal capacity in order to serve the additional growth that is planned and anticipated to occur within its service area. LACOSAN's proposed provision of expanded wastewater treatment and disposal capacity would remove one obstacle to further urban development and population growth in the Clearlake and Lower Lake areas. In accordance with the CEQA definition, implementation of LACOSAN's proposed wastewater facility and disposal plan would be growth-inducing.

The next section reviews LACOSAN's projection of future population growth within its service area and the associated projection of future wastewater flows requiring treatment and disposal. Following this is an analysis of whether the growth projections used by the District to design the proposed wastewater system expansion are consistent with applicable land use plans. This is followed by a discussion of the effects of effluent injection in the Southeast Geysers on growth.

7.2.3 PROJECTION OF FUTURE POPULATION GROWTH AND FUTURE WASTEWATER FLOW

Section 4.11.4.1 summarizes projected population growth within the County and the SERWS service area and explains the methodology used to estimate the current and future number of service connections and, in turn, the number of people connected to the SERWS system. Estimates of the current and projected numbers of people using the SERWS were based on the number of unit service connections in 1993 provided by the Lake County Special Districts. For the years 1990 and 1991, a growth rate of 150 connections per year was used; from 1993 through the year 2000 a growth rate of 200 connections per year was used (Dewante and Stowell, 1991). The District estimates the average number of persons, or users, per unit connection at 2.5. Table 4.11.4-1 shows the projected number of system connections and of system users using these annual connection rates.

In 1989, the number of system connections was approximately 6,500 and the number of system users was estimated to be 16,250. In 1993, connections numbered 6,880, with 17,200 users. For the year 2000 the projected number of system connections is 9,200 and the number of system users is 22,630. Capacity expansion for the SERWTP is proposed to accommodate planned growth in the service area through the year 2020. Thus, the number of connections and users

within the SERWTP service area was estimated through the year 2020, assuming an annual rate of 200± new connections per year. In the year 2010, the projected number of connections is 13,600 and the corresponding number of users is 34,000. By the year 2020 the estimated number of system connections is 20,100 with a corresponding number of people using the system of 50,250.

For Lake County the 1993 estimated population is 56,507. The General Plan projects a county-wide population of 66,100 by the year 2005. These population estimates reflect an average annual population increase of 2.0 percent per year. Using a 2.0 percent annual growth rate the projected population in the year 2010 would be 77,850 and in the year 2020 would be 94,400. The County also prepared a population projection using an average annual growth rate of 4.9 percent per year. Using the 4.9 percent growth rate, the projected county-wide population in the year 2010 would be about 125,400 and in the year 2020 would be roughly 200,300.

At present, the SERWS service area population represents about 28 to 32 percent of the county's population; that is, roughly 30 percent of the population. It is assumed that the service area will continue to constitute about 30 percent of the county population. Further, within the County and within the SERWS service area, the incorporated City of Clearlake will be the largest population center by the year 2000 (projected population of 18,417).

If the SERWS service area continues to represent about 30 percent of the County-wide population, then the population projections developed for the SERWS (based on the estimated number of connections and system users) fall between the two county-wide projection scenarios of 2.0 percent and 4.9 annual growth. The growth projections used to estimate future wastewater flow and to size the treatment and storage facilities are generally consistent with the County's projections. The SERWS project would provide adequate capacity to support the anticipated growth.

The City of Clearlake and the County of Lake project that growth in the SERWTP service area will far exceed currently installed SERWTP capacity. Current estimates of growth indicate that there will be a need for a treatment capacity exceeding 3.0 mgd average daily flow within the next 30 years. In order to achieve this volume of wastewater treatment, new facilities for the SERWTP would have to be constructed. The proposed ultimate 3.27 mgd capacity of the wastewater treatment and disposal system would accommodate the population that could result from development in LACOSAN's SERWS service area, in accordance with the approved County land use plans within the reasonably foreseeable twenty year horizon.

Implementation of the proposed project would allow lifting of the existing moratorium on new connections and permit planned growth, at an average maximum rate of 250 per year. This is consistent with the Lake County and City of Clearlake General Plans. As a result of the new connections, the project will make possible planned residential, commercial and industrial growth, with related employment opportunities. Implementation would also allow lifting of the Cease and Desist Order, and provide compliance with the District's Waste Discharge Requirements.

The District facility plan would not adversely affect the amount, timing or location of planned growth and development. The proposed system expansion would not affect the location of planned growth. The facilities plan does not specify expansion of the collection system. Only the centralized treatment and disposal facilities would be upgraded and expanded under this program. The collection system would be designed to respond to the service needs of development approved by the City of Clearlake and the County. Service would be extended only to areas where development had received approval.

The proposed disposal of sewage effluent from the Middletown WTP would not be growth inducing, as Middletown currently has adequate treatment and disposal capacity. (Existing problems with the MWTP storage ponds are being addressed separately from this proposed project.)

In the year 2021, 5.09 mgd of water in the pipeline would be supplied by diversions from Clear Lake. This 5.09 mgd capacity could potentially be replaced in part with treated effluent from other communities in the Clear Lake area. Therefore, there would be the potential for other communities, such as Clear Lake Oaks, Hidden Valley or Anderson Springs, to hook into the pipeline and use it to dispose of part of the 5.09 mgd of treated wastewater. However, this is not a part of the current project. Any subsequent system connections from other wastewater districts would require separate environmental documentation under NEPA and CEQA.

7.2.4 RELATIONSHIP OF GEOTHERMAL RESOURCES USE TO GROWTH IN LAKE COUNTY

The Lake County General Plan (as well as the Sonoma County General Plan) supports activities that are supportive of the geothermal industry and its associated secondary industries (Lake County, 1988). For example, Policy 4 of the Lake County General Plan states that it is the policy

of the County, "To establish urban and rural areas suitable for the development of industrial activities, to provide guidelines for their development, and to protect lands with industrial potential."

The specific objectives of this policy are as follows:

- 4.1 The county should actively promote the development of a sound and diversified economic base by continuing to promote agriculture, recreation services, and commerce, and by expanding its efforts to encourage industrial development including the development of geothermal service industries, and other resource related and 'clean' industrial applications.
- 4.2 Industrial and agricultural applications which could directly use geothermal resources as a heat source instead of fossil fuels should be encouraged if properly planned and compatible with surrounding land uses.
- 4.3 Industrial development activities should be encouraged to promote economic development, employment opportunities and provide a sound tax base.

The beneficial reuse of treated effluent by injection into The Geysers steamfields supports the County's intention to encourage the use of geothermal resources. This is consistent with the provisions of the Lake County General Plan and the Geothermal Resource and Transmission Element to the General Plan.

The proposed project, by continuing to allow the use of a dependable source of power, would primarily serve existing demand. Because the project would make up for recent declines in energy productivity in the Southeast Geysers, it would support geothermal energy as a continued source of electric power for existing users. In this respect, as a program to compensate for declining power in the Southeast Geysers, the development of power through the effluent injection program would be neither growth-inducing nor growth-accommodating.

The California Energy Commission 1992 Electricity Report forecasts that electric energy use will continue to increase in California. By the year 2011, the state will need over 124,000 giga Watt hours (one gigaWatt hour is one million kiloWatt hours) and nearly 21,500 MW of additional energy and demand per year. In meeting this demand, energy suppliers will need to depend on a variety of energy sources. As one of these sources, geothermal energy in The Geysers continues to play an important part in meeting the existing demand and offsetting the need for additional power plant development elsewhere.

7.3 RELATIONSHIP BETWEEN LOCAL SHORT TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY, AND THE IRREVERSIBLE COMMITMENT OF RESOURCES

CEQA Guidelines Section 15126(e) requires a discussion of the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. Similarly, the Council on Environmental Quality Regulations for implementing NEPA (Section 1502.16) identifies the need to discuss natural or depletable resource requirements and conservation potential for the project. For purposes of this discussion, short-term uses are defined as those occurring during the construction period for the project and the period required for restoration of areas required only temporarily during the construction. In total, this is approximately a three or four year period. Long-term is defined as the operational life of the project, that is, 25 years and beyond.

7.3.1 REDUCTIONS IN PRODUCTIVITY

Reductions in productivity of the environment caused by the project would be entirely short-term, local in extent and less than significant. Construction of the project would require temporarily removing a small amount of land from current agricultural production. Most of this is land used for grazing. A small amount of land planted to orchards probably would be affected by the construction activities. This would be a short-term impact, as all existing such uses of the ROW could be returned to their former uses. In general, no long-term significant disruption of land uses and no relocation of developed land uses would be required for the project, or for any of the alternatives.

Potentially significant and unavoidable impacts to soil and water resources would all be short-term, provided that mitigation measures included in the EIR/EIS are implemented. Eventually, (that is, within several years of the completion of project construction) these areas would become stabilized and revegetated. All air quality impacts would be short-term.

Most impacts to biological resources would be short-term, including loss and/or displacement of plant and animal species during clearing for and use of access roads, structure sites, and the pipeline ROWs. Most of the disturbed habitat affected by construction would be restored. Some areas of chaparral, mixed hardwood and conifer forest, and riparian habitat would be permanently removed for the proposed ROW and proposed access roads. These impacts would be small in area, but would contribute to the cumulative loss of these habitats in the region and

the wildlife species which they support. Some of the wildlife species using these habitats are listed species.

The proposed connector road between the Calpine Bear Canyon Access Road and the NCPA M-Pad would result in the permanent loss of existing vegetation cover and wildlife habitat in areas of cuts and fills, including coverage of at least 180 feet of a pristine unnamed watercourse that is tributary to Bear Creek. The proposed widening of the Unocal access road would also result in the permanent loss of existing vegetation cover in areas of cuts and fills.

Loss of cultural resources would be permanent. These sites would no longer be available for future study. Proposed mitigation through cultural resource evaluation, recovery and curation, would partially mitigate the loss of the resources.

