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*BEFORE THE FEDERAL ENERGY REGULATORY COMMISSION*

# POE HYDROELECTRIC PROJECT
# FERC NO. 2107

# APPLICATION FOR NEW LICENSE

**FINAL: December 2003**

**VOLUME 1 of 4**

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PG&E

# POE HYDROELECTRIC PROJECT
# (FERC NO. 2107)
# APPLICATION FOR NEW LICENSE

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*Required per 18 CFR 4.51 Contents of application.*

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**UNITED STATES OF AMERICA**
**BEFORE THE FEDERAL ENERGY REGULATORY COMMISSION**
**APPLICATION FOR LICENSE FOR MAJOR PROJECT - EXISTING DAM**

## INITIAL STATEMENT

1. Pacific Gas and Electric Company, hereinafter referred to as "Licensee," applies to the Federal Energy Regulatory Commission (FERC) for a new 50-year license for the Poe Hydroelectric Project, FERC No. 2107, hereinafter referred to as "Project," as described in the attached exhibits.

2. The location of the Project is:

   State: California

   County: Butte

   Township or nearby town: Pulga, California

   Stream or other body of water: Feather River

3. The exact name, business address, and telephone number of the Licensee are:

   Pacific Gas and Electric Company

   77 Beale Street

   P.O. Box 770000, N11C

   San Francisco, California 94177

   Telephone: (415) 973-7000

The persons authorized to act as agent for the Licensee in this application are:


a) Mr. Randy Livingston

Lead Director, Power Generation

Pacific Gas and Electric Company

P.O. Box 770000, N11E

San Francisco, California 94177

Telephone: (415) 973-6950

b) Ms. Janet Loduca, Attorney

Pacific Gas and Electric Company

P.O. Box 7442

San Francisco, California 94120

Telephone: (415) 973-0174

c) Mr. Tom Jereb, Project Manager

Pacific Gas and Electric Company

P.O. Box 770000, N11D

San Francisco, California 94177

Telephone: (415) 973-9320

Written communications should be directed to Mr. Livingston and Ms. Loduca at the addresses specified above. Telephone communications should be directed to Mr. Jereb.

4. The Licensee is a corporation of the State of California and is not claiming preference under Section 7(a) of the Federal Power Act.

5. The statutory or regulatory requirements of the State of California that affect the Project as proposed, with respect to bed and banks and to the appropriation, diversion, and use of water for power purposes, and with respect to the right to engage in the business of developing, transmitting, and distributing power and in any other business necessary to accomplish the purposes of the license under the Federal Power Act, are:

a) *California Water Code §1200-1700*: Allows for appropriation of water.

b) *California Water Code §3160; Title 23 California Code of Regulations §3855:* Regulates the filing and issuance of a water quality certificate to applicants otherwise required to obtain such a certificate under federal law.

c) *Public Utilities Code, Division 1, §201 et seq.:* Regulates the right of a public utility to produce, generate, transmit, or furnish power to the public.

The steps which the Licensee has taken or plans to take to comply with each of the laws cited above are:

a) The Licensee has acquired appropriative water rights for Project water.

b) The Licensee will file an application for a water quality certificate with the California State Water Resources Control Board within 60 days from the date of FERC's issuance of the notice of ready for environmental analysis, as required by 18 CFR § 434 (b)(5).

c) The Licensee has filed tariffs with the California Public Utilities Commission which authorize it to produce, generate, transmit, or furnish power to the public.

6. The Licensee is the owner of the existing Project facilities. The Licensee's name and address are provided under Item 3 above.

7. The following exhibits are filed herewith and are hereby made a part of this application. A Project Resource Summary is included to state the Licensee's evaluation of the resources of the Project and its vicinity.

| Exhibit | Title |
|---|---|
| | Project Resource Summary |
| A | Description of Project |
| B | Statement of Project Operation and Resource Utilization |
| C | Construction History and Proposed Construction Schedule |
| D | Statement of Costs and financing |
| E | Environmental Report |
| F | General Design Drawings |
| G | Maps of the Project |
| H | General Information |

8. Pursuant to 18 CFR § 4.32(a) of the Commission's Regulations:

(1) The Licensee has maintained and will continue to maintain any proprietary right necessary to construct, operate, and maintain the Project.

(2)(i) The following is the name and address of the county in which the Project is located.

Butte County
25 County Center Drive
Oroville, CA 95965

(2)(ii) None of the Project boundaries or facilities are located within any city, town, or similar local political subdivision. Unincorporated residential communities located within 15 miles of the Project include Pulga, Paradise, and Magalia. None of these communities have populations of 5,000 or more people.

(2)(iii) Irrigation districts, drainage districts, or similar special purpose political subdivisions that are located within the Project boundary or that own, operate, maintain, or use any Project facilities are as follows:

The California Department of Water resources owns and operates the Oroville Project (FERC No. 2100) immediately below the Poe Project. The Big Bend Dam below the Poe Project (and proposed as a Project 2107 facility) is owned and operated by Licensee but located within the project boundary of Project 2100.

(2)(iv) Other political subdivisions in the general area of the Project that would likely be interested in, or affected by, the application are as follows:

There are none.

(2)(v) The following Native American tribes may be affected by the Project:

Harvey Angle, Chairman
Enterprise Rancheria
2950 Feather River Blvd.
Oroville, CA 95965

Shirley Prusia, Chairman
Mooretown Rancheria
1 Alverda Drive
Oroville, Ca 95966

James Edwards, Chairman
Berry Creek Rancheria
5 Tyme Way
Oroville, CA 95966

9. This application is filed under Federal Power Act Section 15. The Licensee hereby certifies that copies of this application have been mailed to the entities identified in paragraphs 8(2)(i), (iii), and (v) above, as well as any other federal, state, municipal or other local government agencies that there is reason to believe would likely be interested in or affected by this application.

IN WITNESS WHEREOF, Licensee the 15th day of December (month), 2003, has caused its name to be signed by Greg Rueger, Senior Vice President and Chief Nuclear Officer, and its Corporate Seal to be affixed by Eric A. Montizambert, Assistant Corporate Secretary, hereunto duly authorized.

PACIFIC GAS AND ELECTRIC COMPANY

By: ______________________________
Senior Vice President – Generation and Chief Nuclear Officer

Attest: ______________________________
Assistant Corporate Secretary

## VERIFICATION

This application for new license is executed in the State of California, City and County of San Francisco, California 94177, by Greg Rueger, who being first duly sworn, deposes and says that the contents of this application for new license are true to the best of his knowledge or belief, and signs the application this 15th day of December (month), 2003.

PACIFIC GAS AND ELECTRIC COMPANY

By: Greg Rueger

Subscribed and sworn before me, a Notary Public of the State of California, this 15th day of December (month), 2003.

Irene F. Rice

Notary Public
in and for the City and County of
San Francisco, State of California

IRENE F. RICE
Commission # 1350318
Notary Public - California
San Francisco County
My Comm. Expires Apr 9, 2006

My commission expires April 9, 2006

# POE HYDROELECTRIC PROJECT

# (FERC NO. 2107)

# PROJECT RESOURCE SUMMARY

# POE HYDROELECTRIC PROJECT

# PROJECT RESOURCE SUMMARY

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POE HYDROELECTRIC PROJECT (FERC NO. 2107)

PROJECT RESOURCE SUMMARY

# 1 INTRODUCTION

## 1.1 Purpose of the Project Resource Summary

The purpose of this Project Resource Summary is to provide a summary of Pacific Gas and Electric Company's (Licensee's) proposal for continued operation and maintenance of the Poe Hydroelectric Project (Project) under a new license, along with explanations of why the Licensee believes that its proposal optimizes the use of Project resources. Each resource issue is more thoroughly discussed in the relevant exhibits and appendices of the application.

## 1.2 Principles on Which This License Application Is Based

In developing its proposal for continued operation of the Project, the Licensee has been guided by a number of principles derived from the provisions of the Federal Power Act (FPA) as amended by the Electric Consumers Protection Act of 1986 (ECPA). The FPA requires the Federal Energy Regulatory Commission (FERC) to give equal consideration to power and non-power values in making licensing decisions in order to determine the most comprehensive use of a resource. The Commission must resolve competing resource uses in a manner that takes them all into account, but does not necessarily result in the optimization of any single resource. In addition, the proposal for continued operation must be best adapted to a comprehensive plan for improving, developing, or conserving the waterway affected by the Project.

Key principles that have guided the Licensee in the development of this proposal for new license are enumerated below.

**(1) The Environmental Baseline is the Existing Project.** For purposes of relicensing, the Commission has held that the effects of a project will be measured against a baseline of current conditions (FERC Order 513 [June 2, 1989] 54 Fed. Reg. 23756, 23775–23776). Any proposed change to the design or operation of the Project works for either developmental or environmental enhancement purposes must be compared to existing conditions, not pre-project conditions, to determine whether such proposals result in a relicensed project that is best adapted to the comprehensive use of the waterway (id.).

**(2) Balancing of Resources.** All resources cannot be optimized simultaneously; therefore, decisions regarding the future of competing resources will require careful consideration and trade-offs.

**(3) Economically Viable Projects Are in the Public's Best Interest.** Both resource assessment and resource enhancement must be commensurate with the scope of the project and must be justified by the potential resource benefits. Enhancements should be appropriate in complexity and cost, and relevant to the existing and proposed project features and operations.

**(4) Cost-Effectiveness of Hydroelectricity.** Hydro power is very valuable to the electricity consumers in California. Overall, hydro generation is one of the most cost-effective energy resources available in California. Hydro power has historically played an essential role in moderating energy prices in the Licensee's service territory. With the generation industry restructuring and the creation of California's Independent System Operator (ISO), the economic value of hydro will not diminish; instead the beneficiaries of this economic resource can now include all the electric consumers in California.

**(5) Load Shaping and Peaking Value of Hydroelectricity.** Many of the Licensee's hydro resources, including the Poe Project, are operated as peaking hydro to help meet the daily changes in system demands. Hydro's dispatchability and spinning reserve capabilities are also important characteristics of hydro power. Hydro capacity has a high unit ramp rate and can easily, quickly, and economically vary output in response to changing customer loads and system conditions. In addition, hydro power has the ability to operate at no-load or low-load with much higher efficiency than the alternative fossil-fueled peaking plants. Finally, because a large portion of California's electricity resources consists of non-dispatchable sources such as nuclear and regulatory must-take generation, the ISO relies on hydro resources to satisfy a large portion of its operating reserve requirements.

**(6) Reliability of Hydroelectricity.** Hydro generation has one of the highest availability and reliability rates of all generation resources. Reliability of customer service is enhanced by the high availability, reliability, and operational flexibility of existing hydro resources.

(7) **Renewable Source of Power.** Society benefits from this indigenous, renewable resource because it produces no air pollution and hydro power directly offsets the use of non-renewable fossil fuels. In addition, hydro power is a non-consumptive use of water resources that is well integrated into water supply, irrigation, flood control, and other multi-purpose projects.

(8) **Project-Specific and System-wide Impacts.** The 120 MW of Project dependable capacity is part of 4,500 MW of hydropower available to meet northern California's load. Because of its relatively low cost of operation and high reliability it provides an important element of the currently tight energy situation in California.

Almost 1,700 MW of the Licensee's hydro project licenses have either expired, or will expire, before 2005. The economic impacts of relicensing proposals that would increase costs and reduce project capability to follow system loads must be considered not only in terms of the Project economics, but also in terms of their impact on the Licensee's electric system and California's electric consumers. It is important to realize that historically all the costs associated with relicensing were directly passed on to electricity ratepayers, and that Californians currently pay some of the highest electricity rates in the country. No matter what the final outcome of the electric industry restructuring, relicensing costs will be reflected in the market price of power in California.

**(9) Natural Resources Stewardship.** The Licensee's corporate policy statement "Commitment to Environmental Quality" (June 1990) states:

> We are convinced that sound environmental policy and sound business practice go hand in hand. We will pursue both for the benefit of our customers, shareholders, employees and the communities we serve.

Natural resources stewardship is one of the objectives enumerated in the policy:

> Licensee is committed to being a good steward of the natural resources under our management. We will:
>
> - Protect the land, water, wildlife and timber resources under our care.
> - Provide opportunities for responsible recreational use of these natural resources.
> - Work cooperatively with other organizations to further our resource protection goals.

**(10) Safety.** The Licensee's Hydro Generation department has identified safety as the number one goal of the five goals essential to fulfilling the department's vision. The safety goal is:

> Maintain a total commitment to safety for our employees, contractor personnel and the public, and continue to motivate employees to improve safety practices and procedures.

## 1.3 Application of These Principles

The Licensee developed its proposal for the continued operation of the Project with the aforementioned principles in mind. As the Commission's *Hydroelectric Project*

*Relicensing Handbook* states, giving equal consideration to both developmental and non-developmental values

> *"does not mean treating all potential purposes equally or requiring that an equal amount of money be spent on each resource value, but it does mean that all values must be given the same level of reflection and thorough evaluation in determining that the project licensed is best adapted."*

The Licensee carefully analyzed and weighed all affected resources and believes that its proposal strikes a balance in the public's best interest between the competing power and non-power benefits that the Project provides. The Licensee's proposal for continued ownership and operation, with the associated analyses, provides comprehensive evidence for the issuance of a new license for the Project.

The following discussion provides a brief description of the Project, its operation, resource issues, the agency consultation process, and the resulting proposal for the continued operation under a new license.

## 2. PROJECT DESCRIPTION AND OPERATION

### 2.1 Project Description

The Poe Hydroelectric Project diverts water from the North Fork Feather River in Butte County at Poe Reservoir, elevation 1390 ft., and returns it to the river at Poe Powerhouse, elevation 902 ft. The Poe Powerhouse is just upstream of Lake Oroville (normal maximum water surface elevation 900 ft.) owned by the State of California (FERC No.

2100) and is the last in a series of Licensee owned projects on the North Fork Feather River.

The Project consists of a diversion dam and associated reservoir, tunnel, surge chamber and penstock, powerhouse with two generating units and an afterbay reservoir and dam. Exhibit A provides a detailed description of the Project facilities. Project drawings can be found in Exhibit F and G. The project has an installed capacity of 120 MW and has historically produced an average of 584 GWh of electrical energy per year.

## 2.2 Project Operation

The North Fork Feather River above Poe Reservoir has a drainage area of 1950 square miles. The East Branch, which provides a major portion of this drainage (1000 square miles), has essentially no storage capacity. During the winter and spring, this drainage can produce very large flows and typically provides the primary source of water for the operation of the Project during this period. Lake Almanor is the primary upstream storage reservoir with a drainage area of 490 square miles. During the summer and fall when natural run-off is low, water releases are made from Lake Almanor to provide generation at Licensee's projects on the NFFR. Operation of these projects is closely coordinated to maximize the use of available water. When high flows are available, the Project is operated as base load. During the lower-flow summer and fall periods, the Project is typically operated to provide peaking power. The Project is also capable of providing ancillary services such as spinning reserve and regulation.

The Poe Reservoir is a relatively small reservoir and provides only very short term storage. It typically fluctuates up and down about three feet during a day. Poe Dam has four large radial gates and one smaller radial gate. The dam also has a 36 inch bypass pipe which can be used to make minimum instream flow releases. When it is necessary to spill water at Poe Dam, a radial gate is raised to release the desired amount of water from the bottom of the reservoir. As a result of this operation, sediment that is mobilized in the NFFR during high flow events can pass through and is not trapped by the reservoir.

During periods when the Poe Dam is spilling water, the gate control system operates to maintain a set reservoir level. This system provides a reasonably constant spill under most conditions except at times when reservoir inflow conditions change suddenly or the generation level at the powerhouse fluctuates. These fluctuations have the potential to produce rates of change in flows below the Dam that are significant.