For the life of the project, wastewater from the SERWTP and MWTP would be combined with water drawn from Clear Lake and disposed as injection fluid in The Geysers for steam production and energy development. The use of water for this purpose would be an irreversible commitment of the resources for the 25-year design life of the project and would make that water unavailable for other beneficial uses. However, at present and in the near foreseeable future, other beneficial uses of the wastewater are not feasible. Opportunities for spray irrigation and industrial reuse in Lake County are limited and could accommodate only a small portion of the projected wastewater flow. No infrastructure and nearby market exist that would allow conveyance of the wastewater to another county. The cost of tertiary treatment at the SERWTP is currently prohibitive and discharge of wastewater into Clear Lake is prohibited by Lake County Ordinance Code Section 9-23.3, and by the as yet unadopted Inland Surface Waters Plan.

The use of raw lakewater for the project would not be constrained in the possible available beneficial uses in the way noted above for the wastewater. The use of this water, which would be purchased from the Yolo County Flood Control and Water Conservation District, would preclude its commitment to other beneficial uses such as agriculture, public water supply, recreation, wildlife and fisheries.

7.3.2 INCREASES IN PRODUCTIVITY

The proposed project would have significantly beneficial productivity impacts from the standpoint of electrical energy use. The use of effluent for injection into the geothermal steam field would allow continued generation of power and the operation of power plants in the

Southeast Geysers at levels closer to their installed capacity. The project would allow continued operation in the long-term for this form of alternative energy, forestalling construction or expansion of baseload power plants (including those based on fossil fuels with attendant significant adverse air quality effects) to supply power to users both within and outside the region.

7.4 CUMULATIVE IMPACTS

Both CEQA and NEPA require an assessment of the potential cumulative impacts of a project. CEQA Guidelines Section 15355 define cumulative impacts as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts. The individual effects may be changes resulting from a single project or a number of separate projects. The cumulative impact from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over time". NEPA regulations (40 CFR 1508.7) are similar in concept with regard to cumulative impacts.

7.4.1 COUNTY OF LAKE

A cumulative impact assessment can be based on a list of foreseeable future projects in the project area or on a general projection of future growth. This section contains information for both approaches. The Lake County cumulative project list (Table 7.4.1-1) contains 16 residential projects and six commercial projects that are either under construction, recorded or approved and pending. For the twelve residential projects that are approved and pending, it should be noted that the actual start of construction for these projects is indeterminate given the current economic climate. That is, it can only be assumed that any or all of these specific projects would be under construction or completed within the time period used for impact analysis for the proposed project.

Projected Growth in County General Plan

From the Department of Finance estimates, the 1993 population in Lake County is 56,507. (Phillips, 1994) The Housing Element of the Lake County General Plan (July 1992) projects a

TABLE 7.4.1-1: CUMULATIVE PROJECT LIST FOR LAKE COUNTY

Major Subdivision Projects

Project	Lots/a/	Area	Status
Pine Summit No. Six	38	Cobb	Recorded
Estes	5	Nice	Recorded
Hilger	15	Middletown	Recorded
Wardlaw	19	Middletown	Recorded
James	31	Kelseyville	Approved and Pending
Hillcrest Ranch	130	Nice	Approved and Pending
Lakeview Terrace	50	N. Lakeport	Approved and Pending
Middletown Square	86	Middletown	Approved and Pending
Oak Park Estates	36	Lakeport	Approved and Pending
Walnut Grove	14	Nice	Approved and Pending
Shady Oaks	23	Middletown	Approved and Pending
Lakeview Estates	46	Lakeport	Approved and Pending
Robin Hill	28	Lakeport	Approved and Pending
Isle View	55	Lakeport	Approved and Under Construction
Silverado Estates	32	Lakeport	Approved and Under Construction
Clover Creek Meadows	35	Upper Lake	Approved and Pending

Major Commercial Projects

Project	Sq. Ft.	Location	Status
Shady Oaks	23,960	Middletown	Approved and Pending
Loch Lomond Storage	28,800	Loch Lomond	Approved and Pending
Larry's Market	23,300 (future expansion, 22,000)	Nice	Approved and Pending
Red Hills Plaza	107,000	Kelseyville	Pending
Atrium Publishing	23,300	Clearlake	Approved and Pending
Hilger Shopping Center	18,135	Middletown	Under construction

Notes: /a/ Assumes one dwelling unit per lot.

SOURCE: Lake County Planning Department, 1994

county-wide population of 66,100 by year 2005. These population estimates imply an annual average population growth rate of 2.0 percent per year, or about 875 persons.

7.4.2 CITY OF CLEARLAKE

This section provides information on approved and pending projects in the City of Clearlake and on the projected population that is contained in the City's General Plan.

7.4.2.1 CUMULATIVE PROJECTS

Table 7.4.2-1 identifies the subdivision, commercial/industrial and public projects that have been approved or are pending approval in the City of Clearlake.

7.4.2.2 PROJECTED GROWTH IN THE CITY'S GENERAL PLAN

The 1990 U.S. Census shows a population of 11,804 for the City of Clearlake. For purposes of projecting population growth to the year 2005, the City is using an annual growth rate of 4.9 percent, the same rate of population growth as that used by the County (Bonner, 1993). This yields a projected population of 23,100 by the year 2005. There are currently 2.27 persons per household in Clearlake. If this number remains constant, there will be 10,200 households in Clearlake by the year 2005.

7.4.3 SONOMA COUNTY

There are no approved or pending projects in the portion of the Southeast Geysers in Sonoma County.

7.4.4 CUMULATIVE IMPACTS

In the following sections, general cumulative impacts are described for each topical area. The extent to which the proposed project would contribute to the cumulative impacts is identified. Short-term cumulative impacts are those related to assumed construction of approved and pending projects concurrently with the proposed project. Except for the Atrium Publishing project, none of the county major subdivision and commercial projects listed in Table 7.4.1-1 are located in the immediate project area. The projects listed in Table 7.4.2-1 are located in the SERWTP service area. It is assumed for purposes of this analysis that the listed projects in these

TABLE 7.4.2-1: CUMULATIVE PROJECT LIST FOR CITY OF CLEARLAKE

Subdivision Projects

<u>Project</u>	<u>Lots/a/</u>	<u>Status</u>
Lake Glen	61	Approved

Commercial and Industrial Projects

<u>Project</u>	<u>Square Feet</u>	<u>Status</u>
Ray's Sentry Market	43,000	Approved
General Retail/b/	50,700	Approved
Park Place (Industrial)	50,000	Pending
Coast-to-Coast Hardware	8,000	Pending
Subway Restaurant	1,800	Pending

Public Projects

Redbud Library/c/		Pending
City Hall	13,000	Pending
Community Center/c/		Pending

Notes: /a/ It is assumed that there is one dwelling unit per lot.

/b/ Future expansion of retail space in the Clearlake Shopping Center.

/c/ Size is undetermined at this time.

SOURCE: City of Clearlake Planning Department, 1993

tables could be constructed concurrently with the proposed project. This would be a worst-case scenario for cumulative development, since the existing economic conditions likely will slow or prevent some of these developments from moving forward. There are no proposed or newly approved projects in the Southeast Geysers at present.

The long-term projected growth in the region would occur after construction of the proposed project. The proposed project would contribute directly to environmental impacts of this long-term development that will accommodate this projected growth by the extent to which the

project's long-term operation affects the future environment. The proposed project also would contribute indirectly to long-term cumulative effects by removing a major obstacle to growth and development in the SERWTP service area, which, in turn, are sources of environmental impact.

7.4.4.1 GEOLOGY, SOILS AND SEISMICITY

Construction of the listed approved and pending projects and the proposed project would result in potentially significant short-term cumulative erosion hazards and silt generation, particularly in the Clearlake area. As a major construction project in Clearlake, it would be one of the major sources of short-term erosion combined with that of the other projects. County standard mitigation measures for erosion control would be applied to these projects and would substantially reduce erosion problems to an acceptable level.

Long-term cumulative impacts of the project are speculative, but probably are insignificant because it is likely that the project corridor will have become revegetated and stabilized, thereby reducing hazards of erosion.

To the extent that the project is growth-inducing, it would contribute indirectly to the substantial long-term increase in population of the service area and county that could occur over the next 25 years. Residential, commercial and industrial developments, as well as roads and other infrastructure placement to accommodate this projected growth, would eliminate substantial existing open space, exposing the soil to erosion during grading and construction.

Construction of the proposed county-wide approved and pending residential development projects, would result in the exposure of residents to the earthquake hazards of the region. The long-term impact is significant given the large population increase anticipated for both the service area and the county as a whole.

As noted in Section 5.3.2, the project would not directly increase the hazards of a major earthquake in the region.

7.4.4.2 HYDROLOGY AND WATER QUALITY

Construction of the listed approved and pending projects and the proposed project would result in potentially significant short-term cumulative silt generation. The project construction would be the major new source of potential water quality degradation. Most of the silt from the

cumulative impact area would be washed in surface streams into Clear Lake as all but the Middletown and Cobb projects in Table 7.4.1-1 are located in the Clear Lake Basin. Cumulative silt deposition, already a problem in the basin, would contribute to nutrient loading in Clear Lake. The nutrient loading would potentially aggravate the growth of blue-green algae in the lake. County standard mitigation measures for erosion control would be applied to these projects and would substantially reduce erosion problems, and therefore silt deposition, to an acceptable level. The project would also contribute to silt generation in Putah Creek, in which drainage Middletown and Cobb are located.

Long-term cumulative impacts are speculative, but probably are potentially insignificant, given that the proposed corridor and project construction sites would be revegetated and stabilized, thereby eliminating the source of silt deposition.