Poe Powerhouse is often used for peaking and ancillary services and the discharge from the powerhouse is subject to rapid change. To minimize the impact that such flow changes might have on the river channel downstream of the Big Bend Dam, located approximately ½ mile below Poe Powerhouse, a notch was cut in the dam in 1967. This notch was designed to limit the increase in downstream water level rise to no more than one foot in 20 minutes. This dam was originally built in 1910 to divert water for the Big Bend Powerhouse which was inundated by Lake Oroville. Today, the dam functions as an afterbay to Poe Powerhouse, reducing flow fluctuations downstream, and providing tailwater level control for the Poe Powerhouse.

## 3. RESOURCE ISSUES SUMMARY

As is typical of most hydro projects, the relicensing of the Poe Hydroelectric Project involves numerous resource considerations. In addition to the power benefits, the Licensee attempted to balance the needs of recreation, fisheries, wildlife, vegetation, water quality, and cultural resources. The following summarizes the resource issues that were identified during the relicensing process and the resource balancing rationale on which the Licensee's proposals are based.

### 3.1 Water Use and Quality

*Resources to be balanced:*

- *Improved water quality*
- *Increased/improved habitat for rainbow trout and other native aquatic species*
- *Economical power generation*

Water quality monitoring has shown that water quality conditions on the Poe Hydroelectric Project are good and that current Project operations continue to protect existing beneficial uses. However, Licensee recognizes that its power operations on the North Fork Feather River (NFFR) have altered the flow regime, and water temperatures in the Poe bypass reach exceed desired levels during the summer months. Additional flow in the bypass reach would provide some enhancement of water temperature conditions, and Licensee proposes that the minimum instream flow be increased from 50 to 150 cfs, as measured at the Pulga gage (NF23). At the 150-cfs flow level, the existing coldwater habitat would be extended downstream. The ability to achieve lower water temperature conditions in the NFFR depends in large part on the ability to release colder water upstream at Lake Almanor, the primary water storage facility on the NFFR. Licensee has been investigating the feasibility of enhancing coldwater withdrawal from the Prattville Intake at Lake Almanor for many years and has recently made a substantial commitment to pursue a temperature control device as part of the relicensing of the Licensee's upstream Rock Creek - Cresta Project (FERC No. 1962).

## 3.2 Instream Flows

*Resources to be balanced:*

- *Habitat for native and non-native fish species*
- *Coldwater temperatures in the bypass reach*
- *Foraging habitat for bald eagles*
- *Habitat for sensitive amphibian species (foothill yellow-legged frog)*
- *Habitat for sensitive fish species (hardhead)*
- *Economical power generation*
- *Water contact recreation*

Minimum Instream Flow Release Levels

Operation under the current license requires that a minimum instream flow of not less than 50 cfs be maintained at the NF23 gage (located approximately one mile downstream of the Poe Dam) provided that the release from the dam is not less than 25 cfs. In recent years increased leakage on the gate seals has resulted in typical flows of around 100 cfs. The major resource benefits of the status quo are economical power generation while maintaining conditions that support a combined trout and smallmouth bass fishery, populations of foothill yellow-legged frog, a nesting pair of bald eagles, and wading and swimming at river recreation sites.

Factors that need to be considered when making flow recommendations include the following:

- Bald eagle population: One of the most productive bald eagle nests in California is located in the vicinity of the Poe Powerhouse and a significant portion of their foraging during the nesting season occurs on the NFFR above the powerhouse.
- Sensitive amphibian population: Survey data have shown the presence of well-established populations of foothill yellow-legged frog, a Forest Service Sensitive Species, in the Poe bypass reach.
- Existing fishery and potential enhancements: The Poe bypass reach currently supports both cold and warm water species of native and non-native fish. The primary game species are rainbow trout and smallmouth bass. The bypass reach also contains a population of hardhead, a Forest Service Sensitive Species. Increased streamflows would enhance habitat primarily for rainbow trout. Consideration also needs to be given to the impacts of increased flows on other resources (e.g., amphibians, bald eagles, and other fish species).
- Recreational use: Much of the reach is remote and inaccessible, and the primary uses at the few recreation sites are swimming and wading. Whitewater recreation opportunities would be for advanced skill levels only.
- Cold water temperature enhancement: Licensee is pursuing upstream temperature enhancements that may assist in lowering temperatures in the entire NFFR and

benefiting trout populations. Consideration also needs to be given to the impact of reduced water temperatures on other resources (e.g., amphibians and bald eagle foraging species).

- Basin Plan existing beneficial uses for the NFFR: municipal and domestic water supply, power, contact and non-contact recreation, cold freshwater habitat, cold water spawning, and wildlife habitat.
- Natural hydrograph: Upstream reservoir operations have significantly altered natural seasonal flow levels.
- Impacts of potential increased water-based recreation on bald eagles and amphibians.

Fishery data indicate the presence of both cold and warm water species. Increased instream flows would decrease the water temperature and provide greater habitat for sport recreation species such as rainbow trout. However, higher flow increases may disadvantage other species (primarily through a decrease in temperature) and could make foraging by bald eagles more difficult. The actual effects of instream flow increases on foothill yellow-legged frog (FYLF) populations are unknown; however, based on the results of visual encounter surveys and an evaluation of the effects of increased flows on FYLF habitat, overall habitat appears to be reduced at flows between 250 cfs and 310 cfs. Streamside recreational users would likely prefer warmer water conditions associated with low flow releases. Balancing these competing interests does not provide a clear solution, although it is logical to give more weight to factors that may influence sensitive species. With this in mind, Licensee proposes a continuous, year-round minimum instream flow of 150 cfs as measured at the Pulga gage (NF23). Recognizing that there are uncertainties related to the actual response of affected resources to changes in streamflow, Licensee proposes to monitor those responses.

The increase from 50 cfs to 150 cfs year-round release has a cost to society resulting from air pollution from fossil-fueled generation used to replace the foregone hydro generation. The additional air emissions from the substitute generation equated to about 16,240,000 pounds of $CO_2$ per year, or the equivalent of 1300 automobiles per year, which has a societal health and material damage cost ranging from $96,000 to $142,000 per year.

Recreation and Pulse Flows

No pulse or recreation flows (aside from those that occur as a result of natural spill) are proposed. This recommendation is based on 1) the regular occurrence of high flow periods during winter storms and spring run-off; 2) consideration for avoiding impacts to foothill yellow-legged frog eggs, tadpoles, and metamorphs; and 3) consideration for avoiding impacts on bald eagle foraging. Access to information on natural flows for use by whitewater recreationists is discussed under Section 3.7 below.

Gaging of Instream Flows

The current stream gage at NF23 was rebuilt after the flood of January 1997 and provides a good, full range recording location. Data from this gage are fed to the System Operator at Rock Creek Powerhouse where they are monitored 24 hours a day. NF23 is location directly below the Highway 70 bridge at Pulga (approximately 1.5 miles downstream of Poe Dam) and is the closest site to Poe Dam suitable for reliably gaging streamflows. To measure flow directly below Poe Dam, Licensee uses gaging location NF66. This gage consists of a staff gage that is mounted on a rock cliff at the bank of the stream channel; it is read daily by a roving operator reading the staff through a telescope. The gage is in a very inaccessible location and is susceptible to damage during high flows. Mill Creek and Flea Valley Creek provide flow to the NFFR between Poe Dam and NF23. These streams are approximately 0.5 and 1.0 miles downstream, respectively, from Poe Dam. Except during periods of heavy precipitation, these tributaries provide a flow of less than 25 cfs. Recognizing that future instream flow requirements in the Poe bypass reach will be greater than 50 cfs, Licensee proposes that the flow gaging at NF66 be abandoned and flows be monitored at NF23 only.

### 3.3 Spill Flow Operation

*Resources to be balanced:*

- *Reduction of potential fish and amphibian displacement and stranding mortality*
- *Improvement of macroinvertebrate conditions*
- *Economical Project operation*
- *Operational flexibility and associated system operating benefits*

<u>Poe Dam</u>

Historic spill operations at Poe Dam have not been limited by a specific ramping rate requirement other than Licensee's standard practice of avoiding ramping up faster than approximately 600 cfs per hour during the non-spill season for public safety reasons. During natural storm events, the increasing flow rates can be significant, although the decreasing flow rate is generally much less steep. The typical minimum instream release requirement at the dam is currently less than 50 cfs, and large flow increases and decreases at this low flow level could have an impact on aquatic resources. To mitigate this impact, Licensee proposes to implement the same ramping rate requirements at Poe dam as those adopted for the upstream Rock Creek and Cresta dams. These rates are as follows:

> During periods when ramping can be controlled at spill flows less than 3,000 cfs, the Poe Dam ramping rates shown below are proposed. These rates would be followed as close as reasonably practicable given radial gate operating limitations. It should be understood that certain operating situations, such as a unit trip when incoming flows to Poe Reservoir cannot be controlled, would likely cause an exceedance of these rates. Revision to these rates could occur as the result of monitoring Rock Creek - Cresta flow impacts.
>
> March, April and May - 250 cfs/hr. up-ramp and 150 cfs/hr. down-ramp
> June 1 - June 15 - 300 cfs/hr. up-ramp and 150 cfs/hr. down-ramp
> Remainder of the year - 400 cfs/hr. up-ramp and 150 cfs/hr. down-ramp

Poe Powerhouse

Poe Powerhouse provides a valuable contribution to the reliability of the electrical system by providing ancillary service capability allowing for rapid loading to meet system emergencies. As such, the tailwater elevation in the tailrace is subject to a potential increase of three to four feet within about 10 minutes. Immediately downstream of the powerhouse the stream channel has become fairly wide due to the existence of the reservoir formed by the Big Bend Dam. This tends to mitigate the impact of rapid increases in releases from the powerhouse. As the water flows downstream, the elevation in Big Bend Reservoir increases due to the configuration of the notch cut in the dam (see Exhibit Drawing F-8). This notch was designed to keep the rate of increase in the downstream water elevation to no greater than one foot in 20 minutes. As the channel downstream of Big Bend Dam is typically inundated by Lake Oroville between April and mid-summer of normal water years, Licensee believes this buffering effect is adequate to mitigate potential impacts.

### 3.4 Other Aquatic Resource Considerations

*Resources to be balanced:*

- *Enhancement of fishery habitat conditions in the NFFR*
- *Protection of aquatic species*
- *Economical Project operation*

Entrainment

Poe Dam diverts water into an unscreened intake to the Poe tunnel presenting the potential for entrainment. Fish netting surveys were performed in the tailrace channel during powerhouse operation to monitor movement of fish through the system and to identify the level of entrainment during a one-year sampling period. Minnow species were the primary fish entrained. No trout or large adult specimens of any species were observed in the entrainment samples. Fish survival through the turbines is likely very low due to the high head. Although hardhead were present in the samples, due to the low numbers of fish observed and their small size, no action is proposed.

Fish Passage at Poe Dam

Poe Dam is a barrier to upstream movement of fish. Although anadromous species no longer use the NFFR, trout do migrate upstream to spawn. Spawning habitat in the NFFR and tributaries above Poe Dam is limited due to the limited amounts of gravel in the main river and poor tributary access. Even if passage were possible, movement through Poe Reservoir would subject adults and juveniles to predation and entrainment potential. The most suitable spawning habitat in the Poe reach is located just below Poe Dam in Flea Valley Creek, and to a lesser extent in Mill Creek. Both of these streams have sufficient spring and early summer flows for spawning, and surveys indicate that successfully spawning is occurring. Flea Valley Creek is easily accessible for nearly one mile upstream of its confluence with the NFFR. The Mill Creek culvert under Highway 70 makes passage difficult; however, some spawning may occur in the short distance between Highway 70 and the mouth and, under some flow conditions, in the section of Mill Creek above Highway 70 for adults that are able to pass the culvert. No fish passage facilities are proposed for Poe Dam.

Fish Passage at Big Bend Dam

In the early 1960's when Oroville Reservoir was completed, a notch was cut into Big Bend Dam that allows the upstream movement of fish during times when Lake Oroville is at or near its maximum storage level. However, at other times, this dam is a barrier to upstream fish passage. The dam at one time had a fish ladder designed for Chinook salmon passage, major portions of which no longer exist. The Poe Reach would provide some limited spawning habitat for Lake Oroville trout if full-time passage facilities were provided. However, providing easier access for brown trout and bass from Lake Oroville could seriously increase predation on foothill yellow-legged frog eggs, tadpoles, and metamorphs in the NFFR. Removal of the Big Bend Dam would require the construction of a tailwater control facility at Poe Powerhouse tailrace. This alternative would potentially concentrate fish from Lake Oroville just below the powerhouse tailrace, which would, in turn, attract fishermen to the powerhouse area. Finally, under the Big Bend dam removal scenario, the downstream reach of the NFFR would be subject to more rapid flow fluctuations due to the loss of the dampening effect of Big Bend Dam and Reservoir. No action at Big Bend Dam is proposed.

Spawning gravels in the NFFR

The Poe Reach of the NFFR does contain some areas of gravel in locations that might be suitable for spawning. The operation of the Poe radial gates (opening from the bottom) likely contributes to the movement of gravel through Poe Reservoir. It is also possible that the tunnel spoil piles contribute gravel to the river. Erosion from these piles is not a major issue and, while some corrective action at Bardee's Bar Spoil Pile is proposed, no major action to prevent normal erosion at these locations is proposed.

## 3.5 Wildlife Resources

*Resources to be balanced:*

- *Protection of bald eagle foraging habitat*
- *Protection of bat habitat*
- *Management of recreational demand*
- *Enhancement of cold water species habitat*

One of the most productive bald eagle nests in California is located near the Poe Powerhouse. Eagles spend a significant amount of time foraging in the Big Bend Reservoir and the reach of the NFFR above Poe Powerhouse. Although the eagles have adapted well to existing conditions, Licensee proposes that recreational opportunities in the vicinity of Poe Powerhouse not be increased to avoid possible disturbance impacts. Consideration for bald eagles was also given in the proposed recommendations for instream flows and fish passage discussed above. Removal of Big Bend Dam, and the resulting loss of the reservoir, could possibly impact bald eagles that forage in the reservoir and nest nearby.

## 3.6 Botanical Resources

*Resources to be balanced*

- *Protection of special status plants*
- *Improved/increased recreational opportunities*

The Project vicinity is comprised of forest, woodland, chaparral, and grassland habitats and riparian communities. Significant populations of special status plants were located in the Project area where occasional recreational use occurs. Licensee proposes to manage this existing use but not to encourage increased use to protect these populations.

## 3.7 Recreation, Land and Visual Resources

*Resources to be balanced:*

- *Recreational opportunities*
- *Natural scenic resources*
- *Protection of sensitive species (habitat for bald eagles and sensitive plant, amphibian and fish species)*
- *Public safety*
- *Project economics*
- *Protect cultural resources*

Recreational use facilities

Dispersed recreation presently exists in the vicinity of the Project at locations along the NFFR that are accessible by the public. Survey data indicate that the recreational users generally prefer the undeveloped nature of the sites and the solitude that it provides. Licensee proposes that modest improvements be made to better control sanitation and protect the areas from degradation. These improvements are listed below. Licensee proposes to install informational signage but does not propose to encourage additional recreation activities to protect sensitive plants, birds, amphibians, and cultural resources. Licensee also proposes that the recreational use be reviewed periodically.

Sandy Beach: Placement of portable toilet and garbage facilities during the recreation season. Add informational signing. Regravel existing road. Periodic trimming of vegetation to increase sight visibility at Highway 70 entrance.

Bardee's Bar: Installation of a permanent picnic table, trash receptacle and vault toilet. Place informational signing at "Y" in Bardee's Bar road specifying "Pack it in/Pack it out" policy and directional access.

Poe Beach: Improvements in site access through construction of stairs or a primitive trail and installation of a "Pack it in/Pack it out" sign.

Poe Powerhouse: Placement of permanent vault toilet and garbage collection facilities near the powerhouse. Parking will be facilitated through grading of the area adjacent to the road leading down to the beach site from the powerhouse. Installation of informational signage.

Shady Rest: Jointly develop with the Forest Service an ADA accessible surfaced trail from the existing dirt parking area to the river's edge. Rehabilitate existing facilities when necessary.

Poe Reservoir: Improve an existing trail from the Cresta Powerhouse access road area to Poe Reservoir. Place informational signs on Highway 70 specifying "Pack it in/pack it out" and directional access.

Scenic Viewpoint: If acceptable to Caltrans, improve an existing scenic viewpoint area on Highway 70. Provide informational signs.

Visitors Center: Provide a one-time contribution seed money to initiate possible development of a Visitor Center by a governmental agency or non-profit organization.

Whitewater Recreation

The Poe Reach of the NFFR could potentially provide whitewater recreational opportunities for advanced skill level recreationists. Natural spring spill flows in normal and wet years may potentially provide boatable levels of flow. Licensee will work with whitewater groups to develop an information system that will allow recreationists access to information on flow conditions. The regulated release of high flows during the spring and summer seasons could be detrimental to amphibians. In addition, spring and early summer whitewater activities could be detrimental to bald eagle nesting. Thus, no recreation flows (aside from those that occur as a result of natural spill) are proposed.

Visual Resources

To enhance visual resources in the Project area, Licensee proposes to conduct minor painting at Poe Dam, remove the steel bridge at Bardee's Bar and initiate revegetation of the Bardee's Bar spoil pile to the extent reasonably feasible. In addition to initiating revegetation work on the Bardee's Bar spoil pile, erosion control measures will be implemented to control drainage and protect the toe of the spoil pile where it is subject to the flow of the NFFR.

### 3.8 Cultural Resources

*Resources to be balanced:*

- *Preservation of cultural resources*
- *Recreation access and use*

Only two cultural resource sites recommended as National Register eligible exist within the area of potential effect. These locations were significantly disturbed during the Project construction and other uses (including seasonal flooding) and have been used for informal recreation since Project completion. Recreational improvements proposed for these areas will be placed so as to draw human activity away from the area of concern. Additional recreational activities could be detrimental to cultural resources.

## 4. AGENCY CONSULTATION AND OUTSTANDING ISSUES

**Collaborative Discussion of Protection, Mitigation, and Enhancement Measures**

The Licensee has received requests regarding the desire to conduct a collaborative process to reach agreement on appropriate protection, mitigation, and enhancement measures for the Project.

Licensee proposes to conduct a six-month collaborative process beginning in January 2004. The goal of the collaborative process is to reach agreement with all stakeholders willing to fully participate on appropriate protection, mitigation, and enhancement measures for the Project. All meetings will be open to the public. Written meeting notification will also be mailed to all known stakeholders two weeks prior to the meeting.

The location of the meetings will be rotated on a monthly basis between Oroville and Sacramento. A meeting facilitator will be used. All participants must agree to fully participate to the best of their ability. Meeting protocols will be agreed to at the first meeting.

## 5. PROJECT ECONOMIC SUMMARY

The Licensee proposes to spend about $1.9 million in construction and studies, plus $50,000 per year in monitoring and O&M to enhance and protect the environmental and recreational resources at the Project. These proposals would increase the cost of Project power by over $300,000 per year (using FERC's current cost method). In addition, the Licensee proposes to triple the minimum instream flow requirement to 150 cfs year-round, which will require the purchase of replacement power costing over $1,000,000 per year. Table PRS-1 contains the detailed cost information.

The adoption of all of the recreation and environmental proposals discussed with Agencies would significantly increase the cost of Project power and would also significantly decrease the Project generation. The estimated costs to implement the Agencies' proposals would total up to an additional $13 to $15 million in construction, plus about $100,000 per year in monitoring and O&M, plus about $3.8 to $5.5 million in replacement power costs. These proposals would increase the cost of Project power by about $2 million per year over the Licensee's proposals (using FERC's current cost method). Table PRS-2 contains the detailed cost information.

Table PRS-3 summarizes the generation levels, annual power value and cost of Project power for the No-Action, Licensee Proposal, and Agency Proposal cases. The total net impact of adopting the Licensee's Proposals would increase ratepayers' cost by about $1.4 million per year. Adopting Agency Proposals would increase the ratepayers' costs by about $6 to $8 million per year over the Licensee's Proposals. These annual cost impacts include the additional construction, studies, O&M, and replacement power (both energy and ancillary services).

## Table PRS – 1

### LICENSEE PROPOSALS IN FINAL LICENSE APPLICATION

**Average Annual Cost of the Total Project using FERC's Current Cost Method (w/ 14% FCR)**

**Estimated Costs $ 1,000's ($ 2004)**

| Item Description | One-Time Capital<br>$1,000's | Annual Expense<br>$1,000's/yr | Replacement Power costs<br>$ 1,000's/yr | Average Annual Costs<br>$ 1,000's/yr |
|---|---|---|---|---|
| **LICENSEE PROPOSALS IN FINAL LICENSE APPLICATION** | | | | |
| Minimum Instream Flow increase to 150cfs @ Pulga gage (563.8 GWh/yr at 5.62 cents per kWh) | | | $1,057 /yr | $1,057 /yr |
| Ramp rate limitations at Poe dam - controls loss of operating flexibility | $100 | | $0.1 /yr | $14 /yr |
| **Recreation Facilities** | | | | |
| Sandy Beach Improvements | $28 | $5.2 /yr | | $9 /yr |
| Bardees Bar Improvements | $54 | $9.0 /yr | | $17 /yr |
| Poe Beach Improvements | $39 | $0.3 /yr | | $6 /yr |
| Poe Powerhouse Improvements | $60 | $8.4 /yr | | $17 /yr |
| Shady Rest Improvements | $25 | $1.0 /yr | | $5 /yr |
| Poe Reservoir/Cresta PH Trail Improvements | $28 | $1.0 /yr | | $5 /yr |
| Hwy 70 Scenic Viewpoint improvements | $38 | $1.0 /yr | | $6 /yr |
| Annual Recreation monitoring | $0 | $20.0 /yr | | $20 /yr |
| **Visual Improvements** | | | | |
| Paint Poe Dam Light Fixtures | $5 | $0.5 /yr | | $1 /yr |
| Bardees Bar/Audit 2 Spoil Pile Reveg. | $300 | $3.0 /yr | | $45 /yr |
| Bardees Bar Steel Bridge Removal | $450 | $0.0 /yr | | $63 /yr |
| **Vegetation Management** | | | | |
| Noxious Weed Control | $0 | $5.0 /yr | | $5 /yr |
| **Erosion Control** | | | | |
| Bardees Bar/Audit #2 Spoil Pile Improvements | $770 | $0.0 /yr | | $108 /yr |
| **Total Licensee Proposal Costs** | **$1,897** | **$54.4 /yr** | **$1,056.6 /yr** | **$1,377 /yr** |
| **Total "Licensee Proposal" Average Annual Costs** | | | | **$10,213 /yr** |
| **Cost of production** | **563.8 GWh/yr** | | | **$18.1/MWh** |
| **Net "Licensee Proposal" Average Annual Costs** | | | | **-$22,530 /yr** |

Table PRS – 2

**POTENTIAL NEW LICENSE CONDITIONS (in excess of Licensee Proposals)**

**Average Annual Cost of the Total Project using FERC's Current Cost Method (w/ 14% FCR)**

**Estimated Costs $ 1,000's ($ 2004)**

| **Item Description** | **One-Time Capital $1,000's** | **Annual Expense $1,000's/yr** | **Replacement Power costs $ 1,000's/yr** | **Average Annual Costs $ 1,000's/yr** |
|---|---|---|---|---|
| **POTENTIAL NEW LICENSE CONDITION (in excess of Licensee Proposals)** | | | | |
| Minimum Instream Flow increase to 500cfs | | | $3,807 /yr | $3,807 /yr |
| Flow release facility modifications at Poe Dam to release up to 500 cfs (current max. release capability is 150 cfs) | $5,000 | $50 /yr | | $750 /yr |
| **Fish Passage at Big Bend Dam** | | | | |
| Option 1 - Construct and maintain new fish ladder | $8,000 | $75 /yr | | $1,195 /yr |
| Option 2 - Remove Big Bend, construct a tailrace weir, constrain operation | $10,000 | | $1,687 /yr | $3,087 /yr |
| **Total Potential Licensee Conditions by Others (low)** | **$13,000** | **$125.0 /yr** | **$3,806.7 /yr** | **$5,752 /yr** |
| **Total Potential Licensee Conditions by Others (high)** | **$15,000** | **$50.0 /yr** | **$5,493.5 /yr** | **$7,643 /yr** |
| | | | **Low estimate** | **High estimate** |
| **Total "Potential New Licensee" Average Annual Costs** | | | **$15,964 /yr to** | **$17,856 /yr** |
| **Cost of production** | **496.1 GWh/yr** | | **$32.2 /MWh to** | **$36.0 /MWh** |
| **Net "Potential New Licensee" Average Annual Costs** | | | **-$16,778 /yr to** | **-$14,886 /yr** |

Table PRS - 3

**Poe Project Economic Analysis using FERC's Current Cost Method**

**Comparison of economic analyses**

**Estimated Costs $ 1,000's ($ 2004)**

| | No-Action Case | Licensee Proposals Case | Other Proposals Case | |
|---|---|---|---|---|
| | | | Low estimate | High estimate |
| Dependable Capacity (MW) | 120 | 120 | 120 | 120 |
| Annual generation (GWh) | 582.6 | 563.8 | 496.1 | 496.1 |
| Annual Power value: Annual generation | | | | |
| thousands $ | $32,742 /yr | $31,686 /yr | $27,879 /yr | $26,192 /yr |
| mills / kWh | 56.2 | 56.2 | 56.2 | 52.8 |
| Annual cost: | | | | |
| thousands $ | $8,836 /yr | $9,156 /yr | $11,101 /yr | $11,306 /yr |
| mills / kWh | 15.2 | 16.2 | 22.4 | 22.8 |
| Current net annual benefits: | | | | |
| thousands $ | $23,906 /yr | $22,530 /yr | $16,778 /yr | $14,886 /yr |
| mills / kWh | 41.0 | 40.0 | 33.8 | 30.0 |

# POE HYDROELECTRIC PROJECT, FERC NO. 2107

## GLOSSARY OF TERMS

| *Term* | *Definition* |
|---|---|
| | **A** |
| A | ampere |
| AA | Federal Antiquities Act |
| ADA | Americans with Disabilities Act |
| Adit | An almost vertical pipe or short horizontal passage entering a tunnel, either to add water from a conduit, sluice or other water source, or as a maintenance access tunnel (also referred to as a portal if located at the beginning or end of the tunnel.) |
| af | acre-foot, the amount of water needed to cover one acre to a depth of one foot |
| Afterbay | A reservoir located immediately downstream from a powerhouse, sometimes used to re-regulate flows to the river or stream |
| AFRP | Anadromous Fish Restoration Program |
| AGC | Automatic Generation Control (the ability to control the megawatt output of a given powerhouse from remote site, such as the ISO) used to support California electric regulation system |
| APE | Area of Potential Effect as pertaining to Section 106 of the National Historic Preservation Act |
| Automatic/semi-automatic/manual powerhouses | An automatic powerhouse can be started, stopped, and have its load and voltage changed from a remote or master station, via supervisory control. A semiautomatic powerhouse with SCADA may allow a remote station to change load and/or voltage, and may allow a remote shutdown, but must be started manually. A semi-automatic powerhouse without SCADA will send alarms to a remote or master station. A manual powerhouse must have all its functions performed at the powerhouse |
| | **B** |
| Basin Plan | The RWQCB Water Quality Control Plan for the Sacramento River Basin and San Joaquin River Basin, Fourth Edition, 1998 |
| Big Bend Dam | A concrete gravity dam downstream of Poe Powerhouse originally built as a diversion structure for Big Bend Powerhouse (inundated by Lake Oroville) |
| Black Start Capability | The ability of a unit to start up without the use of an external transmission or distribution voltage power source |
| BMP | Best Management Practice |
| BOD | biological oxygen demand |
| | **C** |
| C | Celsius |
| CDFG | California Department of Fish and Game |
| CDPR | California Department of Parks and Recreation |
| CDSOD | California Division of Safety of Dams within the CDWR |
| CDWR | California Department of Water Resources |
| CE | A species or subspecies listed as endangered under the California Endangered Species Act |
| CEQA | California Environmental Quality Act |
| CESA | California Endangered Species Act |
| CFR | Code of Federal Regulations |
| cf | cubic foot |
| cfs | cubic feet per second |
| CNDDB | California Natural Diversity Data Base |
| CNPPA | California Native Plant Protection Act |
| CNPS | California Native Plant Society |
| CNPS-1A | Plants presumed to be extinct in California |
| CNPS-1B | Species considered by the CNPS as rare or endangered in California and elsewhere |

| *Term* | *Definition* |
|---|---|
| CNPS-2 | Species considered by the CNPS as rare or endangered in California but more common elsewhere |
| CNPS-3 | Species that require more information before assigning to other lists – A review list |
| CNPS-4 | Species considered by the CNPS as plants of limited distribution |
| Conduit | A pipe, flume or canal used for diverting or moving water from one point to another, usually used when there is no existing streambed or waterway |
| CP | Amphibian and reptile species designated as protected under the CDFG sport fishing regulations as authorized by the California Code of Regulations, Title 14 |
| CPUC | California Public Utilities Commission |
| CR | A species or subspecies listed as rare under the California Endangered Species Act |
| CSC | Special Concern Species, an administrative designation by CDFG |
| CT | A species or subspecies listed as threatened under the California Endangered Species Act |
| CWA | Federal Clean Water Act |
| **D** | |
| dbh | diameter at breast height |
| DEA | draft environmental assessment |
| DEIR | Draft Environmental Impact Report |
| Distribution System | The substations, transformers and lines that convey electricity from high-power transmission lines to the consumer |
| DO | dissolved oxygen |
| **E** | |
| EA | Environmental Assessment |
| EAP | Emergency Action Plan |
| EIR | Environmental Impact Report |
| EIS | Environmental Impact Statement |
| ESA | Federal Endangered Species Act |
| EVC | Existing Visual Condition |
| **F** | |
| F | Fahrenheit |
| FAC | Federal Advisory Committee |
| FACA | Federal Advisory Committee Act |
| FE | A species or subspecies listed as endangered under the Federal Endangered Species Act |
| FEMA | Federal Emergency Management Agency |
| FEPD | A federally-listed endangered species currently proposed for delisting from the ESA |
| FERC | Federal Energy Regulatory Commission |
| FERC Project Boundary | The area surrounding Project facilities and features as delineated in Exhibit F or G of the FERC license. |
| Flashboards | Removable boards installed seasonally in reservoir spillways to temporarily increase storage capacity |
| FLPMA | Federal Land Policy and Management Act |
| Flume | A lined structure, commonly made of wood, metal or concrete, used for conveyance of water, usually where no streambed exists or the topography is not suitable for a canal or tunnel |
| Forebay | A reservoir upstream from the powerhouse, from which water is drawn into a tunnel or penstock for delivery to the powerhouse |
| FP | A species or subspecies designated as "fully protected" under the Calif. Fish & Game Code |
| FPA | Federal Power Act |
| Francis Turbine | A radial-inflow reaction turbine, where flow through the runner is radial to the turbine shaft |
| FSC | Special Concern Species, an administrative designation by USFWS (former category 2 species) |
| FSCD | First Stage Consultation Document, also known as Initial Consultation Document or ICD |
| FSS | A species or subspecies designated as "sensitive" by the USFS |
| FT | A species or subspecies listed as threatened under the Federal Endangered Species Act |