To the extent that the project is growth-inducing it would contribute indirectly to the substantial long-term increase in population of the service area and county that could occur over the next 25 years. Residential, commercial and industrial developments, as well as roads and other infrastructure placement to accommodate this projected growth would expose the soil to erosion during grading and construction, with the silt being discharged into water bodies. Additionally, urban development in the SERWTP service area and in the county as a whole would result in the generation of substantial pollutants, such as oil, grease, pesticides and herbicides and heavy metals, and substantial nutrients from fertilizers and organic mulches. These substances, as well as surface litter, would be generated in substantially greater quantity and discharged in stormwater runoff into streams and lakes, including Clear Lake. Large developments (over 5 acres) and industrial developments would be required to comply with EPA requirements for stormwater pollution prevention plans, approved through NPDES permits. These would substantially reduce the amount of silt and other urban pollutants discharged into streams and lakes.

Long-term development in the SERWTP service area and in the county as a whole would substantially increase the use of water resources for domestic, commercial and industrial uses. This could include greater use of surface waters, for example, withdrawals from Clear Lake, as well as other water bodies in the project area. Greater use of ground water resources also would occur. Because the project would allow the treatment of wastewater, it would indirectly contribute to the substantial increase in the use of these water resources. This would be in part compensated by the reduced need to divert raw lake water for the project over time.

Long-term development in the region would result in substantial generation of wastewater. The proposed project addresses a part of this wastewater problem for the County. Other service districts face a similar problem of the need for expanded treatment capacity and effluent disposal. It is possible that wastewater from Clear Lake Oaks and Hidden Valley could be added to the wastewater of the proposed project derived from the SERWTP and MWTP at some time in the future. Given that capacity is available in the proposed pipeline, the addition of wastewater from these sources could be accommodated, resulting in a reduced need to withdraw raw lake water from Clear Lake for the project. It has also been proposed that wastewater from other parts of the county be transported to The Geysers. For example, wastewater from the Lakeport and Kelseyville areas potentially could be disposed by deep injection into the Northwest Geysers to the north of the proposed project area.

7.4.4.3 BIOLOGICAL RESOURCES

Approved and pending development would cumulatively result in the disturbance of a significant area of open space in the County and their associated habitats. The project would contribute significantly to these impacts. A smaller area of open space and habitat disturbance in Clearlake would be a part of this impact. The portion of the project in Clearlake where habitat disturbance would occur is small, as most of the project is located in existing roads in this area.

In the long term, the project would contribute to the loss of natural vegetation and wildlife habitat in both the SERWTP service area and in the county as a whole. Specifically, the cumulative impacts of the project include the permanent reduction of habitat of the northwestern pond turtle, red-legged frog, foothill yellow-legged frog, California horned lark, loggerhead shrike, black-shouldered kite, Cooper's hawk and sharp-shinned hawk. The proposed project would contribute to the cumulative loss of individual plants including listed and candidate plant species, and other special status plant species.

The project would contribute insignificantly to the cumulative losses of more common habitats in the county, notably oak woodlands and chaparral, that would be directly removed by long-term development. Most of the corridor would remain as open space and could be recolonized by native species, although trees and large shrubs likely would be removed during regular maintenance to keep the ROW clear. Most of the corridor could be used by wildlife. In contrast, the long-term development indirectly related to the project because of its growth-inducing aspect, as well as other developments elsewhere in the county, would permanently remove a substantial amount of open space and their associated plants and animals. These plant

communities provide habitat for numerous species of mammals, avifauna, reptiles and amphibians, including some that are special status species. The project would contribute, but not significantly, to permanent losses of aquatic habitat in streams.

7.4.4.4 AIR QUALITY

The project would contribute significantly to short-term cumulative air quality degradation related to construction of approved and pending projects in the service area. The timing of these projects are uncertain, and thus the impacts may not occur concurrently. Only a portion of the proposed project would be constructed in the vicinity of the Clear Lake projects. Dust control measures and emissions control on construction vehicles would substantially reduce emissions of PM₁₀ and ozone precursors. The required Permit to Construct issued by the LCAQMD would place on all these construction projects requirements that would minimize air pollutant generation. The basin has excellent air quality, and it is not anticipated that these pending and approved projects, if constructed, would result in an exceedance of air quality standards.

The long-term, direct, air quality cumulative impact of the project in the county is insignificant. The project would generate a small amount of pollutants, but these would be minor in comparison to other sources of air pollution. Population growth and development over the next 25 years would result in substantial increases in emissions of PM₁₀, precursors of ozone and possibly air toxics. The project would be indirectly related to these emission sources because of its growth-inducing aspect. Significant impacts may be kept in check by changing regulations and emission control requirements. For example, there is not a direct relationship between population growth and vehicle emissions because of required improvements in emission controls on vehicles. It is assumed that long-term development would occur in conformance with LCAQMD regulations and policies, as enforced through the permit to construct and permit to operate processes. It is assumed that, in the event criteria pollutant standards could be violated by cumulative development, the LCAQMD would either place more stringent requirements on permits to construct and to operate, or would pace the issuance of new permits to hold emissions in check.

Long-term sustained geothermal operations in the Southeast Geysers would be a result of the project. As noted in Section 5.3.5, the project would not result in significant air quality impacts. However, by lengthening the operating life of the steamfield, the project would contribute to cumulative air quality emissions in the broader KGRA.

7.4.4.5 NOISE

All the approved and pending projects, as well as the proposed project, would result in noise generation. Short-term noise for construction for the project would add to cumulative noise, primarily in Clear Lake where it would occur during the construction period for those projects, and in The Geysers where existing significant sources of noise from steamfield and power plant operations already are present. These are temporary impacts of construction.

The project would contribute to significant , cumulative, long-term noise only in The Geysers, as noted in Section 5.3.6. By providing a long-term source of water for injection, the project would promote continued steam field and power plant operations that are a source of noise complaints from nearby residents.

To the extent that the project would remove an obstacle to growth in the SERWTP service area, it would contribute indirectly to substantially increased noise of new development construction and operation in the long-term. It is assumed, however, that such development would occur within the allowable noise limits established by County and City of Clearlake ordinances and General Plan policies.

7.4.4.6 CULTURAL RESOURCES

The proposed project, combined with some of the approved and pending projects, would contribute to the cumulative loss of cultural resources in the SERWTP service area and the county as a whole. The losses would be permanent and potentially significant. All projects would be required to comply with requirements of the National Historic Preservation Act and related laws that would result in preservation or recovery of some historic and prehistoric resources. There are numerous potentially significant cultural resources throughout the county.

Impacts of long-term development on cultural resources cannot be determined at this time. It is assumed that significant losses would occur related to this development, both for construction of the projects as well as the infrastructure to serve them. To the extent that the project would remove an obstacle to growth in the SERWTP service area, it would contribute indirectly to losses of cultural resources from new development construction in the long-term. Once constructed, the project would not directly create further impacts on cultural resources.

7.4.4.7 VISUAL RESOURCES

The project would contribute to short-term cumulative alterations of the visual landscape in the service area. The project impact would be insignificant. Most of the approved or pending projects would occur in or near the urbanized part of the SERWTP service area, but would add to cumulative loss of open space. In contrast, the proposed project would eliminate an insignificant amount of open space and would not contribute significantly to this overall permanent cumulative impact on visual resources from these pending and approved projects.

The direct long-term impact of the project on the visual environment also would be insignificant. However, to the extent that the project would remove an obstacle to growth in the SERWTP service area, it would contribute indirectly to potentially substantial losses of open space from new development in the long-term.

7.4.4.8 LAND USE

The project would contribute insignificantly to cumulative changes in land use in the short-term. None of the approved or pending projects are directly related to the proposed project. The amount of land use change proposed for the project is small compared to the combined total land use changes indicated in Tables 7.4.1-1 and 7.4.2-1.

The direct long-term impact of the project on land use also would be insignificant. However, to the extent that the project would remove an obstacle to growth in the SERWTP service area, it would contribute indirectly to potentially significant new development and land use changes in the long-term.

7.4.4.9 SOCIOECONOMICS AND PUBLIC FACILITIES

The project would contribute insignificantly to cumulative changes in economics, housing, and demand for public services and facilities in the short-term. None of the approved or pending projects are directly related to the proposed project. The impact on socioeconomics and public facilities for the project is small compared to the combined total developments indicated in Tables 7.4.1-1 and 7.4.2-1.

The direct long-term impact of the project on employment also would be insignificant, as it would be a small share of the overall employment in the county. However, to the extent that the

project would remove an obstacle to growth in the SERWTP service area, it would contribute indirectly to potentially significant new development in the long-term. By removing the moratorium on development, the project would open the way for substantial growth as discussed in Section 7.2. This growth could result in very significant changes in economics of the county, increases in employment, more housing, and greater demand for public services and facilities. These changes would occur within the allowable growth envisioned in policies of the General Plans of Lake County, the City of Clearlake, as well as other communities. The project would continue to support the collection of taxes, royalties and other fees related to geothermal operations in the KGRA that support public services.

7.4.4.10 ENVIRONMENTAL CONTAMINATION HAZARDS

The project would contribute insignificantly to cumulative hazards of environmental contamination in the short-term. Some of the approved or pending projects may be constructed in areas with existing contamination, and disturbance of those sites could subject workers and nearby individuals to contamination hazards. Construction of each of the projects also is likely to involve a wide variety of potentially hazardous and toxic substances.

The direct long-term impact of the project on environmental contamination would be insignificant. This would mostly be related to use of fuel, oil and other substances for normal operations of the facilities. As noted, the transport, handling, storage and use of chlorine probably is the most significant of these hazardous substances. To the extent that the project would remove an obstacle to growth in the SERWTP service area, it would contribute indirectly to potentially significant new development in the long-term, and thereby, greater hazards of environmental contamination related to urban development.

7.4.4.11 TRAFFIC AND CIRCULATION

The project would contribute an insignificant amount to cumulative traffic. If all the pending and approved projects were constructed during the same period, the project would not add significantly to this traffic. This is because only the portion of the project in Clearlake would be located near the other pending and approved projects. Most of the project construction is located in areas of the county which are remote from these development projects.