| *Term* | *Definition* |
|---|---|
| Ft | feet |
| FTPD | A federally listed, threatened species currently proposed for delisting from the ESA |
| FWCA | Fish and Wildlife Coordination Act |
| **G** | |
| g | gram |
| GIS | Geographic Information System |
| Generator | A machine powered by a turbine that produces electric current |
| GWh | gigawatt hour (equals one million kilowatt hours) |
| **H** | |
| HABTAT | IFIM simulation model |
| "H"-frame structure | A wood pole transmission structure that consists of two wood poles with a horizontal cross arm above the conductor |
| Hp | horsepower |
| hr | hour |
| HSI | Habitat Suitability Indices |
| Hz | hertz (cycles per second) |
| **I** | |
| ICD | Initial Consultation Document, see FSCD |
| IFIM | USFWS Instream Flow Incremental Methodology |
| Immediate Vicinity | The area extending to about one mile out from project features |
| in | inch |
| ISO | California Independent System Operator |
| **J** | |
| | |
| **K** | |
| k | kilometer: 1,000 meters |
| kg | kilograms: 1,000 grams |
| kg/day | kilograms per day |
| kg/ha | kilograms per hectare |
| kg/yr. | kilograms per year |
| kV | kilovolts: 1,000 volts |
| kVA | kilovolt amperes |
| kW | kilowatts: 1,000 watts |
| kWh | kilowatt-hour: 1,000 watt hours |
| **L** | |
| l | liter |
| Licensee | Pacific Gas and Electric Company |
| **M** | |
| m | meter |
| MBTA | Migratory Bird Treaty Act |
| µ | micro |
| $mgC/m^2$ | miligrams of carbon per square meter |
| µg/l | micrograms per liter |
| µmho/cm | micromohos per centimeter, a measurement of conductivity |
| mg/l | milligrams per liter |
| mi. | mile |
| mills/kWh | cents per kilowatt hour |
| MIR | minimal implementation requirement, a USFS system |
| MIS | USFS Management Indicator Species |
| mm | millimeters |

| *Term* | *Definition* |
|---|---|
| Must-Run | Energy or ancillary services necessary to maintain system reliability |
| MVA | megavolt-ampere |
| MW | megawatt |
| MWh | megawatt-hours |
| | **N** |
| NCPA | Northern California Power Agency |
| ND | no data available |
| NEPA | National Environmental Policy Act |
| NFFR | North Fork Feather River |
| NFMA | National Forest Management Act |
| NGVD | National Geodetic Vertical Datum |
| NHI | Natural Heritage Institute |
| NHPA | National Historic Preservation Act |
| NMFS | Department of Commerce, National Marine Fisheries Service |
| NOI | Notice of Intent |
| NPS | National Parks Service |
| NRHP | National Register of Historical Places |
| NTU | Nephelometric turbidity unit |
| NWI | National Wetlands Inventory |
| NWS | National Weather Service |
| | **O** |
| | |
| | **P** |
| PAOT | people at one time |
| Peaking | Operation of generating facilities to meet maximum instantaneous electrical demands |
| Penstock | An inclined pressurized pipe through which water flows from a forebay or tunnel to the powerhouse turbine |
| pf | power factor |
| PG&E Company | Pacific Gas and Electric Company, regulated utility subsidiary of PG&E Corporation |
| PH | Powerhouse |
| Poe Dam | Dam located on the NFFR near Pulga |
| Poe Powerhouse | A 120 MW powerhouse located on the NFFR near the upper end of Lake Oroville. |
| Poe Tunnel | Tunnel from Poe Reservoir to Poe Powerhouse |
| PMF | Probable maximum flood |
| POAOR | California Public Opinions and Attitudes in Outdoor Recreation Survey |
| Power Factor | The ratio of actual power to apparent power. Power factor is the cosine of the phase angle difference between the current and voltage of a given phase. Unity power factor exists when the voltage and current are in phase |
| Project | Licensee's Poe Hydroelectric Project, FERC No. 2107 |
| Project Area | Zone of potential, reasonably direct impact. It usually extends 0 to 100 feet out from Project features. |
| Project Region | An area on the order of County or National Forest size |
| Project Vicinity | The area extending to about ten miles out from Project features |
| Protection | All of the relays and other equipment which are used to open the necessary circuit breakers to separate pieces of equipment from each other when trouble develops |
| Protective Relay | A device whose function is to detect defective lines or apparatus, or other power system conditions of an abnormal or dangerous nature, and to initiate appropriate control circuit action |
| PSR | Pacific Southwest Region of USFS |
| PURPA | Public Utilities Regulatory Policies Act |
| PX | California Power Exchange |

| *Term* | *Definition* |
|---|---|
| | **Q** |
| QF | A qualifying facility, a cogenerator or small power producer that sells its excess power to a public utility |
| | |
| | **R** |
| ramping | The act of increasing or decreasing stream flows from a powerhouse, dam or division structure |
| relicensing | The process of acquiring a new license for a project that has an existing license from FERC |
| Reservoir Useable Capacity | A volume measurement of the amount of water that can be stored for generation, down to a minimum level |
| Riparian | Relating to the bank of a natural course of water |
| RM | River mile as measured along the river course |
| RNA/ACEC | Research Natural Area/Area of Critical Environmental Concern |
| rpm | revolutions per minute |
| RTU | remote terminal unit. A remotely located piece of equipment used for collecting data and/or for operating equipment via SCADA |
| Run-of-the-River | A hydro project that uses the flow of a stream with little or no reservoir capacity for storing water |
| RWQCB | Regional Water Quality Central Board |
| | **S** |
| SCADA | Supervisory Control And Data Acquisition system |
| SCORP | State Comprehensive Outdoor Recreation Plan |
| Secchi | A method of measuring surface transparency in a reservoir |
| SHPO | California Department of Parks and Recreation, Office of Historic Preservation, State Historic Preservation Officer |
| Sluice | An artificial channel for conducting water, with a valve or floodgate to regulate the flow |
| SMZ | Streamside Management Zone as defined by SNF |
| SNEP | Sierra Nevada Ecosystem Project |
| SNTEMP | USFWS' Stream Temperature Model |
| SOHA | Spotted Owl habitat areas |
| Special Status Species | Species or subspecies listed under the FESA or CESA as endangered or threatened, or by a Federal or State agency as a species of special concern, sensitive species, fully protected species or management indicator species. |
| Spill Channel | Property down gradient from a conduit for which an easement over private property or withdrawal under FERC license has been granted. A spill channel is used when it becomes necessary to release water from a section of conduit. |
| Spillway | A passage for releasing surplus water from a reservoir |
| sq. ft | square foot |
| sq. mi. | square mile |
| State | State of California |
| Station Use | Energy used to operate the generating facility's auxiliary equipment |
| STORET | USEPA's computerized water quality data storage system |
| Study Area | The geographic area covered by a specific study |
| SUP | Special Use Permit issued by the Forest Service |
| Surge Chamber | A structure, similar to a holding tank, located on a tunnel or penstock which is used to absorb and attenuate the overflow and prevent any disruption due to a sudden change in water pressure through a tunnel or penstock. |
| SWDU | Statement of Water Diversion and Use |
| Switching Center | The main control center for any given river system, which is responsible for operation of the automatic, semiautomatic and manual powerhouses on that river system. The Switching Center is staffed 24 hours a day |
| SWRCB | State Water Resource Control Board |

| *Term* | *Definition* |
|---|---|
| | **T** |
| Tailrace | Channel through which water is discharged from the powerhouse turbines |
| TDS | total dissolved solids |
| Three-winding Transformer | A transformer with a primary, secondary and tertiary winding which may be used to connect generation with two different voltage transmission circuits, or with both distribution and transmission circuits, without the use of additional transformers |
| TP | total phosphorous |
| Trash Rack | A mechanism, found on a dam or intake structure, which clears the water of debris before the water passes through the structure |
| TSS | total suspended solids |
| Turbine | A machine that converts the energy of a stream of water into the mechanical energy of rotation. This energy is then used to turn an electrical generator or other device. Also called a "water wheel" |
| | **U** |
| USBIA | U.S. Department of Interior, Bureau of Indian Affairs |
| USBLM | U.S. Department of Interior, Bureau of Land Management |
| USBR | U.S. Department of Interior, Bureau of Reclamation |
| USC | United States Code |
| USCOE | U.S. Department of Defense, Army Corps of Engineers |
| USDA | U.S. Department of Agriculture |
| USDI | U.S. Department of Interior |
| USEPA | U. S. Environmental Protection Agency |
| USFS | U.S. Department of Agriculture, Forest Service |
| USFWS | U.S. Department of Interior, Fish and Wildlife Service |
| USGS | U.S. Department of Interior, Geological Survey |
| | **V** |
| V | volts |
| VQO | Visual Quality Objectives, a USFS System |
| VQI | Visual Quality Index, a USFS System |
| | **W** |
| W | watts |
| WHR | California Wildlife Habitat Relationships Database |
| WUA | weighted usable area |
| | **X** |
| | **Y** |
| YOY | young-of-the-year |
| | **Z** |
| Zone of Potential Effect | Physical area in which the project has a potential for influence on resources. May be different for each resource area |
| ZPE | Zone of Potential Effect |

# EXHIBIT A
# DESCRIPTION OF PROJECT

## Table of Contents



## TABLES

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# EXHIBIT A
# DESCRIPTION OF PROJECT

*18CFR § 4.51(b) Exhibit A is a description of the project. This exhibit need not include information on project works maintained and operated by the U.S. Army Corps of Engineers, the Bureau of Reclamation, or any other department or agency of the United States, except for any project works that are proposed to be altered or modified. If the project includes more than one dam with associated facilities, each dam and the associated component parts must be described together as a discrete development. The Description for each development must contain:*

*(1) The physical composition, dimensions, and general configuration of any dams, spillways, penstocks, powerhouses, tailraces, or other structures, whether existing or proposed, to be included as part of the project;*

*(2) The normal maximum surface area and normal maximum surface elevation (mean sea level), gross storage capacity, and usable storage capacity of any impoundments to be included as part of the project;*

*(3) The number, type, and rated capacity of any turbines or generators, whether existing or proposed, to be included as part of the project;*

*(4) The number, length, voltage, and interconnections of any primary transmission lines, whether existing or proposed, to be included as part of the project (see 16 U.S.C. 796(11));*

*(5) The specifications of any additional mechanical, electrical, and transmission equipment appurtenant to the project; and*

*(6) All lands of the United States that are enclosed within the project boundary described under paragraph (h) of this section (Exhibit G), identified and tabulated by legal subdivisions of a public land survey of the affected area or, in the absence of a public land survey, by the best available legal description. The tabulation must show the total acreage of the lands of the United States within the project boundary.*

The Licensee's Poe Project (FERC No. 2107) is located on the North Fork Feather River (NFFR), near Pulga, California. Water is diverted from the NFFR at Poe Reservoir and transported through a tunnel and penstocks to Poe Powerhouse, approximately 7.6 miles downstream. The primary Poe Project features are described below.

## A.1 PROJECT STRUCTURES

### A.1.1 Poe Diversion Dam

Poe Diversion Dam is a concrete gravity dam with a crest length of about 400 feet, a maximum height of about 60 feet; and a spillway crest elevation of 1,350.2 USGS. Spill gates occupy much of the length of the dam and include four 50 ft. wide by 41 ft. high radial flood gates, a 20 ft. wide by 7 ft. high small radial gate, and a small skimmer gate that is no longer used.

### A.1.2 Big Bend Dam

Big Bend Dam is a concrete gravity dam located downstream of Poe Powerhouse. It has a crest length of 370 feet and a maximum height of 61 feet. The dam maintains the tailwater elevation for Poe Powerhouse and dampens downstream flow changes during start-up of Poe Powerhouse. This dam is located within the project boundary for the California Department of Water Resource's Lake Oroville (FERC No. 2100).

### A.1.3 Intake Structure and Tunnel

A concrete intake structure is located on the shore of Poe Reservoir. The pressure tunnel is about 19 feet in diameter with a total length about 33,000 feet. A differential surge chamber is located near the downstream end of the tunnel.

### A.1.4 Penstock

The penstock is a steel underground penstock, about 1,000 feet in length and approximately 14 feet in diameter.

### A.1.5 Powerhouse and Switchyard

The powerhouse is a reinforced concrete structure 175 feet long and 114 feet wide. An outdoor switchyard is located adjacent to the powerhouse.

## A.2 PROJECT IMPOUNDMENTS

The surface area, elevation, and storage capacity of the Poe Project impoundments are shown in Table A-1.

**Table A-1**
**Poe Project Impoundments**

| Project Impoundment | Normal Maximum Water Surface Area (Acres) | Normal Maximum Water Surface Elevation (Feet)* | Gross Storage Capacity (Acre-Ft.) | Usable Storage Capacity (Acre-Ft.) |
|---|---|---|---|---|
| Poe Reservoir | 53 | 1,391.2 | 1,203 | 470 |
| Big Bend Dam (Poe Afterbay) | 42 | 905 | ** | ** |

* Elevations are USGS datum (USGS datum = PG&E datum - 19.53 ft.)
** Upon decommissioning of Big Ben Powerhouse, a notch was cut in Big Bend Dam to provide re-regulation of flows from Poe Powerhouse and limit the rate of rise in flow below the dam.

## A.3 PROJECT ELECTRICAL EQUIPMENT

The prime movers at Poe Powerhouse consist of two vertical shaft, Francis type turbines rated at 76,000 horsepower, 421 feet net head, 1,750 cfs and 225 rpm. Each turbine has an 84 inch pressure regulatory/synchronous bypass and a 138 inch butterfly type turbine shutoff valve. Each Turbine is directly connected to a vertical shaft synchronous generator. The two generators are each rated at 79,350 kVA, 13.8 kV, 3,320 amperes, 0.90 power factor and 225 rpm. Each generator has a direct-connected amplidyne exciter rated at 285 kW, 250 volts and 1,140 amperes. Normal total power output from Poe

Powerhouse is 120 MW. Project features in the switchyard include two 3-phase 69,000 kVA transformers and two 230 kV circuit breakers. The breakers connects the two 230 kV transformer banks to the 230 kV transmission bus. A third circuit breaker in the switchyard acts as a transmission bus tie and is a non-project transmission facility. Disconnect and bypass switches are provided for each of the circuit breakers.

## A.4 TRANSMISSION LINES

No transmission facilities are contained within the Project. The power generated at Poe Powerhouse is delivered into the Rock Creek - Rio Oso No. 1 230 kV transmission line. This line loops into the Poe switchyard and is part of the interconnect transmission grid controlled by the California Independent System Operator.

## A.5 APPURTENANT ADDITIONAL EQUIPMENT

There are no additional mechanical, electrical or transmission equipment appurtentant to the Project.

## A.5 LANDS OF THE UNITED STATES

Of the 313 acres of land within the project boundary, Licensee owns 157 acres. This acreage will increase with the addition of Big Bend Reservoir. Private holdings comprise 12 acres. The USFS manages 144 acres of National Forest System (NFS) lands within the Project Boundary.

| Exhibit | Township and Range | Sections | USFS Acres |
|---|---|---|---|
| Exhibit G-2 | T 23 N, R 5 E | 27, 28, 29, 32, 3 | 55.52 |
| Exhibit G-3 | T 23 N, R 5 E | 32 | 6.86 |
| | T 22 N, R 5 E | 5,7,8,18, 19, 30, 31 | 81.21 |

# POE HYDROELECTRIC PROJECT

# FERC NO. 2107

## EXHIBIT B

## STATEMENT OF PROJECT OPERATION

## AND RESOURCE UTILIZATION PROJECT

# EXHIBIT B

## PROJECT OPERATION AND RESOURCE UTILIZATION

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### List of Figures



### List of Tables

# EXHIBIT B
# STATEMENT OF PROJECT OPERATION AND RESOURCE UTILIZATION

*18CFR § 4.51(c) Exhibit B is a statement of project operation and resource utilization. If the project includes more than one dam with associated facilities, the information must be provided separately for each such discrete development. The exhibit must contain:*

*(1) A statement whether operation of the powerplant will be manual or automatic, an estimate of the annual plant factor, and a statement of how the project will be operated during adverse, mean, and high water years,*

*(2) An estimate of the dependable capacity and average annual energy production in kilowatt-hours (or a mechanical equivalent), supported by the following data:*

*(i) The minimum, mean, and maximum recorded flows in cubic feet per second of the stream or other body of water at the powerplant intake or point of diversion, with a specification of any adjustment made for evaporation, leakage, minimum flow releases (including duration of releases), or other reductions in available flow, monthly flow duration curves indicating the period of record and the gauging stations used in deriving the curves, and a specification of the period of critical streamflow used to determine the dependable capacity,*

*(ii) An area-capacity curve showing the gross storage capacity and usable storage capacity of the impoundment, with a rule curve showing the proposed operation of the impoundment and how the usable storage capacity is to be utilized;*

*(iii) The estimated hydraulic capacity of the powerplant (minimum and maximum flow through the powerplant) in cubic feet per second;*

*(iv) A tailwater rating curve; and*

*(v) A curve showing powerplant capability versus head and specifying maximum, normal, and minimum heads;*

*(3) A statement, with load curves and tabular data, if necessary, of the manner in which the power generated at the project is to be utilized, including the amount of power to be used on-site, if any, the amount of power to be sold, and the identity of any proposed purchasers; and*

*(4) A statement of the applicant's plans, if any, for future development of the project or of any other existing or proposed water power project on the stream or other body of water, indicating the approximate location and estimated installed capacity of the proposed developments.*

## B.1 PROJECT OPERATION

The Poe Powerhouse consists of two generating units with automatic operation using supervisory control from the Licensee's Rock Creek Powerhouse (FERC No. 1962). The powerhouse is equipped with automatic generation control capability. The average annual capacity factor is about 56 percent, based on an installed capacity of 120,000 kw.

The Poe Powerhouse is upstream of the large Oroville reservoir owned by the State of California (FERC No. 2100) and is the last in a series of Licensee owned projects on the North Fork Feather River. Its operation is integrated with Licensees upstream projects, which include the Upper North Fork Feather River Project (FERC No. 2105), the Rock Creek - Cresta Project (FERC No. 1962) and the Bucks Creek Project( No. 619). These operations are integrated to maximize the benefit of both natural river flows and releases from upstream storage, primarily from Lake Almanor (Project No. 2105) and Bucks Lake(Project No. 619). During adverse and mean water years, the Poe powerhouse is typically operated on a peaking basis. The plant output varies on a hourly basis from minimum or no load during the off peak periods, up to the plant's maximum output during peak demand periods. During the mid-peak demand periods, the plant is operated near its more efficient loads depending on the available flow. During periods of high flow, the plant is operated at its maximum capacity in order to minimize spill. In the event of a severe flood event of over 45,000 cfs, the intake gate is closed, the powerhouse shut-down and all gates placed in the full open position (fully raised)

## B.2 PROJECT DEPENDABLE CAPACITY AND AVERAGE ANNUAL ENERGY

The existing Project has a dependable capacity rating of 120 MW and has historically generated an average annual energy of about 583 GWH[1].

[1] 25 year actual average (1977-2001)

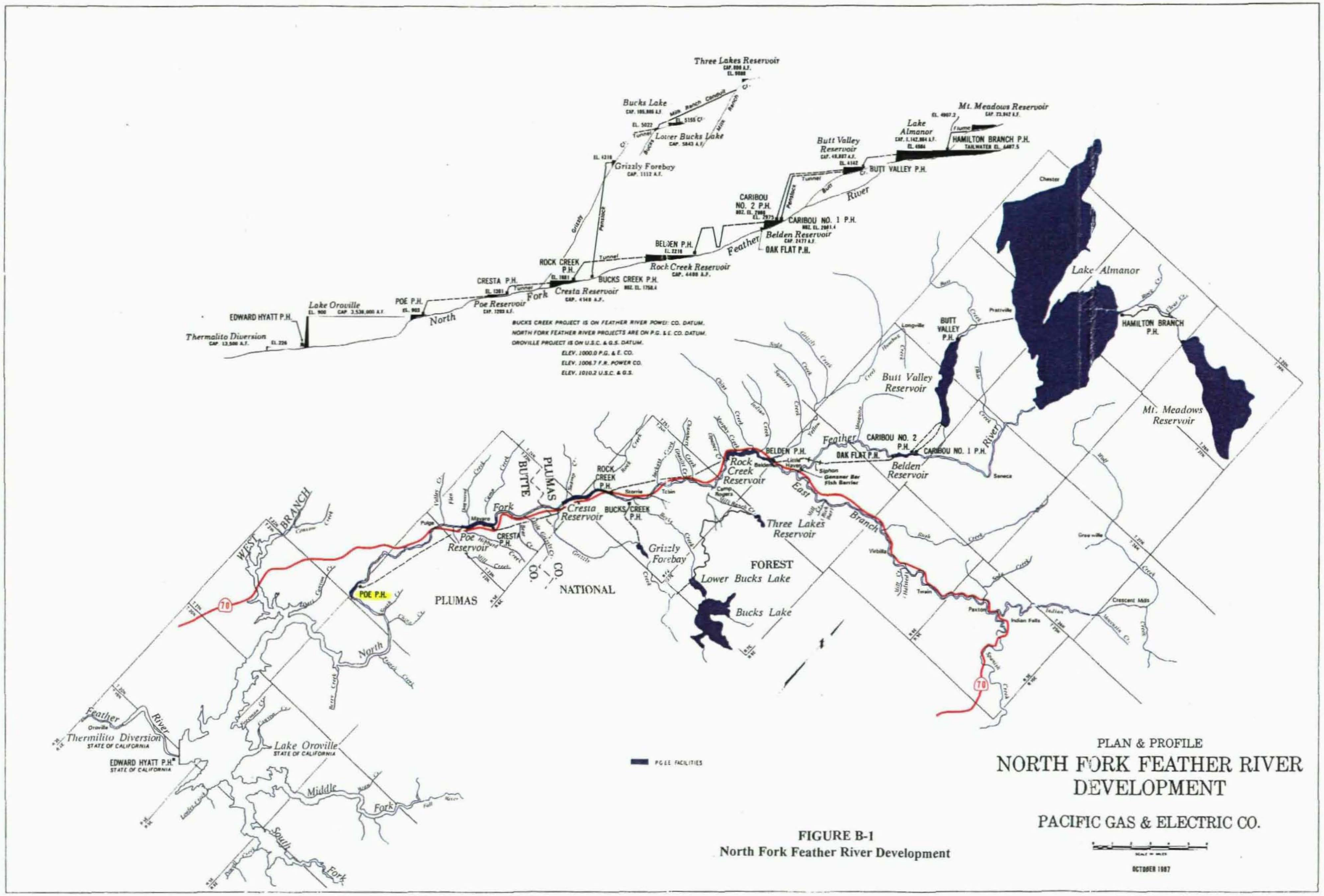



**FIGURE B-1**
**North Fork Feather River Development**

**Streamflow Data.** The Poe Project diverts flow from the North Fork Feather River at Poe Dam. The minimum, mean and maximum daily flow at this location are 5 cfs, 896 cfs, and 100,876 cfs respectively, based on recorded flows at Gage NF23. Appendix B-1 includes flow duration curves for historical Poe Powerhouse flows and stream gage records in the vicinity of Poe Powerhouse showing spills and minimum flow releases. Appendix B-2 contains a report on the results of on IHA flow analysis. The Project dependable capacity is based on the Project's load carrying ability during the critical hydrologic period coincident with the Licensee's peak system load. Currently, the critical hydrologic period was during 1977, and the peak system load typically occurs during the summer months of July and August.

**Project Impoundment Data.** The Poe Reservoir provides the diversion into the Poe tunnel but provides very little storage capability. Under normal operation, the water surface elevation ranges from a maximum of 1,389.8 ft. (USGS datum) and a minimum of 1,380 ft. (USGS datum). The normal daily fluctuation of the reservoir is about three feet, providing only about 150 acre-feet of capacity. This amount of water would support generation at full load for approximately 30 minutes. Exhibit Drawing G-2 shows the area - capacity curve for Poe Reservoir.

**Project Hydraulic Capacity.** The maximum normal flow through the Poe Powerhouse with both units operating is estimated to be 3,700 cfs, with the existing turbine runners. The minimum hydraulic capacity of the powerhouse is 0 cfs. During high flow events, the maximum flow through Poe Powerhouse can temporarily exceed this value.

**Project Tailwater Rating Curve.** The tailwater conditions at Poe Powerhouse are essentially defined by the existing Big Bend Dam approximately one half mile downstream of the powerhouse and the gravel, rocks and other sediment that has collected in the reservoir. Tailwater data for the project is shown in the following table.

**Table B-1**

**Tailwater Rating Curve**

| Total Flow in cfs | Tailwater Elev. In ft., USGS datum |
|---|---|
| 0 | 896.0 |
| 150 | 896.0 |
| 500 | 896.1 |
| 750 | 896.2 |
| 1000 | 896.3 |
| 1250 | 896.5 |
| 1500 | 896.7 |
| 1750 | 896.9 |
| 2000 | 897.2 |
| 2250 | 897.5 |
| 2500 | 897.9 |
| 2750 | 898.3 |
| 3000 | 898.7 |
| 3250 | 899.2 |
| 3500 | 899.7 |
| 3750 | 900.2 |
| 4000 | 900.5 |

**Project Capability Vs. Head:** A curve showing the existing powerhouse capacity versus head is provided below. The project's gross head is relatively constant at about 490 feet. The maximum gross head is about 493 feet and minimum gross head is about 484 feet.

| **Head (Feet)** | **Powerhouse Capability (MW)** |
|---|---|
| 493 | 120 |
| 484 | 118 |

## B.3 PROJECT UTILIZATION

Licensee will use the output of the Project to serve its customer load in northern and central California. Based on the current rules governing the operation of the electric markets in California, investor owned utilities, such as Licensee, are directed by the state to serve as much of their own customer load as possible with their own generation. Licensee will purchase power from the wholesale electricity market to meet the remaining portion of its customers' electricity demands.

## B.4 PROPOSED FUTURE DEVELOPMENTS

Several year ago the Licensee purchase new turbine runners for Poe Powerhouse. However, the installation of the equipment was reassessed upon deliver of the equipment and the decision was made to postpone the final installation. This work is expected to be completed in the near future. No additional project development or improvements are anticipated at this time.

# POE HYDROELECTRIC PROJECT

# FERC NO. 2107

## EXHIBIT C

## CONSTRUCTION HISTORY

## AND PROPOSED CONSTRUCTION SCHEDULE

# EXHIBIT C
# CONSTRUCTION HISTORY
# AND PROPOSED CONSTRUCTION SCHEDULE

| |
|---|
| *18 CFR § 4.51(d) Exhibit C is a construction history and proposed construction schedule for the project. The construction history and schedules must contain:*<br>*(1) If the application is for an initial license, a tabulated chronology of construction for the existing projects structures and facilities described under paragraph (b) of this section (Exhibit A), specifying for each structure or facility, to the extent possible, the actual or approximate dates (approximate dates must be identified as such) of:*<br>*(i) Commencement and completion of construction or installation;*<br>*(ii) Commencement of commercial operation, and*<br>*(iii) Any additions or modifications other than routine maintenance; and*<br>*(2) If any new development is proposed, a proposed schedule describing the necessary work and specifying the intervals following issuance of a license when the work would be commenced and completed.* |

The construction history of the Poe Hydroelectric Project is summarized in Table C-1.

No new construction is proposed.

**Table C-1**
**Poe Hydroelectric Project Construction History**

| Facility | Start of Construction | Construction Completed | Commercial Operation Date |
|---|---|---|---|
| Big Bend Dam | 1908 | 1910 | |
| Poe Dam | 1957 | 1958 | |
| Poe Reservoir | 1957 | 1958 | |
| Poe Tunnel | 1957 | 1958 | |
| Poe Penstock Intake | 1957 | 1958 | |
| Poe Penstock | 1957 | 1958 | |
| Poe Powerhouse | 1957 | 1958 | Unit 1 - June 4, 1958<br>Unit 2 - May 21, 1958 |

# POE HYDROELECTRIC PROJECT

# FERC NO. 2107

## EXHIBIT D

## STATEMENT OF COSTS AND FINANCING

# EXHIBIT D

## STATEMENT OF COSTS AND FINANCING

*18 CFR § 4.51(e) Exhibit D is a statement of costs and financing. The statement must contain:*

*(1) If the application is for an initial license, a tabulated statement providing the actual or approximate original cost (approximate costs must be identified as such) of:*

*(i) Any land or water right necessary to the existing project; and*

*(ii) Each existing structure and facility described under paragraph (b) of this section (Exhibit A).*

*(2) If the applicant is a licensee applying for a new license, and is not a municipality or a state, an estimate of the amount which would be payable if the project were to be taken over pursuant to section 14 of the Federal Power Act upon expiration of the license in effect [see 16 U.S.C. 807], including:*

*(i) Fair value;*

*(ii) Net investment; and*

*(iii) Severance damages.*

*(3) If the application includes proposals for any new development, a statement of estimated costs, including:*

*(i) The cost of any land or water rights necessary to the new development; and*

*(ii) The cost of the new development work with a specification of:*

*(A) Total cost of each major item;*

*(B) Indirect construction costs such as costs of construction equipment, camps, and commissaries;*

*(C) Interest during construction; and*

*(D) Overhead, construction, legal expenses, taxes, administrative and general expenses, and contingencies.*

*(4) A statement of the estimated average annual cost of the total project as proposed, specifying any projected changes in the costs(life-cycle costs) over the estimated financing or licensing period if the applicant takes such changes into account, including:*

*(i) Cost of capital (equity and debt);*

*(ii) Local, state, and Federal taxes;*

*(iii) Depreciation and amortization,*

*(iv) Operation and maintenance expenses, including interim replacements, insurance, administrative and general expenses, and contingencies; and*

*(v) The estimated capital cost and estimated annual operation and maintenance expense of each proposed environmental measure.*

*(5) A statement of the estimated annual value of project power, based on a showing of the contract price for sale of power or the estimated average annual cost of obtaining an equivalent amount of power (capacity and energy) from the lowest cost alternative source, specifying any projected changes in the cost of power from that source over the estimated financing or licensing period if the applicant takes such changes into account.*

*(6) A statement specifying the source and extent of financing and annual revenues available to the applicant to meet the costs identified in paragraphs (e)(3) and (4) of this section.*

*(7) An estimate of the cost to develop the license application; and*

*(8) The on-peak and off-peak values of project power, and the basis for estimating the values, for projects which are proposed to operate in a mode other than run-of-river;*

*(9) The estimated average annual increase or decrease in project generation, and the estimated average annual increase or decrease of the value of project power due to a change in project operations (i.e., minimum bypass flows, limiting reservoir fluctuations).*

## D.1 ORIGINAL COST OF EXISTING PROJECT

This is not an application for an initial license. Therefore, a statement of the original cost of Project land or water rights, structures, or facilities is not applicable.