The direct long-term contribution of the project to traffic would be insignificant. Operation of the project would generate a negligible amount of traffic, most of it located in areas distant from

development. To the extent that the project would remove an obstacle to growth in the SERWTP service area, it would contribute indirectly to potentially significant new development in the long-term, and thereby, greater traffic volumes related to urban development.

8.0 EIR/EIS SCOPING AND ISSUES IDENTIFICATION; EIR/EIS DISTRIBUTION

8.1 SCOPING AND ISSUES IDENTIFICATION

The Notice of Preparation/Notice of Intent to prepare a joint EIR/EIS was issued by LACOSAN, the Lake County Planning Department and BLM on March 2, 1993. A copy of the notice is included in Appendix A. Two public scoping meetings were held to receive comments on issues and concerns that should be addressed in the EIR/EIS. The first scoping meeting was held on March 25 in Sacramento, the second was held on March 26 in Lakeport. Letters of comment received during the scoping comment period (March 2 to April 16) are included in Appendix A. At these meetings the project was described, including the history of the project and actions leading to the present project.

On July 23, 1993, a supplemental Notice of Preparation/Notice of Intent was issued to incorporate changes to the proposed project that included a back-up disposal component of the project using created wetlands near Anderson Marsh State Park. A public scoping meeting was held on August 23, 1993 in Lakeport. August 23 also was the date of the close of the public scoping comment period. Copies of the supplemental notice and written comments are included in Appendix A.

On March 31 1994, a second supplemental Notice of Preparation/Notice of Interest was issued to incorporate changes to the proposed project that included increase in the size of the pipeline to a 24-inch diameter, additional pumps, and distribution and injection in the Unocal leasehold serving PG&E Units 18 and 20. A public scoping meeting was held on April 13, 1994 in Lakeport.

The following is a brief summary is environmental issues, suggested alternatives and mitigation measures which were raised in the scoping process.

Access roads. Question was raised regarding the location and impacts of new access roads for the project.

Air quality. Question was raised whether injection of effluent could change air quality emissions and odors in the steamfield. Question was raised whether new air quality management equipment may be required.

8.0 EIR/EIS Scoping and Issues Identification; EIR/EIS Distribution

Alternatives. The EIR/EIS should discuss off-shore diffusers, Burns Valley Creek discharge, seasonal discharge to the outlet arm of Clear Lake, creation of a constructed marsh at a location near the SERWTP, discharge of effluent to Big Borax Lake.

Back-up disposal. EIR/EIS should describe the M-Pad back-up disposal well, its depth and capacity. (Note: the M-Pad well was subsequently eliminated from the project.)

Bridges and highways. Impacts to bridges and highways should be discussed in the EIR/EIS.

Clear Lake. EIR/EIS should describe the impacts on Clear Lake from withdrawals of water and discharge of effluent.

Conflict with the Basin Plan. The EIR/EIS should discuss the conflict of effluent discharge into the Clear Lake Outlet Channel (CLOC) with the Basin Plan and county ordinances. Additionally, the EIR/EIS should include discussion of the process for lifting the discharge prohibitions. (Note: discharge into the CLOC was subsequently eliminated from the project.)

Construction. Information was requested regarding the methods of trenching and stream crossings, width of the corridor and disturbed area restoration.

Corrosion. Concern was expressed about corrosion of the pipeline by effluent and how this would be monitored. Additionally the question was raised whether additives to the effluent would be needed.

Cultural resources. The EIR/EIS should describe the impacts on cultural resources. Consultation with Native American groups should be conducted.

Design life. The EIR/EIS should describe the project's design life.

Discharge into Clear Lake. The EIR/EIS should describe the amount of effluent discharge to the Clear Lake Outlet Channel, the location of the discharge pipeline and outlet structure. (Note: discharge into the CLOC was subsequently eliminated from the project.)

Diversions from Clear Lake. Question was raised whether diversion of lake water would occur during drought years.

Drainage. Impacts on drainage facilities within State highway right of way should be discussed. Mitigation should be identified.

Earthquake effects. Question was raised whether the project would induce increased earthquake hazards. Concern was expressed that the project should include injection strategies that would not increase earthquakes over Magnitude 2 on the Richter scale. It was requested that a pre-project inventory of structural integrity of homes should be made and mitigation should include financial compensation for damages due to induced earthquakes.

8.0 EIR/EIS Scoping and Issues Identification; EIR/EIS Distribution

Effects on algae growth. The EIR/EIS should describe impacts of nutrients, particularly nitrates and phosphates on Cache Creek, and specifically effects on algae growth and fish populations. (Note: discharge into the CLOC was subsequently eliminated from the project.)

Effects on environmentally sensitive areas. The EIR/EIS should discuss impacts on any wetlands, specific impacts to Anderson Marsh, wild and scenic rivers, floodplains, vernal pools, streams, critical habitats and other environmentally sensitive areas.

Effects on geothermal reservoir. Question was raised regarding the impacts of injection on the geothermal reservoir rock.

Effects on power plant operations. Question was raised whether effluent water chemistry could affect power plant operations and air quality emissions at the plants.

Effluent chemistry. The EIR/EIS should describe the chemistry of the effluent.

Failure. It was requested that the EIR/EIS should describe the need for a spill and pipeline rupture response plan.

Farmland. The EIR/EIS should describe farmland in the project area and whether it is environmentally significant.

Financing. Describe how the project will be financed.

Growth inducement. Growth inducing effects on residential development and associated traffic should be described. Mitigation should be described including formation of benefit assessment districts, improvement zones or impact fees to mitigate effects on the State transportation system.

Highway encroachment. The EIR/EIS should address requirements for encroachment on state highways.

Injection permits. It was requested that the process for permitting of injection be described in the EIR/EIS.

Monitoring. It was requested that studies be required to prevent impacts on ground water, e.g., origins of springs and groundwater migration, and monitoring of the springs for early detection of water quality problems related to the project. Request was made for a shallow well monitoring system near injection wells.

Number of injection wells. Question was raised regarding the minimum and maximum number of wells that could be used for effluent injection.

Nutrient additions. The EIR/EIS should discuss the effects of nutrients on Anderson Marsh related to effluent discharge. Maintenance of the marsh should be described. (Note: discharge into the CLOC was subsequently eliminated from the project.)

Nutrient removal. The use of constructed ponds, marshes and wetlands should be considered for removal of nutrients in effluent discharges. (Note: discharge into the CLOC was subsequently eliminated from the project.)

Pipeline maintenance. Describe maintenance activities such as pigging.

Pipeline design. Question was raised regarding the size of the pipeline and the materials of construction.

Pipeline capacity. Question was raised whether the pipeline would be large enough to accommodate growth in the service area.

Plants. Concern was expressed over impacts on native vegetation, including listed plant species. Surveys of special status plants and animals are recommended.

Power supply. Question was raised how power would be supplied to operate the project.

Project abandonment. Question was raised regarding ultimate abandonment of the project and the related effects. Request was made for a procedure for terminating injection if impacts on induced earthquakes, air quality and water contamination become excessive.

Revegetation. Question was raised regarding the nature of the revegetation program following construction.

Service Districts included in the project. Question was raised whether other service districts, such as Hidden Valley and Clear Lake Oaks, would be included in the project.

Use of ponds and sprayfields. It was requested that the EIR/EIS describe the use of sprayfields or storage ponds during periods when the pipeline would be shut down for maintenance.

Visual effects. It was requested that the EIR/EIS should discuss visual impacts and mitigation for pipelines, new roads and the Highway 29 scenic corridor.

Water Quality. Question was raised regarding chemistry of the effluent in relation to groundwater, including potential for impacts to bottling companies using spring water at Cobb Mountain.

Well monitoring and testing. Request was made for an ongoing program of testing and inspection of well casings. Additionally, request was made for field tests of effluent effects downhole.

Wildlife. The EIR/EIS should describe impacts to wildlife, including barriers to migration, and impacts to fish.

**8.2 AGENCIES AND ORGANIZATIONS RECEIVING COPIES OF THE DRAFT
EIR/EIS**

Anderson Springs Community Services District
Bill Levers, Woodland, California
Cal Cities Water Company, Clearlake Park, California
California Division of Oil, Gas and Geothermal Resources, Santa Rosa, California
California Energy Commission, Chuck Najarian, Siting/Environmental Division, Sacramento,
California
California Regional Water Quality Control Board, Sacramento, California
California State Lands Commission, Sacramento, California
California State Lands Commission, Long Beach, California
Calpine Corporation, Santa Rosa, California
City of Clearlake, Clearlake, California
City of Clearlake Planning Department, Clearlake, California
Clearlake County Library, Clearlake, California
Clearlake Oaks County Water District, Clearlake Oaks, California
Cobb Mountain Spring Water Co., Cobb, California
Department of Conservation, Sacramento, California
Department of Fish and Game, Yountville, California
Department of Transportation, Eureka, California
Frank Haigler, Vacaville, California
Friends of Cobb Mountain, Cobb, California
HEAL, Lucerne, California
Highlands Water Company, Clearlake, California
INEL, Idaho Falls, Idaho
Konocti Water District, Clearlake, California
Krista Rector, Cloverdale, California
LACOSAN, Lakeport, California
LAFCO, Santa Rosa, California
Lake County Agricultural Commissioner, Lakeport, California
Lake County Air Quality Management District, Lakeport, California
Lake County Board of Supervisors, Lakeport, California
Lake County Building Department, Lakeport, California
Lake County Counsel, Lakeport, California
Lake County Department of Public Works, Lakeport, California
Lake County Environmental Health Department, Lakeport, California
Lake County Improvement District #1 Advisory Council