## D.2 AMOUNT PAYABLE IN THE EVENT OF PROJECT TAKEOVER

In the event the Project is taken over at the end of the license term, pursuant to Section 14 of the Federal Power Act, the Licensee would be entitled to receive its net investment plus severance damages. From an economic standpoint, a federal or municipal takeover would have a significant adverse effect upon the Licensee's customers, upon taxpayers generally, and upon investors in securities of the Licensee.

At this time, it is difficult to assess the impact of a takeover. The net impact would depend on how the Licensee is compensated for the cost of replacing the Project power and reliability features, and other costs incurred by reason of severance from the Licensee's system. However, there is no doubt that takeover would increase the Licensee's costs and interfere with efficient utilization of this area's resources.

The amount payable to the Licensee in the event of a takeover, as provided in Section 14 of the Federal Power Act, includes the net investment, not to exceed fair value. Some of the principles bearing upon the final determination of fair value are yet to be ascertained. There are, however, some basic figures as to which there should be no substantial dispute. The net book value, which is the historical cost less accumulated depreciation, is estimated to be about $18.1 million, as of November 2003.

The definition of fair value could mean the market value of the Project, or the net investment plus severance damages. Due to the uncertainty in the generation market in California, an estimate of the Project's market value has not been made. Under the second "fair value" interpretation, the Licensee would be entitled to receive severance damages in addition to its net investment as provided in Section 14 of the Federal Power Act. Here again, applicable principles are uncertain. It would appear that such damages should include, among other things, payments for costs incurred in providing new facilities to continue service, payment for additional costs of generation, and payment for diminution of value to the rest of the Licensee's system. Due to the uncertainty in the generation market in California, an estimate of severance damages has not been made.

## D.3 CAPITAL COST OF PROPOSED DEVELOPMENT

No new development is proposed at this time; therefore, this section does not apply.

## D.4 ANNUAL PROJECT COSTS

### D.4.1 Project Economics Methodology

Long-term economics have been estimated through the anticipated new license term. FERC's current cost method of economics was used to derive the average annual cost of the total project. This method uses current electric power value conditions. Future inflation and escalation of prices are not considered.[1]

The economics include the costs of owning and operating the Project. Project cost components include unrecovered past capital additions (e.g., the depreciated plant in service costs, or net book value), relicensing, future capital replacements, normal operations and maintenance, FERC fees, taxes, insurance, and environmental protection, mitigation and enhancement measures (PM&E's). A Fixed Charge Rate (FCR) of 14% will be used for capital improvements, (capital improvements are improvements that have a service life in excess of one year and which are repaid over time); the FCR includes capital recovery with a cost of capital of about 9%, taxes and insurance costs. Expenses, such as payroll costs, are paid in the year the expenditure is made and do not include any tax or insurance component. This cost of capital is made up of the following components:

| | Capital Ratio (%) | Nominal Cost (%) |
|---|---|---|
| Common Equity | 52 | 11.22 |
| Preferred Securities | 2 | 6.5 |
| Debt | 46 | 6.616 |
| Weighted Average Cost of Capital | | 9.0 |

The net book value represents the cost of owning the facilities and reflects unrecovered past capital expenditures. The costs of relicensing, under recently revised CPUC regulations, enter into the rate base upon receipt of the new license. These relicensing

[1] See Mead Corporation, Publishing Paper Division, 72 FERC Para. 61,027 (July 13, 1995).

costs are also unrecovered past and ongoing expenditures and will be included in the project economics.

All the other costs listed above represent estimated future costs. Table D-1 summarizes the Project's average annual costs with the existing license conditions, e.g. the "No Action" case.

### D.4.2 Project Costs with Existing License Conditions

The current net book value is estimated to be about $18.1 million. The Licensee's estimated total cost of processing and filing this FERC application is about $6.3 million. The normal annual operation and maintenance costs are estimated to be about $2.3 million per year. Future capital replacements are estimated to average an additional $1.6 million per year. The 2003 annual FERC fee was about $ 400,000. See Table D-1 for a summary of Project costs excluding any potential new PM&E's.

**Table D-1**

**POE RELICENSING PROJECT – FINAL LICENSE APPLICATION**

**Average Annual Cost of the Total Project using FERC's Current Cost Method (w/ 14% FCR)**

**Estimated Costs $ 1,000's ($ 2004)**

| Item Description | Capital, One-Time or Repeating $1,000's or $1,000's/yr | Annual Expense $1,000's/yr | Replacement Power costs $ 1,000's/yr | Average Annual Costs $ 1,000's/yr |
|---|---|---|---|---|
| **NO ACTION CASE - EXISTING CONDITIONS** | | | | |
| Replacement power costs | | | -$32,742 /yr | -$32,742 /yr |
| Net Book Value | $18,100 | $0 /yr | | $2,534 /yr |
| FERC License Application | $6,300 | $0 /yr | | $882 /yr |
| Normal O&M | $0 | $2,300 /yr | | $2,300 /yr |
| Future Capital Additions | $1,600 /yr | $0 /yr | | $2,720 /yr |
| FERC Fees | $0 | $400 /yr | | $400 /yr |
| **Total "No Action" Capital and Expense Costs** | | **$2,700 /yr** | **-$32,742 /yr** | **$8,836 /yr** |
| **Cost of production** | **582.6 GWh/yr** | | | **$15.2 /MWh** |
| **Net "No Action" Average Annual Costs** | | | | **-$23,906 /yr** |

## D.4.3 Costs of Environmental Enhancement Measures

The estimated costs of potential PM&E associated with a new FERC license are shown in Tables D-2 and D-3.

## Table D – 2

## POE RELICENSING PROJECT - FINAL LICENSE APPLICATION

**Average Annual Cost of the Total Project using FERC's Current Cost Method (w/ 14% FCR)**

**Estimated Costs $ 1,000's ($ 2004)**

| Item Description | One-Time Capital $1,000's | Annual Expense $1,000's/yr | Replacement Power costs $ 1,000's/yr | Average Annual Costs $ 1,000's/yr |
|---|---|---|---|---|
| **LICENSEE PROPOSALS IN FINAL APPLICATION** | | | | |
| Minimum Instream Flow increase to 150cfs @ Pulga gage (563.8 GWh/yr at 5.62 cents per kWh) | | | $1,057 /yr | $1,057 /yr |
| Ramp rate limitations at Poe dam - controls loss of operating flexibility | $100 | | $0.1 /yr | $14 /yr |
| **Recreation Facilities** | | | | |
| Sandy Beach Improvements | $28 | $5.2 /yr | | $9 /yr |
| Bardees Bar Improvements | $54 | $9.0 /yr | | $17 /yr |
| Poe Beach Improvements | $39 | $0.3 /yr | | $6 /yr |
| Poe Powerhouse Improvements | $60 | $8.4 /yr | | $17 /yr |
| Shady Rest Improvements | $25 | $1.0 /yr | | $5 /yr |
| Poe Reservoir/Cresta PH Trail Improvements | $28 | $1.0 /yr | | $5 /yr |
| Hwy 70 Scenic Viewpoint improvements | $38 | $1.0 /yr | | $6 /yr |
| Annual Recreation monitoring | $0 | $20.0 /yr | | $20 /yr |
| **Visual Improvements** | | | | |
| Paint Poe Dam Light Fixtures | $5 | $0.5 /yr | | $1 /yr |
| Bardees Bar/Audit 2 Spoil Pile Reveg. | $300 | $3.0 /yr | | $45 /yr |
| Bardees Bar Steel Bridge Removal | $450 | $0.0 /yr | | $63 /yr |
| **Vegetation Management** | | | | |
| Noxious Weed Control | $0 | $5.0 /yr | | $5 /yr |
| **Erosion Control** | | | | |
| Bardees Bar/Audit #2 Spoil Pile Improvements | $770 | $0.0 /yr | | $108 /yr |
| **Total Licensee Proposal Costs** | **$1,897** | **$54.4 /yr** | **$1,056.6 /yr** | **$1,377 /yr** |
| **Total "Licensee Proposal" Average Annual Costs** | | | | **$10,213 /yr** |
| **Cost of production** | **563.8 GWh/yr** | | | **$18.1/MWh** |
| **Net "Licensee Proposal" Average Annual Costs** | | | | **-$22,530 /yr** |

Table D – 3

**POE RELICENSING PROJECT - FINAL LICENSE APPLICATION**

**Average Annual Cost of the Total Project using FERC's Current Cost Method (w/ 14% FCR)**

**Estimated Costs $ 1,000's ($ 2004)**

| Item Description | One-Time Capital $1,000's | Annual Expense $1,000's/yr | Replacement Power costs $ 1,000's/yr | Average Annual Costs $ 1,000's/yr |
|---|---|---|---|---|
| **POTENTIAL NEW LICENSE CONDITION (in excess of Licensee Proposals)** | | | | |
| Minimum Instream Flow increase to 500cfs | | | $3,807 /yr | $3,807 /yr |
| Flow release facility modifications at Poe Dam to release up to 500 cfs (current max. release capability is 150 cfs) | $5,000 | $50 /yr | | $750 /yr |
| **Fish Passage at Big Bend Dam** | | | | |
| Option 1 - Construct and maintain new fish ladder | $8,000 | $75 /yr | | $1,195 /yr |
| Option 2 - Remove Big Bend, construct a tailrace weir, constrain operation | $10,000 | | $1,687 /yr | $3,087 /yr |
| **Total Potential Licensee Conditions by Others (low)** | **$13,000** | **$125.0 /yr** | **$3,806.7 /yr** | **$5,752 /yr** |
| **Total Potential Licensee Conditions by Others (high)** | **$15,000** | **$50.0 /yr** | **$5,493.5 /yr** | **$7,643 /yr** |
| | | | **Low estimate** | **High estimate** |
| **Total "Potential New Licensee" Average Annual Costs** | | | **$15,964 /yr to** | **$17,856 /yr** |
| **Cost of production** | **496.1 GWh/yr** | | **$32.2 /MWh to** | **$36.0 /MWh** |
| **Net "Potential New Licensee" Average Annual Costs** | | | **-$16,778 /yr to** | **-$14,886 /yr** |

## D.4.4 Total Project Costs

Average annual costs of Project power are presented for three different economic scenarios: The "No-Action" case represents license conditions under the current FERC license. The "Licensee Proposals" case represents new license conditions proposed by the Licensee. "Other Proposals" case represents a range of new license conditions discussed or proposed by others that the Licensee does not support. Two scenarios are presented for the Other Proposals case – a low and a high estimate of PM&E's. Average annual cost of Project Power for these cases is summarized in Table D-4.

Table D – 4

POE RELICENSING PROJECT - FINAL LICENSE APPLICATION

Project Economic Analysis using FERC's Current Cost Method

Comparison of economic analyses

Estimated Costs $ 1,000's ($ 2004)

| | No-Action Case | Licensee Proposals Case | Other Proposals Case | |
|---|---|---|---|---|
| | | | Low estimate | High estimate |
| Dependable Capacity (MW) | 120 | 120 | 120 | 120 |
| Annual generation (GWh) | 582.6 | 563.8 | 496.1 | 496.1 |
| Annual Power value: Annual generation | | | | |
| thousands $ | $32,742 /yr | $31,686 /yr | $27,879 /yr | $26,192 /yr |
| mills / kWh | 56.2 | 56.2 | 56.2 | 52.8 |
| Annual cost: | | | | |
| thousands $ | $8,836 /yr | $9,156 /yr | $11,101 /yr | $11,306 /yr |
| mills / kWh | 15.2 | 16.2 | 22.4 | 22.8 |
| Current net annual benefits: | | | | |
| thousands $ | $23,906 /yr | $22,530 /yr | $16,778 /yr | $14,886 /yr |
| mills / kWh | 41.0 | 40.0 | 33.8 | 30.0 |

### D.4.5 Taxes

Future taxes are estimated on the basis of yearly net book value. The 2003 property and other taxes (not including income taxes) for the Project were about $380,000. The other taxes include franchise, business, and use taxes. The Licensee paid about $480,000 in Project-related income taxes in 2003.

## D.5 VALUE OF PROJECT POWER

The long-term Qualifying Facilities (QFs) contracts are source of replacement power prices. The Licensee publishes Short Run Avoided Costs (SRACs) monthly according to CPUC direction. See Section D-8 and Exhibit H- 2.1 for a complete discussion of how the value of Project power was determined. The current 12-month average SRAC will be deemed the current replacement power cost. At an SRAC of 5.62 cents per kWh, the current value of Project power, under the No Action case is about $32.7 million per year.

## D.6 SOURCES OF FINANCING

The Licensee is financially able to operate and maintain the Project. In support of this statement, the Licensee refers to its financial statements that it has submitted annually to the Commission in FERC Form 1, and to its record in constructing, operating, and maintaining projects. However, in late 2000 and early 2001, the Licensee had difficulty in meeting its purchased power costs due to the regulatory framework in California, and filed for Chapter 11 bankruptcy in April 2001. The bankruptcy court, State legislators and regulators continue to address this cash flow issue; a resolution expected soon.

## D.7 COST OF APPLICATION

The Licensee's estimated total cost of processing and filing this FERC application is about $6.3 million. Over $5 million has been spent to date.

## D.8 ON-PEAK AND OFF-PEAK VALUE OF PROJECT POWER

The long-term QF contracts are source of on-peak and off-peak replacement power prices. Table D-5 shows the published SRACs paid to California's QFs from 2000 through November 2003. The Time-Of-Delivery time periods are shown in Table D-6.