8.0 EIR/EIS Scoping and Issues Identification; EIR/EIS Distribution

Lake County Office of Education, Lakeport, California
Lake County Planning Commission, Lakeport, California
Lake County Planning Department, Lakeport, California
Lake Port Library
Lakeport County Library, Lakeport, California
Lakeshore Fire District, Clearlake, California
Lower Lake Water District
Middletown Concerned Citizens, Middletown, California
Middletown County Library, Middletown, California
Middletown Sewer Advisory Board, Middletown, California
Middletown Visitors Center, Middletown, California
Northern California Power Agency, Middletown, California
Office of Planning and Research, Sacramento, California
Operating Engineers Local Union No. 3, Santa Rosa, California
Pacific Gas & Electric Company, Healdsburg, California
Paul Richins, California Energy Commission, Sacramento, California
Peter Lipman, U.S. Geological Survey, Menlo Park, California
Redbud Public Library
Soil Conservation Service, Lakeport, California
Sonoma County Board of Supervisors Office
Sonoma County Planning Department, Santa Rosa, California
Sonoma County Public Library
South Lake Fire Station
State Water Resources Control Board, Sacramento, California
U.S. Bureau of Land Management, Ukiah, California
U.S. Bureau of Land Management, Sacramento, California
U.S. D.O.I., Bureau of Land Management, Washington, D.C.
U.S. Department of Agriculture - Rural Development Administration, Santa Rosa, California
U.S. Department of Commerce Economic Development Administration, Seattle, Washington
U.S. Department of Energy, Idaho Falls, Idaho
U.S. Department of Energy, Geothermal Division, Washington, D.C.
U.S. EPA, San Francisco, California
Unocal Corporation, Santa Rosa, California
Whispering Pines Drinking Water
Yolo County Flood Control & Water Conservation District, Woodland, California
Yolo County Planning Department, Woodland, California

9.0 CONSULTATION AND COORDINATION

9.1 LEAD, COOPERATING, RESPONSIBLE AND TRUSTEE AGENCIES

Under NEPA, Cooperating Agencies are those agencies with jurisdiction over the proposed project by law, special expertise or other involvement. The lead agencies for the project (LACOSAN and the U.S. Bureau of Land Management) must seek the cooperation of federal, state and local agencies that have jurisdiction through permitting or legal oversight and/or have special expertise in any environmental issue that is addressed in the EIR/EIS. All agencies which review the EIR/EIS would not necessarily be cooperating agencies.

Under CEQA, a Responsible Agency is a public agency, other than the Lead Agency, which has discretionary approval power over the project. Most Responsible Agencies also serve as Cooperating Agencies. A Trustee Agency is a state agency having jurisdiction by law over natural resources affected by the project which are held in trust for the people of the State of California.

9.1.1 FEDERAL LEAD AGENCY

The U.S. Bureau of Land Management (BLM). The BLM is the federal lead agency for the project. Under the authority of the Geothermal Steam Act of 1970, and the Federal Land Policy and Management Act of 1976 and other federal laws, the BLM permits the right of way on federal lands in The Geysers and provides oversight for geothermal well construction and operation. BLM serves as federal lead agency to fulfill its responsibilities under the National Environmental Policy Act (NEPA). The BLM prepares the EIS and is the federal agency responsible for permitting the part of the project on federal land. BLM has oversight authority for compliance with NEPA and other federal law, including implementation of mitigation.

9.1.2. FEDERAL COOPERATING AGENCIES

The U.S. Department of Energy (DOE). The DOE is a cooperating agency for the project. The DOE provides partial funding for The Geysers effluent pipeline and effluent injection proposal. No specific permit for the project is required from the DOE.

U.S. Fish and Wildlife Service (USFWS). The USFWS has responsibility for management of fisheries and wildlife resources and enforcement of the federal Endangered Species Act and Migratory Bird Treaty Act. No specific permit for the project is foreseen, but under the Endangered Species Act, a formal consultation may be required with regard to potential disturbance of federally listed and/or candidate species of plants and animals by the project.

U.S. Army Corps of Engineers (COE). The COE serves as a cooperating agency for the project if it would result in the placement of fill in waters of the United States or dredging. Its authority is derived from the federal Clean Water Act (for fill placement) and from the federal Rivers and Harbors Act (for dredging). A permit for fill in the unnamed tributary creek to Bear Creek may be required. The construction of facilities in Clear Lake for the lake diversion intake may require a permit from the COE. The COE also has responsibility for oversight of other agencies in implementation of Executive Order 11988, Floodplain Management, and Executive Order 11990 Protection of Wetlands.

U.S. Environmental Protection Agency (EPA). The EPA may serve as a cooperating agency for both partial funding and permitting of the SERWTP facilities plan. Under the federal Clean Water Act, the EPA has responsibility for permitting of publicly owned treatment works (POTWs) and for issuance of, or oversight to, delegated agencies for issuance of National Pollutant Discharge Elimination System Permits (NPDES). The EPA has delegated this authority to the California Regional Water Quality Control Board, but maintains oversight authority for the project.

The EPA also has oversight capacity for injection in The Geysers. The EPA has a Memorandum of Agreement (7/30/91) which assigns to the CDOG&GR (below) responsibility for administering injection.

U.S. Department of Agriculture Rural Development Administration (RDA). The RDA is a potential cooperating agency providing partial funding for the project. The RDA has no permit or oversight authority.

U.S. Geological Survey (USGS). The USGS has no permit or oversight authority. However, it would provide review of issues related to geothermal operations and seismic hazards.

9.1.3 STATE COOPERATING AND RESPONSIBLE AGENCIES

State Water Resources Control Board and Regional Water Quality Control Board (RWQCB).

The State Water Resources Control Board may provide partial funding of the project. The RWQCB has authority for permitting of the proposed facilities. The Central Valley Regional Water Quality Control Board has this responsibility in Lake County. The North Coast Regional Water Quality Control Board has similar responsibility in Sonoma County. Delegated authority is derived under the federal Clean Water Act for issuance of an NPDES permit and state authority is delegated under the Porter-Cologne Water Quality Control Act. An NPDES permit is required for compliance with the EPA November 1990 Stormwater Application Rule; this is in relation to stormwater discharges related to proposed construction disturbance.

California Division of Oil and Gas and Geothermal Resources (CDOG&GR). The CDOG&GR has permitting authority over injection of fluids into geothermal wells located on land leased from the State of California or privately owned lands. The authority for permitting and inspection is derived from Section 3700 of the Public Resources Code. Additionally, under a Memorandum of Agreement with the EPA, the CDOG&GR administers injection into geothermal wells.

California Energy Commission (CEC). The CEC is a cooperating state agency, providing partial funding for the project. The CEC has no permit or oversight authority for the project.

State Historic Preservation Officer (SHPO). Under authority delegated by the Advisory Council on Historic Preservation for enforcement of the National Historic Preservation Act and other federal and state statutes protecting cultural resources, SHPO has oversight responsibility with regard to cultural resources. Consultation with the SHPO would be required for the project because of the potential to destroy pre-historic and historic sites and resources. No permit is required from SHPO.

Lake County Air Quality Management District (LCAQMD). The LCAQMD would issue a permit to construct and a permit to operate the project. The permits apply to each component of the project. The LCAQMD derives its delegated authority by EPA from the federal Clean Air Act. State authority is based on the State air pollution control laws, Air Toxics "Hot Spots" Information and Assessment Act and the California Health and Safety Code.

Northern Sonoma County Air Pollution Control District (NSCAPCD). The NSCAPCD has similar responsibilities to the LCAQMD for the portion of the project in Sonoma County.

California Department of Transportation (Caltrans). An Encroachment Permit would be required for construction within any ROW of a state highway. Permit authority is derived from the Streets and Highways Code Sections 660-734.

9.1.4 LOCAL LEAD AGENCY

Lake County Sanitation District (LACOSAN). LACOSAN is the lead agency for the project to fulfill its responsibilities under the California Environmental Quality Act (CEQA). LACOSAN is one of the project sponsors and has responsibility for wastewater collection, treatment, storage and disposal in Lake County. LACOSAN prepares the EIR and is the local agency responsible for approving and implementing the project and ensuring that mitigation is properly carried out on all LACOSAN-administered land related to this project.

In 1988, the Lake County Board of Supervisors established an approval process for County initiated projects. This includes Planning Commission review for consistency with CEQA and the General Plan.¹ The Planning Commission subsequently provides recommended mitigation measures for incorporation into the project design based upon the environmental and General Plan analysis. The Board makes a final determination on the mitigation measures to be included in the project design. Finally, the local agency (in this case LACOSAN) is required to report to the Board on compliance with required mitigation measures.

9.1.5 LOCAL COOPERATING AND RESPONSIBLE AGENCIES

Lake County Planning Commission. The Planning Commission reviews the EIR/EIS, recommends a project with incorporated mitigation measures to the LACOSAN Board of Directors, and approves conditional use permits for the private component of the project.

Lake County Planning Department. The Planning Department has responsibility for processing of use permits for the private component of the project and enforcement of use permit conditions and mitigation monitoring requirements. The Department would provide oversight for compliance with ordinances related to land use, socioeconomics, water quality, erosion control,

¹ This includes incorporation of performance and development standards of the Lake County Zoning Ordinance into County initiated projects.

public safety, biological and cultural resources, noise, visual resources, and mitigations incorporated into the project design.

Lake County Public Works Department. The Department would issue encroachment permits for construction and use of county roads for placement of the pipeline.

Lake County Building Department. The Department would review building plans for structures proposed as part of the project.

Sonoma County Planning Department. The Planning Department has responsibility for issuance of use permits for the private component of the project and enforcement of use permit conditions and mitigation monitoring requirements. The Department would provide oversight for compliance with ordinances related to land use, housing, biological and cultural resources, noise, visual resources, and mitigations incorporated into the project design.

Yolo County Flood Control and Water Conservation District. The District has authority to sell make-up water withdrawn from Clear Lake to LACOSAN.

City of Clear Lake. The City has authority for permitting construction on and use of private and City-owned lands and public roads within the city limits.

9.1.6 STATE TRUSTEE AGENCIES

California Department of Fish and Game (CDFG). The CDFG is the primary trustee agency with regard to fish and wildlife of the state, to designated rare and endangered native plants and to other areas administered by the department. CDFG has no permitting authority, but serves its oversight role through the development of Stream or Lake Alteration Agreements with the project sponsors and lead agencies. Consultation with CDFG also would be required for compliance with the California Endangered Species Act.

California State Lands Commission (SLC). The SLC is a trustee agency under CEQA and has oversight for submerged lands and the beds of navigable rivers, sloughs and lakes. Clear Lake is State-owned sovereign land granted in trust by the Legislature to the County of Lake. SLC has no permit authority, but maintains oversight for county actions related to Clear Lake.

9.2 CONSULTATION REQUIREMENTS

Consultation requirements refer to the specific agencies which must be consulted if the project is to be approved by the lead agencies. Consultation requirements are not necessarily related to issuance of permits as identified in Section 9.1.

9.2.1 FISH AND WILDLIFE COORDINATION ACT (16 USC SEC. 651 ET SEQ.)

The Fish and Wildlife Coordination Act, as applied to this project, requires BLM to consult with the USFWS and CDFG before approving the project. The consultation is intended to prevent the loss of or damage to wildlife and fishery resources and to provide for the development and improvement of wildlife resources in connection with the project. The BLM is required to (1) include in project reports recommendations made by the USFWS and CDFG, (2) give full consideration to these recommendations, and (3) include in approval conditions for project plans justifiable means and measures for wildlife purposes.

9.2.2 ENDANGERED SPECIES ACT (16 USC SEC. 1521 ET SEQ.)

Section 7 of the Endangered Species Act, as applied to this project, requires consultation by BLM with the Secretary of the Interior to ensure that approval of the proposed project does not jeopardize the continued existence of federally listed or candidate endangered or threatened species of plants and animals, or result in the destruction or adverse modification of the critical habitat of these species. The BLM must request from the USFWS information on the existence within the project area of listed species or species proposed for listing prior to issuance of a permit for the project. Species listed in this EIR/EIS are drawn from a preliminary assessment of likely species protected or potentially protected under the Act. The species list may change prior to construction. The USFWS may issue a biological opinion regarding the potential effect of the project on the listed species and establish mitigation requirements.

9.2.3 NATIONAL HISTORIC PRESERVATION ACT (15 USC SEC. 470 ET SEQ.)

Section 106 of the National Historic Preservation Act, as applied to this project, requires the BLM and LACOSAN to evaluate the effects of the project on historic, archaeological and cultural resources. Agencies are required, within the vicinity of the project, to identify historical or archaeological properties, including properties on the National Register of Historic Places, and those that the agency and the State Historic Preservation Officer (SHPO) agree are eligible for listing in the National Register. A preliminary list has been prepared for this project as part

of studies conducted by the Sonoma State University Cultural Resources Facility. As it appears that sites on non-federal land may be eligible for listing in the National Register and could be adversely affected by the project, LACOSAN is required to consult with the SHPO and the Advisory Council on Historic Preservation to develop alternatives or mitigation measures to allow the project to proceed.

9.2.4 SECTION 404 CLEAN WATER ACT (33 CFR, PARTS 320 - 330)

The BLM and LACOSAN may be required to consult with the COE for discharge of fill into waters of the U.S. Construction of the project would entail placement of fill in multiple segments of watercourses. The consultation would determine whether an individual or nationwide permit would be required. Consultation with the COE is required so that alternatives to filling of water courses can be identified or mitigation requirements can be established so that the project can proceed.

9.2.5 SECTION 10 RIVERS AND HARBORS ACT

LACOSAN may be required to consult with the COE for construction of facilities within Clear Lake including the make-up water intake structure and pipeline. Consultation is similar to the Section 404 process, with an emphasis on mitigation of spoils material removal.

9.2.6 STREAM OR LAKE ALTERATION AGREEMENT

As applied to the project, LACOSAN and BLM are required to consult with CDFG to establish mitigation requirements for any alteration of a watercourse channel and its banks and alteration of Clear Lake. These are prepared in the form of a Stream Alteration Agreement or Lake Alteration Agreement and have the same effect as mitigation required by CEQA/NEPA.

9.2.7 EXECUTIVE ORDER 11988 - FLOODPLAIN MANAGEMENT

EO 11988 requires Federal agencies to prepare floodplain assessments for proposals located within or affecting floodplains. If an agency proposes to conduct an action within a floodplain, it must consider alternatives to avoid adverse effects and incompatible development in the floodplain. If the only practicable alternative involves siting in a floodplain, the agency must minimize potential harm to or within the floodplain and explain why the action is proposed within the floodplain.

Implementation of EO 11988 would be the responsibility of the BLM, with review of the assessment by the Corps of Engineers. LACOSAN would demonstrate compliance with EO 11988 through consultation with the Corps in conjunction with Section 404 of the Clean Water Act and through its participation in implementing a Stream Alteration Agreement with the California Department of Fish and Game.

9.2.8 EXECUTIVE ORDER 11990 - PROTECTION OF WETLANDS

EO 11990 requires Federal agencies to prepare wetlands assessments for proposals located within or affecting wetlands. Agencies must avoid undertaking new construction located in wetlands unless no practicable alternative is available and the proposed action includes all practicable measures to minimize harm to wetlands.

Implementation of EO 11990 would be the responsibility of the BLM, with review of the assessment by the Corps of Engineers.

LACOSAN would demonstrate compliance with EO 11990 through consultation with the Corps in conjunction with Section 404 of the Clean Water Act and through its participation in implementing a Stream Alteration Agreement with the California Department of Fish and Game.

10.0 EIR/EIS AUTHORS AND PERSONS CONSULTED

10.1 REPORT AUTHORS

This EIR/EIS was prepared for the Lake County Sanitation District and the U.S. Bureau of Land Management by Environmental Science Associates, Inc., San Francisco, California, Gary W. Oates, President. The report was prepared under the direction of Mark F. Winsor, Project Manager; and Juliet Bolding and Marie Galvin, Deputy Project Managers. Gary Oates served as ESA Officer-in-Charge. The technical assignments and qualifications of all the contributors are provided below. Sections of the EIR/EIS dealing with the SERWTP Facilities Plan were prepared (with modifications) by Goddard and Goddard Engineering.

Geology, Seismicity and Soils

Michael Dwyer, of Michael Dwyer, Inc., is a registered geologist and certified engineering geologist in California. Over the past 27 years, he has supervised and/or participated in more than 2,000 projects involving geologic hazards investigations, geologic feasibility investigations, and preparation of geologic maps.

Mark F. Winsor, Ph.D., is supervisor of ESA's Geo- and Hydro- Sciences Group within the Natural Resources Department. As a Senior Project Manager, he has 17 years of experience in geology and hydrology and has made critical evaluations of erosion hazards, sedimentation, water supply, groundwater resources and water quality for more than 300 projects throughout California.

Hydrology and Water Quality

Mark F. Winsor, Ph.D. (see above).

Juliet Bolding has been a member of ESA's Water, Wastewater and Resource Assessment Group within the Natural Resources Department for two years. She is an environmental analyst with technical specialization in biological assessment, water resources and public services impacts.

David C. Dobson, Ph.D., is a Senior Project Manager with Golder Associates, Alameda, California. He has extensive experience conducting geologic and hydrologic studies of hazardous and non-hazardous waste sites, including assessments of compliance with applicable EPA and state of California regulations.

Barry W. Dial is a Project Programmer with Golder Associates and has over 10 years of experience. He develops groundwater flow and structural response models for a wide range of engineering and geotechnical applications.

David W. Smith Ph.D, principal of Merritt Smith Consulting, Lafayette, California, is an aquatic ecologist with 10 years of experience in water quality and aquatic ecology impact assessment for water and wastewater projects (i.e., wastewater discharges, water diversions, and non-point source pollution).

Biological Resources

Kathy Cuneo, Ph.D., is a botanist/ecologist who has worked in ESA's Natural Resources Department for over 15 years. She specializes in plant geography and vegetation mapping, wetlands delineations, environmental assessment, and restoration planning.

Trish Tatarian is an associate biologist in ESA's Ecological Group within the Natural Resources Department. She is a wildlife biologist with a focus on raptors, special status bird species, aerial photograph interpretation, and vegetation and wildlife habitat characterization.

Air Quality, Noise, Energy and Materials

Jeff Wehling, a Senior Associate member of ESA's Physical Sciences Department, has nine years' experience in air quality, noise, and energy studies covering a wide range of projects. His project experience includes air quality, noise and energy analyses for numerous proposed wastewater treatment facilities, pipelines and transmission lines.

Cultural Resources

Cultural resources investigations were conducted by the Sonoma State University Academic Foundation, Cultural Resources Facility. Cr. Adrian Praetzellis, Principal Investigator, directed and reviewed these investigations. Ms. Leigh Jordan served as Project Coordinator. Research

and field studies were also conducted by Jack Meyers, Eric Allison, Susan Alvares, David Beiling, R. Willie Doddles, Sunshine Psota, Haskola Rivera, Tim Rivera, N. Scotty Thompson, Elyn Walken and Michael Jablonowski.

Visual/Aesthetic Resources

Mark F. Winsor, Ph.D., has 17 years experience in environmental consulting. He has prepared visual impact assessments for energy development and transmission throughout California, applying the BLM VRM and U.S. Forest Service VMS assessment systems.

Marie Galvin is an Associate in ESA's Environmental Planning Department. In her first year at ESA, she has prepared land use, visual quality, cultural resources, and public services and utilities impact analyses for various projects.

Land Use, Socioeconomics and Public Services

Jan Newton, Ph.D., is an economics professor and an economic consultant with over 20 years of experience. She specializes in community economic development, environmental and natural resource economics, fiscal impact assessment, and socioeconomic impact analysis.