## Table D-5
## Historic Short-Run Avoided Costs for QF Energy

**PG&E CO. ENERGY PURCHASE PRICES FOR QUALIFYING FACILITIES**
**(BASED ON SHORT RUN AVOIDED COST METHODOLOGY)**

| | | (CENTS / KWH) With Time-Of-Delivery Metering | | | | Without Time-Of-Delivery Metering |
|---|---|---|---|---|---|---|
| Effective Period | Seasonal Period | Peak | Partial-Peak | Off-Peak | Super Off-Peak | Seasonal Average |
| January 1 - 31, 2000 | B | --- | 3.315 | 3.188 | 3.051 | 3.212 |
| February 1 - 29, 2000 | B | --- | 3.521 | 3.385 | 3.241 | 3.411 |
| March 1 - 31, 2000 | B | --- | 3.517 | 3.372 | 3.237 | 3.408 |
| April 1 - 30, 2000 | B | --- | 4.045 | 3.893 | 3.724 | 3.920 |
| May 1 - 31, 2000 | A | 3.328 | 3.194 | 3.076 | 2.956 | 3.125 |
| June 1 - 30, 2000 | A | 4.305 | 4.131 | 3.972 | 3.824 | 4.043 |
| July 1 - 31, 2000 | A | 4.805 | 4.611 | 4.459 | 4.268 | 4.511 |
| August 1 - 31, 2000 | A | 4.409 | 4.231 | 4.065 | 3.917 | 4.140 |
| September 1 - 30, 2000 | A | 5.979 | 5.738 | 5.542 | 5.311 | 5.614 |
| October 1 - 31, 2000 | A | 5.418 | 5.199 | 5.008 | 4.813 | 5.087 |
| November 1 - 30, 2000 | B | --- | 6.579 | 6.321 | 6.056 | 6.375 |
| December 1 - 31, 2000 | B | --- | 17.094 | 16.467 | 15.736 | 16.564 |
| January 1 - 31, 2001 | B | --- | 18.114 | 17.397 | 16.675 | 17.553 |
| February 1 - 28, 2001 | B | --- | 13.872 | 13.343 | 12.769 | 13.441 |
| March 1 - 31, 2001 | B | --- | 13.127 | 12.607 | 12.084 | 12.720 |
| April 1 - 30, 2001 | B | --- | 9.677 | 9.297 | 8.908 | 9.377 |
| May 1 - 31, 2001 | A | 9.616 | 9.228 | 8.887 | 8.542 | 9.029 |
| June 1 - 30, 2001 | A | 6.148 | 5.899 | 5.685 | 5.461 | 5.772 |
| July 1 - 31, 2001 | A | 3.805 | 3.651 | 3.524 | 3.380 | 3.573 |
| August 1 - 31, 2001 | A | 3.651 | 3.504 | 3.366 | 3.243 | 3.428 |
| September 1 - 30, 2001 | A | 3.048 | 2.925 | 2.830 | 2.707 | 2.862 |
| October 1 - 31, 2001 | A | 2.252 | 2.161 | 2.077 | 2.001 | 2.115 |
| November 1 - 30, 2001 | B | --- | 4.252 | 4.092 | 3.914 | 4.120 |
| December 1 - 31, 2001 | B | --- | 3.969 | 3.823 | 3.653 | 3.846 |
| January 1 - 31, 2002 | B | --- | 3.900 | 3.746 | 3.590 | 3.779 |
| February 1 - 28, 2002 | B | --- | 3.147 | 3.027 | 2.897 | 3.050 |
| March 1 - 31, 2002 | B | --- | 3.466 | 3.334 | 3.191 | 3.359 |
| April 1 - 30, 2002 | B | --- | 4.725 | 4.532 | 4.349 | 4.578 |
| May 1 - 31, 2002 | A | 3.508 | 3.367 | 3.242 | 3.116 | 3.294 |
| June 1 - 30, 2002 | A | 3.189 | 3.060 | 2.956 | 2.833 | 2.995 |
| July 1 - 31, 2002 | A | 3.140 | 3.013 | 2.902 | 2.789 | 2.948 |
| August 1 - 31, 2002 | A | 3.070 | 2.946 | 2.837 | 2.727 | 2.883 |
| September 1 - 30, 2002 | A | 3.494 | 3.353 | 3.238 | 3.104 | 3.281 |
| October 1 - 31, 2002 | A | 3.810 | 3.657 | 3.514 | 3.385 | 3.578 |
| November 1 - 30, 2002 | B | --- | 5.629 | 5.425 | 5.182 | 5.455 |
| December 1 - 31, 2002 | B | --- | 5.609 | 5.396 | 5.163 | 5.435 |
| January 1 - 31, 2003 | B | --- | 6.067 | 5.827 | 5.585 | 5.879 |
| February 1 - 28, 2003 | B | --- | 6.629 | 6.376 | 6.102 | 6.424 |
| March 1 - 31, 2003 | B | --- | 9.832 | 9.457 | 9.050 | 9.527 |
| April 1 - 30, 2003 | B | --- | 6.259 | 6.020 | 5.761 | 6.064 |
| May 1 - 31, 2003 | A | 5.096 | 4.890 | 4.720 | 4.527 | 4.785 |
| June 1 - 30, 2003 | A | 5.500 | 5.278 | 5.086 | 4.885 | 5.164 |
| July 1 - 31, 2003 | A | 5.238 | 5.027 | 4.841 | 4.653 | 4.919 |
| August 1 - 31, 2003 | A | 4.635 | 4.448 | 4.293 | 4.117 | 4.352 |
| September 1 - 30, 2003 | A | 4.977 | 4.776 | 4.603 | 4.421 | 4.673 |
| October 1 - 31, 2003 | A | 4.649 | 4.461 | 4.287 | 4.130 | 4.365 |
| November 1 - 30, 2003 | B | --- | 5.824 | 5.621 | 5.361 | 5.644 |
| **12-MONTH AVERAGE** | | **5.02** | **5.77** | **5.56** | **5.33** | **5.62** |

**Table D-5**
**SRAC -- TIME OF DELIVERY INFORMATION**

| Time Of Delivery Periods | Period A - Summer (May 1 - October 31) | Period B - Winter (November 1 - April 30) | Days Applicable |
|---|---|---|---|
| Peak | Noon - 6:00 PM | NA | Weekdays except holidays |
| Partial-Peak | 8:30 AM - Noon | 8:30 AM - 9:30 PM | Weekdays except holidays |
| | 6:00 PM - 9:30 PM | | Weekdays except holidays |
| Off-Peak | 9:30 PM - 1:00 AM | 9:30 PM - 1:00 AM | Weekdays except holidays |
| | 5:00 AM - 8:30 AM | 5:00 AM - 8:30 AM | Weekdays except holidays |
| | 5:00 AM - 1:00 AM | 5:00 AM - 1:00 AM | Weekends and holidays |
| Super Off-Peak | 1:00 AM - 5:00 AM | 1:00 AM - 5:00 AM | All days |

**Holidays:** New Year's Day, Presidents Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving, and Christmas.

## D.9 CHANGES TO PROJECT POWER

The amount and value of Project power is affected by minimum instream flow requirements (MIF), and other operational constraints such as ramping rates. Table D-6 summarizes the impact to Project power due to various changes in project operation.

**Table D-6**
**Generation Summary under Various Project Operations**

| Project Operation (i.e. Minimum instream flow, reservoir constraints, ramping rates) | Average Annual Energy, GWh | Foregone Energy, GWh | Dependable Capacity, MW | Annual Power Value, $1,000's/year |
|---|---|---|---|---|
| No-Action Case: current 50 cfs MIF | 582.6 | | 120 | $32,740 |
| Licensee-proposed 150 cfs year-round MIF, and ramping limits at Poe dam | 563.8 | 18.8 | 120 | $31,690 |
| 200 cfs year-round MIF | 554.3 | 28.3 | 120 | $31,150 |
| 300 cfs year-round MIF | 535.0 | 47.6 | 120 | $30,070 |
| 500 cfs year-round MIF | 496. | 86.5 | 120 | $27,880 |
| 500 cfs year-round MIF, constrain peaking due to removal of Big Bend dam | 496. | 86.5 | 120 | $26,190 |

# POE HYDROELECTRIC PROJECT

# FERC NO. 2107

# EXHIBIT E

# ENVIRONMENTAL REPORT

# EXHIBIT E

# ENVIRONMENTAL REPORT

## Table of Contents

## Report E1

# GENERAL DESCRIPTION OF THE LOCALE

## Table of Contents



## Figures

# Report E1

## GENERAL DESCRIPTION OF THE LOCALE

> *18 CFR § 4.51(f) Exhibit E is an Environmental Report. Information provided in the report must be organized and referenced according to the itemized subparagraphs below. See § 4.38 for consultation requirements. The Environmental Report must contain the following information, commensurate with the scope of the proposed project:*
>
> *(1) General description of the locale. The applicant must provide a general description of the environment of the project and its immediate vicinity. The description must include general information concerning climate, topography, wetlands, vegetative cover, land development, population size and density, the presence of any floodplain and the occurrence of flood events in the vicinity of the project, and any other factors important to an understanding of the setting.*

## E1.1 GENERAL DESCRIPTION OF THE LOCALE

The Licensee's Poe Hydroelectric Project (FERC No. 2107) is located on the North Fork Feather River (NFFR), near Pulga, California. Water is diverted from the NFFR at Poe Reservoir and transported through a tunnel and underground penstock to Poe Powerhouse, approximately 7.6 miles downstream (Figure E1-1). The Poe Hydroelectric Project is an integral part of the Licensee's hydroelectric development in the NFFR drainage (Figure E1-2) and is hydraulically coordinated with flow from the Licensee's Upper NFFR Project (FERC 2105), Bucks Creek Project (FERC 619), and the Rock Creek-Cresta Project (FERC 1962), as well as with flow from the NFFR and its tributaries. The Licensee's powerhouses in the NFFR drainage include Hamilton Branch (unlicensed), Butt Valley (FERC 2105), Caribou 1 and 2 (FERC 2105), Oak Flat (FERC 2105), Belden (FERC 2105), Bucks Creek (FERC 619), Rock Creek (FERC 1962), and Cresta (FERC 1962). Additionally, Grizzly Powerhouse, which is owned by the city of Santa Clara, is dispatched by the Licensee in coordination with the Bucks Creek Project.

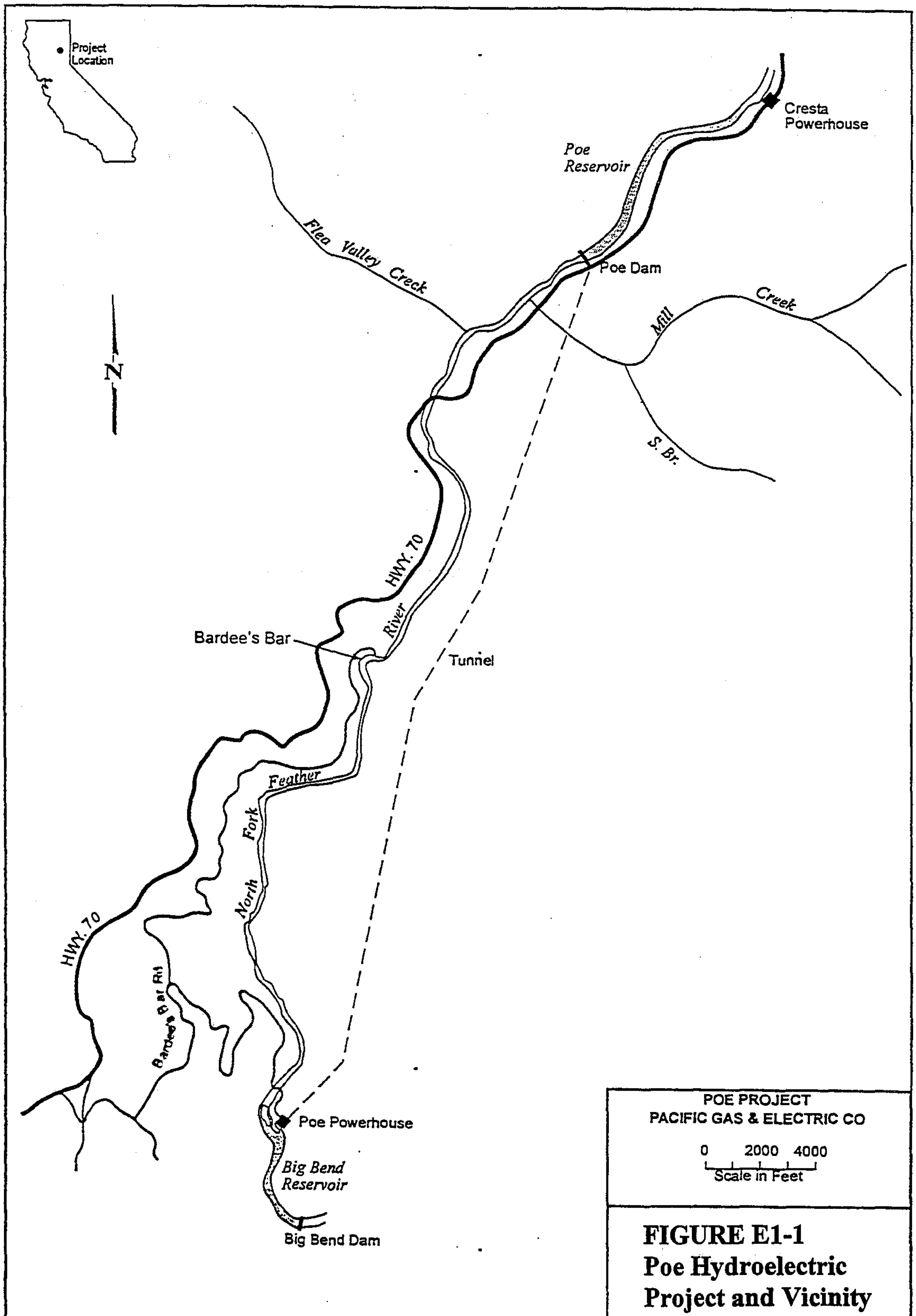
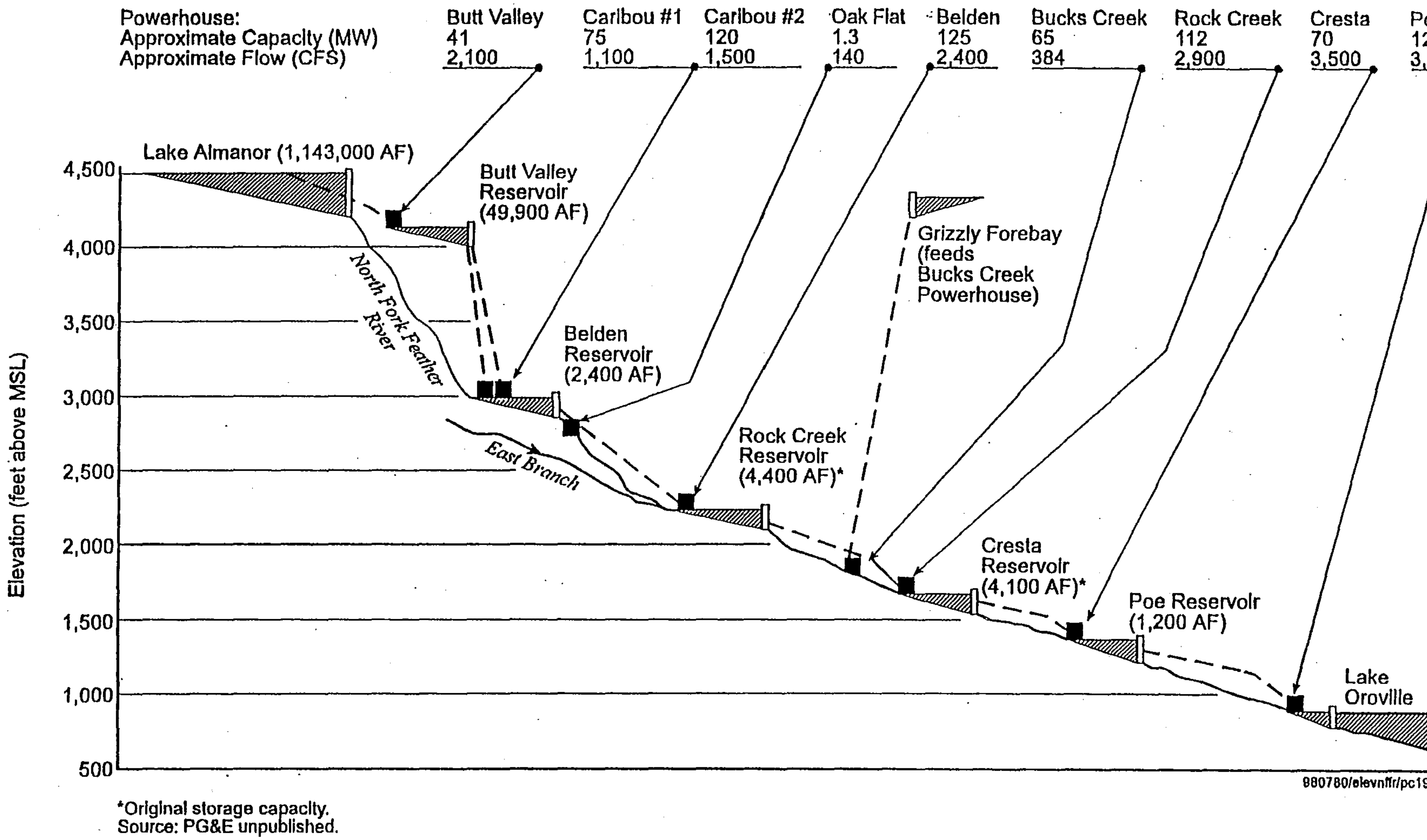



**FIGURE E1-1**
**Poe Hydroelectric Project and Vicinity**

980780/Poe water




*Original storage capacity.
Source: PG&E unpublished.