Marie Galvin (see above)

Environmental Contamination Hazards

Samuel Uhland, R.E.A., is an Environmental Compliance Specialist in the Physical Sciences and Engineering Department at ESA. His responsibilities include performing environmental assessments and regulatory compliance audits, and preparing site safety plans and documents concerning solid waste and hazardous materials issues. He is a Registered Environmental Assessor in the state of California.

Traffic and Circulation

Paul Mitchell, an associate in ESA's Physical Sciences and Engineering Department, has three years of experience performing traffic impact analyses for numerous development projects, covering virtually every type of land use. He is particularly experienced in studies of industrial

installations, universities, and recreational areas. He has a B.S. in Civil Engineering from San Francisco State University.

Jack R. Hutchison, P.E., is a Supervisory Associate in ESA's Physical Sciences and Engineering Department. He is a registered professional traffic engineer in California with 16 years experience in a wide range of transportation analyses, from planning-level impact analyses to operations and design evaluations.

Geothermal Reservoir Conditions

Christopher W. Klein, Ph.D., is a supervising geochemist with GeothermEx, Inc., Richmond, California, and has 19 years of experience. He has an extensive background in exploration geochemistry, well-testing and well-site geochemical studies, computerized models of fluids behavior, and chemical data interpretation from geothermal fields.

Minh Pham is a reservoir engineer with GeothermEx, Inc. He specializes in geothermal reservoir simulation, and numerical simulation software development.

Subir K. Sanyal, Ph.D., is Vice-President of Reservoir Engineering for GeothermEx, Inc. and has over 20 years of experience. He has managed reservoir engineering programs, interpreted well test data and geophysical logs, and assessed geothermal and hydrocarbon reservoirs.

Seismicity

Roger W. Greensfelder, Ph.D., is a Senior Geophysical Associate with GeothermEx, Inc. Over the past 20 years, he has worked on projects throughout the world involving reflection seismology, borehole geophysics, neotectonics, earthquake hazard analysis and seismic, geoelectrical, gravity and magnetic surveys.

Growth-Inducing Impacts

Leslie Moulton is a Managing Associate in ESA's Natural Resources Department and leads the water and wastewater resource assessment group. In her ten years with ESA, she has conducted impact analyses for over a dozen major water and wastewater system projects. In the past 3 years she has completed growth inducement analyses for five program EIRs on wastewater

system facilities including the Union Sanitary District Master Plan, the Napa Sanitation District Master Plan and the Central Contra Costa County Sanitary District Interceptor Project.

Cumulative Impacts

Mark F. Winsor (see above)

Jan Newton (see above)

Publications Support

Liz Haines provided technical editing. Lisa Bautista and Daryl Hewitt provided work processing. Yuki Kawaguchi provided graphics support.

10.2 AGENCIES AND PERSONS CONTACTED

The following Lake County staff provided information document review and guidance during preparation of this EIR/EIS: Mr. Steve Brodnansky, Mark Dellinger and Gary Brown of LACOSAN. Mr. Kim Seidler and Steven Zalusky of the Lake County Planning Department reviewed administrative drafts of the EIR/EIS. Mr. Robert Reynolds and Ross Kauper, Lake County Air Quality Management District and Robert Bridges, Lake County Counsel's office, also reviewed the Administrative Draft EIR/EIS.

The Bureau of Land Management also provided information document review and guidance during preparation of this EIR/EIS, principally Mr. Rich Estabrook, BLM, Ukiah.

Additional reviewers included Ms. Teresa Perkins, Mr. Marshall Reed, and Robert Creed, U.S. Department of Energy, and D. Faulder, INEL.

Information and document review also was provided by Mr. Bill Smith, Tom Box, C.E. Woods, Dean Cooley, Eric Steger and Tom MacPhee representing the industry partners.

FEDERAL AGENCIES

Tom Cavanaugh, United States Army Corps of Engineers

Ed Sing, United States Army Corps of Engineers

Wayne S. White, Terrestrial Ecologist, United States Fish and Wildlife Service

Margerie Zalesak, Certified Industrial Hygienist, United States Mine Safety and Health Administration

STATE AGENCIES

Larry Bowermaster, Project Studies Engineer, Caltrans District 1

Allen Buckmann, Department of Fish and Game

Rick Macedo, Department of Fish and Game

Larry E. Week, Department of Fish and Game

Ken Stelling, California Division of Oil and Gas and Geothermal Resources

Bruce Burton, Department of Health Services

Bud Getty, Department of Parks and Recreation

Marla Hastings, Department of Parks and Recreation

Breck Parkman, Department of Parks and Recreation

Whalen Toy, Sanitary Engineer Associate, State Water Resources Control Board

REGIONAL AGENCIES

Paul Marshall, Central Valley Regional Water Quality Control Board

LAKE COUNTY

Mark Lockhart, Agricultural Commissioner, Agricultural Commission

Ross Kauper, Air Quality Management District

Robert Reynolds, Air Pollution Control Officer, Air Quality Management District

Debbie Mills, Assistant Manager, Department of Employment Development

Patricia Levine, Department of Environmental Health (Clearlake Office)

Manuel Ramirez, Environmental Health Specialist, Department of Environmental Health

Steve Hill, Flood Control and Water Conservation District

Tom Smythe, Flood Control and Water Conservation District

Steve Why, Flood Control and Water Conservation District/University of California at Davis

Bruce Burton, Sanitary Engineering Branch, Health Services Department

Richard Blake, Health Department

Kim Seidler, Planning Director, Planning Department

Jerry Bowden, Planning Department

Mark Phillips, Planner, Planning Department

Steve Zalusky, Planning Department

Todd Mansell, Associate Engineer, Department of Public Works

Mark Dellinger, Sanitation District

Steve Brodnansky, Sanitation District

SONOMA COUNTY

Sigrid Swedenborg, Planner, Planning Department

Richard Rogers, Planning Department

John Laird, Supervising Engineer, Northern Sonoma County Air Pollution Control District

Sean Connolly, Air Quality Specialist III, Northern Sonoma County Air Pollution Control District

Jim Gallagher, Tax Assessor

YOLO COUNTY

Paul Fitzmorris, Environmental Health Department

Chris Barton, Flood Control and Water Conservation District

Paul Bartkiewicz, Attorney, Flood Control and Water Conservation District

CITY OF CLEARLAKE

Sandra Bonner, City of Clearlake

Dan Obermeyer, City of Clearlake

John Wanger, City Engineer, City of Clearlake

PRIVATE FIRMS

Eliot Allen, Criterion, Inc.

Dean Cooley, PG&E

Tom Box, Calpine

Bill Smith, NCPA

Eric Steger, P.E., Unocal

Mitch Stark, Unocal

Tom MacPhee, Unocal

Charlie Bunker, Project Engineer, Eco:Logic Engineers

Rich Stowell, Eco:Logic Engineers

Stan Spalding, Dewante and Stowell Consulting Engineers

James Kuwada, Independent Air Quality Consultant

Michael Dyett, Principal, Blayney & Dyett

Harry Veizades, Veizades and Associates Consulting Engineers

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12.0 GLOSSARY

A-Weighted Sound Level (dBa): A quantity, in decibels, read from a standard sound-level meter that is switched to the weighting network labeled "A". The A-weighting network network discriminates against the lower frequencies according to a relationship approximating the auditory sensitivity of the human ear at moderate sound levels. The A-weighted sound level measures approximately the relative "noisiness" or "annoyance" of many common sounds.

Acre-foot: A water volume measurement term, equal to the amount of water which would cover an area of one acre to a depth of one foot. An acre-foot equals 325,851 gallons.

Aestivation: Time that is spent during the summer in torpor or in a dormant condition.

Air Basin: A self-contained region with minimal influence on air quality from contiguous regions. California's 14 air basins have been established by the Air Resources Board.

Air Pollutant Concentrations: A measure of the average density of pollutants, usually specified in terms of pollutant mass per unit volume of air (typically in micrograms per cubic meter) or in terms of relative volume of pollutant per unit volume of air (typically in parts per million).

Air Pollutant Emissions: Discharges into the atmosphere, usually specified in terms of weight per unit time for a given pollutant from a given source.

Air Quality Standards: A health based standard for air pollution established by the federal government and the State.

Alluvium: A geological term describing beds of sand, gravel, silt, and clay deposited by flowing water. "Younger" alluvium is sand, gravel, silt, and clay deposits of recent geologic age. "Older" alluvium is characterized by deposit dating back 100's of thousands to more than 1 million years.

Ambient Air Quality: The quality of the air at a particular time and place.

Ammonia (NH₃): Ammonia is primarily an irritant to the eyes, mucous membranes, and upper respiratory tract. Ammonia normally occurs as a result of natural processes and as a fertilizer in agricultural operations. In geothermal plants, ammonia would be present in the steam as gas and subsequently dissolved in the condensate.

Aquifer: A geologic formation or structure that transmits water in sufficient quantity to supply the needs for a water development, such as a well.

Aquifer: A geologic formation that stores, transmits, and yields significant quantities of water to wells and springs.

Attenuation: Noise levels are reduced, or attenuate, with increasing distance from the noise source. For line sources, such as motor vehicle traffic, noise will decrease by about three to five dBA for every doubling of the distance from the roadway, depending on the shielding effect of vegetation and noise barriers, such as earthen berms and sound walls, and sound absorptiveness of the intervening terrain. Conversely, noise will increase by approximately three to five dBA when the distance to the roadway is halved. For point or stationary noise sources, however, a noise reduction of six to nine dBA is experienced for each doubling of the distance from the noise source.

British Thermal Unit: One British Thermal Unit (Btu) is the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at sea level.

Carbon Monoxide (CO). CO is an odorless, invisible gas usually formed as the result of incomplete combustion of organic substances. Ambient CO concentrations normally correspond closely to the spatial and temporal distributions of vehicular traffic. CO concentrations also are influenced by wind speed and atmospheric mixing. Under inversion conditions, CO concentrations may be distributed more uniformly over an area out to some distance from vehicular sources. High levels of CO can impair the transport of oxygen in the bloodstream, thereby aggravating cardiovascular disease and causing fatigue, headaches, and dizziness.

Co-seismic (deformation): Any phenomenon accompanying an earthquake.

Coda (of an earthquake): The latter part of an earthquake is radiated wave-train.

Creep: Plastic deformation (not brittle) in rock, or along a fault, not accompanied by seismicity.

Cretaceous: Era of geologic time, 136 to 65 million years ago.

Crust: Outermost shell of the earth, usually 20-40 miles thick in continental areas.

Designated Scenic Highway or Route: An eligible route that has been subjected to all of the steps contained in the Scenic Highway Program, found to possess scenic or historical amenities worthy of preservation.

Eligible Route: Any highway or street designated in the list of eligible routes contained in the Scenic Highways Element of the Lake County General Plan.

Epicenter: Point on earth's surface directly above earthquake focus (hypocenter), the point of initial fault rupture.

Fault: A fracture surface along which two crustal blocks have experienced (or will experience) relative movement.

Focal Depth: See under Epicenter.

Focus: See under Epicenter.

Folivores: Leaf eating species.

Forbs: Any herb, except grasses and plants that resemble grasses.

Franciscan Basement Rocks: Rocks of Jurassic and Cretaceous age (150 to 100 million years old) which make up most of the California Coast Range.

Fry: Newly hatched fish between the egg and fingerling stages. Depending upon the species, fry can be a few millimeters to a few centimeters long.

Fugitive Emissions: Emissions described as "fugitive" are those that are released to the atmosphere in some manner other than through a stack or pipe. Vehicle movement on an unpaved road causing entrainment of dust into the atmosphere is an example of a fugitive source of emissions.

GAMP: The Geysers Air Monitoring Program, or GAMP, currently includes three monitoring stations within Lake County. These stations continuously monitor H_2S , PM_{10} , metals, radon and meteorological parameters.

Geodetic: Refers to highly precise land surveys which, when repeated, may reveal deformation of the earth's crust.

Glean: To collect or to feed off of an object.

Granivores: Grain eating species.

Groundwater: Water within the earth that supplies wells and springs. Specifically, water in the zone of saturation where all openings in soils and rocks are filled - the upper surface of which forms the water table.

Guilds: Species feeding on the same prey in same habitat but using different methods, for example insect eaters that hover, bark glean, foliage glean, etc.

Habitat: The natural environment of a plant or animal.

Holocene: The last 10,000 years-last segment of Quaternary time.

Hydrogen Sulfide (H_2S): H_2S is gaseous and is both an irritant and an asphyxiant. Chronic, or long-term, exposure can cause irritation of the upper respiratory tract, and if exposure is prolonged, pulmonary edema may result. Acute, or short-term, exposure can cause headaches, dizziness, diarrhea and other afflictions of the nervous system. H_2S has a "rotten egg" odor, with a very low threshold of detectability, and is a source of discomfort to the public. The lowest published determinations for odor perception indicate an average threshold concentration of about five parts per billion by volume (ppbv), although some people may be able to smell H_2S at levels as low as one ppbv (Weres et. al., 1977). Also, a low and a high H_2S odor perception threshold has been identified to be 0.0007 and 0.0140 milligram per cubic meter (mg/m³) respectively; this threshold is by weight and not by volume (Ruth, 1986).

Hypocenter: See under Epicenter.

Infiltration: Leakage of groundwater into sewer system due to faulty pipes, old joints, etc.

Insectivores: Insect eating species.

Intensity, earthquake: See under Modified Mercalli Intensity.

Inversions: An inversion is an atmospheric condition where a layer of cool air is trapped by a layer of warm air so that the underlying cool air cannot rise. Inversions spread polluted air horizontally rather than vertically elevating ground-level concentrations.

Invertebrates: Animal lacking a spinal column or back bone.

Jurassic: Era of geologic time, 195 to 136 million years ago.

Kilowatt-hour: A kilowatt-hour (kWh) is a unit of electrical energy consumed or generated. It equals one thousand watt-hours or 3,413 Btu. One megawatt-hour (MW) is one million watt-hours.

Magnitude (M): A measure of the intrinsic size of an earthquake, not to be confused with intensity, which rates effects at particular places. A unit-increase in magnitude represents a 30-fold increase in elastic wave energy radiated by an earthquake. There are several methods of calculating magnitude, *e. g.* Richter (or local), coda-length, or surface-wave; for magnitudes less than 7, they yield similar numbers.

Mercury (Hg): Inhalation of mercury vapor may produce an acute, corrosive bronchitis and interstitial pneumonitis and, if not fatal, may be associated with symptoms of central nervous system effects such as tremor or increased excitability. The majority of the baseline body content of mercury results from the consumption of foods; after absorption mercury circulates in the blood and ultimately is stored in the liver, kidneys, spleen and bone. Oral ingestion of mercury can cause abdominal cramps, diarrhoea, and suppression of urine. The dominant chemical species of mercury found in geothermal steam is elemental mercury.

Microearthquake: Any earthquake with $M \leq 3$; so-called, because few of these are ever felt by persons.

Microstrain: Strain measured in units of 10^{-6} (1 part per million).

Modified Mercalli Intensity: One of several scales used to qualitatively rate earthquake effects on people, objects, structures, and the ground surface. The modified Mercalli scale has been the accepted standard in North America and Europe (excepting Russia) since 1931.

Normal Faulting: Movement along a dipping (inclined) fault, wherein the upper block slips downward along the lower block.

Official State Scenic Highway: A State or County route whose Scenic Corridor Protection Program has been reviewed and approved by the State Highway Advisory Committee.

Ozone (O₃): O₃ is a gas which not emitted directly into the atmosphere, but is a secondary air pollutant produced in the atmosphere through a complex series of photochemical reactions involving hydrocarbons (HC) and nitrogen oxides (NO_x). Significant O₃ production generally requires about three hours in a stable atmosphere with strong sunlight. O₃ is a regional air pollutant because its precursors are transported and diffused by wind concurrently with O₃ production. O₃ causes eye and respiratory irritation, reduces resistance to lung infection, and may aggravate pulmonary conditions in persons with lung disease. O₃ also is damaging to vegetation and untreated rubber.

Passerines: Perching birds.

Project Sponsors: The companies and/or agencies participating in the project. These include Calpine Corporation, the Northern California Power Agency and LACOSAN. Pacific Gas and Electric Company is participating to the extent that they purchase effluent-based steam from Calpine.

Peak Ground Acceleration (PGA): Maximum amplitude of an accelerograph record (accelerogram) of earthquake ground shaking, usually expressed either in cm/sec² or as a fraction of the acceleration due to gravity ("g") (1 g=980cm/sec²).

Quaternary: Most recent geologic epoch - the last 2 million years.

Record of Decision: Under requirements of the National Environmental Policy Act, a public written record of a federal agency's decision on an action. The Record of Decision also describes alternatives that were considered, the environmentally preferable alternative and a statement about mitigation and avoidance actions that will be undertaken.

Respirable Particulate Matter (PM₁₀): PM₁₀ consists of particulates 10 microns (ten-millionths of a meter) or less in diameter. Particles of this size have been determined to cause adverse health effects when inhaled. Very small particles of certain substances (e.g., sulfates and nitrates) can cause lung damage directly, or can contain adsorbed gases (e.g., chlorides or ammonium) that may be injurious to health. Dust from construction operations and vehicle movement (over paved and unpaved roads) are major sources of PM₁₀.

Reverse Faulting: The opposite of normal faulting.

Right-Lateral (faulting): Describes displacement across a (near) strike-slip fault, wherein (in plain view) the side of the fault opposite the observer appears to have moved to the right.

Riparian Habitat: The land and plants bordering a stream, lake, or tidewater.

Rumsey Gauge: A gauge placed in the lake by a man named Rumsey for the purpose of keeping a record of lake levels. At 7.56 feet on the gauge the lake is considered full, with a flood stage of zero.

Scenic Corridor: The bands of land generally adjacent to the scenic highway right-of-way that complete the visual appearance and integrity of the total composition of the scenic highway. The boundaries of the scenic corridor may coincide with the boundaries of the visual corridor but are usually less.

Seismic Moment: A measure of seismic energy radiated as elastic waves in an earthquake.

Seismicity: Refers to the rate of occurrence and magnitude distribution of earthquakes in any selected region.

Shear Modulus: Shear stress divided by shear strain - an elastic property of a material.

Strike-Slip (fault): Type of fault movement wherein blocks move horizontally along faults which are very steeply (or vertically) inclined.

Sulfur Dioxide (SO₂): The major source of gaseous SO₂ is combustion of high-sulfur fuels; it is not a direct emission from geothermal plants. SO₂ is formed by the chemical conversion of H₂S

which occurs within hours after the introduction of H_2S to the atmosphere. SO_2 affects the upper respiratory tract and the bronchi, and can cause irritation to the nose and the throat.

Surface Supply: Water in reservoirs, lakes, or streams; expressed either in terms of rate of flows (cubic feet per second) or volume (acre-feet).

Tectonic (s): Of or relating to the large-scale pattern of deformation of the earth's crust and uppermost mantle.

Tectonic Plate: A unit of earth's crust and uppermost mantle that moves with respect to another tectonic plate; where such plates are in contact, major faulting or folding (buckling) of crustal rocks, often accompanied by seismicity, takes place.

Transform Faulting: Strike-slip faulting at a tectonic-plate boundary.

Watershed: The total area above a given point on a stream that contributes water to its flow; the entire region drained by a waterway or which drains into a lake or reservoir.

Wetlands: Areas that are permanently wet or intermittently covered with water, such as swamps, marshes, bogs, muskeys, and overflow land of river valleys. Also, land types, such as salt marshes and brackish marshes, subject to saline and tidal influences.