**FIGURE E1-2**
**Hydroelectric Development in the North Fork Feather River Drainage**

## E1.2 CLIMATE AND WEATHER

The Poe Hydroelectric Project is on the western slopes of the Sierra Nevada mountain range in Butte County. The NFFR Basin has mild, dry summers and moderate-to-heavy precipitation during the winter. Water flowing into the NFFR and its tributaries is derived from precipitation and snowmelt in the watershed. The area typically receives highest flows during the snowmelt period, which extends from March through early July. However, heavy flood events may occur as early as December. Peak estimated flow at Pulga was 100,000 cfs on January 1, 1997. Periods of low flow occur during the late summer and early fall, or during the late fall and winter when temperatures are low and precipitation remains in the form of snowpack.

## E1.3 TOPOGRAPHY

The Poe Hydroelectric Project is located in the NFFR canyon at an elevation range of approximately 900-1,400 feet. Canyon slopes rise steeply from the NFFR, reaching about 3,000 feet in elevation within the first mile from Project features. The NFFR is a high-gradient river, with reach characteristics alternating between riffle-cascades and pools. The Poe Reach of the NFFR, which extends between Poe Dam and Poe Powerhouse, has a lower gradient than the upper portions of the NFFR. The Poe Reach is 7.6 miles in length, with a change in elevation of approximately 450 ft.

## E1.4 WETLANDS

The Project uses waters of the NFFR. The steep rock terrain provides wetlands outside the immediate vicinity of the river and the small reservoirs created by Poe and Big Bend dams.

## E1.5 VEGETATIVE COVER

The Project is comprised of five major plant communities including Sierran mixed conifer forest, cismontane woodland, montane riparian forest, montane chaparral, and annual grassland. Within the vicinity of the Project, these plant communities commonly intergrade, forming broad ecotones rather than sharp boundaries. These habitats are described in Section E3.3.

## E1.6 LAND DEVELOPMENT

The Project is located in northeastern Butte County near the town of Pulga, California. The primary industries in this area, as in the whole county, are forest products, agriculture, and tourism.

Project lands and lands adjacent to the Project are maintained primarily as open space and used as recreation and timber lands. Most of the lands are either owned by the Licensee or are National Forest System lands administered by the Plumas National Forest.

## E1.7 POPULATION SIZE AND DENSITY

The Butte County population in 2000 was about 201,600. The largest community is Chico with a population of 52,800 residents. The closet community to the Project is Pulga with a population of 24. There are scattered residents throughout the entire Project vicinity where there are parcels of non-licensee or National Forest lands.

## E1.8 FLOODPLAINS

The Poe Hydroelectric Project is located in the canyon of the NFFR. Although this river can receive substantial flow, the steep canyon walls contain all the flow.

Table of Contents: Water Use & Quality

# E2-WATER USE AND QUALITY

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**Report E2**
# WATER USE AND QUALITY

## E2 WATER USE AND QUALITY

### E2.1 PROJECT SETTING

The Licensee's Poe Project (FERC License No. 2107) is located on the North Fork Feather River (NFFR), near Pulga, California (Figure E2.1-1). The Project uses water that is diverted from the NFFR at Poe Reservoir and transported through a tunnel and underground penstock to Poe Powerhouse. The Poe Project is an integral part of the Licensee's hydroelectric development in the NFFR drainage (Figure E2.1-2), and is hydraulically coordinated with flow from the Licensee's Upper NFFR Project (FERC 2105), Bucks Creek Project (FERC 619), and Rock Creek-Cresta Project (FERC 1962), as well as with flow from the NFFR and its tributaries. The Licensee's powerhouses in the NFFR drainage include Hamilton Branch (unlicensed), Butt Valley (FERC 2105), Caribou No. 1 and No. 2 (FERC 2105), Belden (FERC 2105), Oak Flat (FERC 2105), Bucks Creek (FERC 619), Rock Creek (FERC 1962), and Cresta (FERC 1962). Additionally, Grizzly Powerhouse, which is owned by the city of Santa Clara, is dispatched by the Licensee in coordination with the Bucks Creek Project.

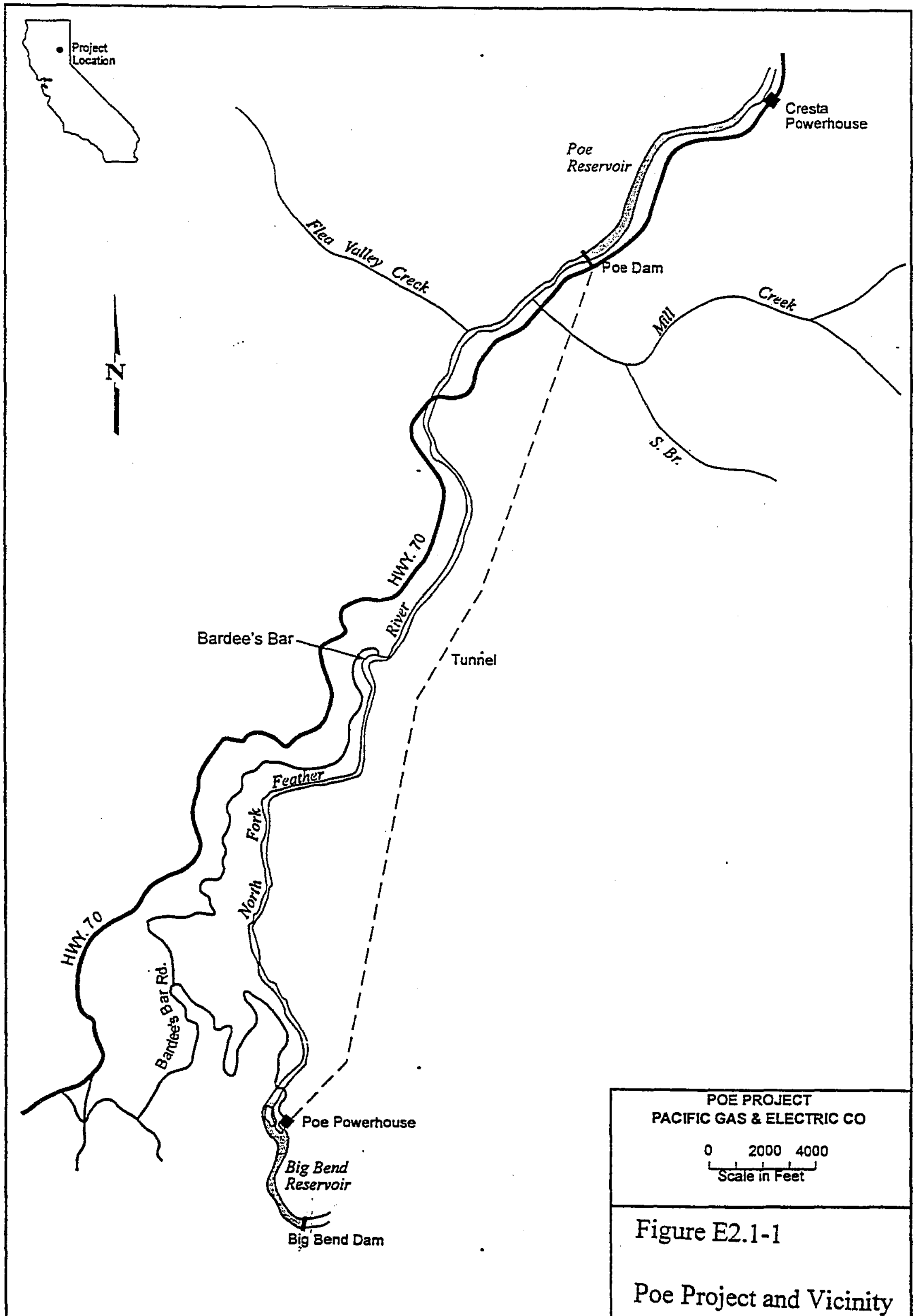
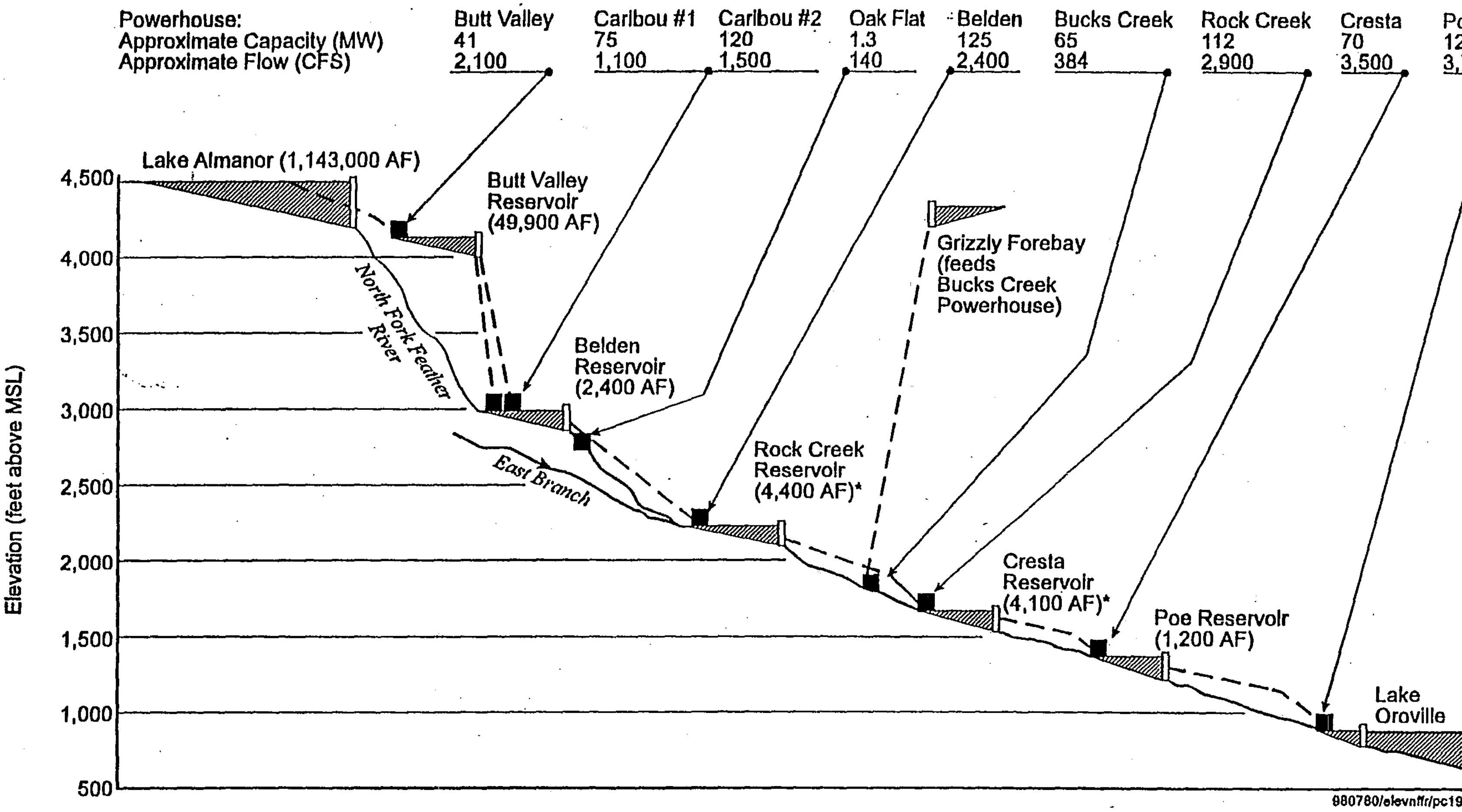



Figure E2.1-1

Poe Project and Vicinity

980780/Poe water




*Original storage capacity.
Source: PG&E unpublished.

Figure E2.1-2

Hydroelectric Development in the North Fork Feather River Drainage

## E2.2 WATER USE

In addition to power generation, the NFFR is used for municipal and domestic supply, as well as contact and non-contact recreation (Central Valley Region Water Quality Control Board [CVRWQCB] 1998). The river system also provides cold freshwater habitat, cold freshwater spawning, and wildlife habitat (CVRWQCB 1998). The NFFR upstream of the Project is heavily diverted for hydroelectric generation purposes. There is very little diversion for consumptive purposes in the upper watershed. The California Department of Water Resources (DWR) Lake Oroville receives the inflow from the NFFR. As part of the Central Valley Project, Lake Oroville is one of the major storage facilities tributary to the Sacramento River, providing power generation, flood control, recreation, and fish and wildlife habitat. It supports the water supply needs of much of northern and southern California.

Moderate levels of water-based recreation occur in the Project area; such activities include swimming, fishing, rafting, and picnicking. There is relatively little residential development in the Project area. The small community of Pulga is located on the river downstream of Poe Dam in the upper Project area. This community consists of a few buildings, supporting a small population that is widely scattered in the surrounding watershed. There is very little non-recreation based land use in the Project area. Some logging occurs in the upper elevation watershed areas. The Union Pacific Railroad operates a main line route that parallels the NFFR throughout the Project area.

## E2.3 HYDROLOGY

The Poe Project is located in Butte County in the western foothills of the Sierra Nevada mountain range. The hydrology of the greater NFFR Basin is affected by diverse conditions including: the regional and seasonal distribution of precipitation, the influence of snowmelt, differing geologic and geographic settings, diversion of flows for hydroelectric uses, and the consumptive use of surface and ground waters.

The NFFR Basin has mild, dry summers and moderate-to-heavy precipitation during the winter. As moisture-laden air from the Pacific Ocean moves inland; it crosses the mountain ranges of Northern California, including the Sierra Nevada Range. As the marine air ascends the western faces of these mountain ranges, much of its moisture condenses and falls as rain or snow, leaving less moisture for the plateaus to the East. In an average year, most of the precipitation occurs October through May, with the remainder usually occurring as summer storms. Water flowing into the NFFR and its tributaries is derived from precipitation and snowmelt in the upper watersheds. The area typically receives the highest flows during the snowmelt period, which can extend from March through early June.. Low-flow periods occur during the late summer and early fall and may continue into the late fall and winter when temperatures are low and precipitation remains as snowpack.

The upper NFFR is a high-gradient river, with reach characteristics alternating between riffle-cascades and pools. The Poe Reach of the NFFR, which extends between Poe Dam and Poe Powerhouse, has a lower gradient than the upper portions of the NFFR. The Poe Reach is 7.6 miles in length, with a change in elevation of approximately 500 ft.

Water used for the Poe Project is hydraulically integrated with regulated flows from upstream hydroelectric projects (Upper NFFR, Bucks Creek, and Rock Creek-Cresta) and unregulated flows of tributaries, particularly the East Branch of the NFFR. Lake Almanor, which is part of the Upper NFFR Project, is the primary storage reservoir on the NFFR. The East Branch of the NFFR is the major source of water to the NFFR during high-precipitation periods and/or snowmelt seasons. Table E2.3-1 presents a summary of available flow data for various U. S. Geological Survey (USGS) gaging stations in the NFFR drainage (Pacific Gas and Electric Company 2000a, [USGS] 2001).

During normal operation, the NFFR powerhouses are used to follow load during peaking periods. During high runoff periods, the powerhouses are operated near full capacity to utilize available water and minimize spilling. During periods with decreased runoff, the powerhouses are operated primarily in the load following and peaking mode, drawing water from the main upstream storage reservoir (Lake Almanor).

The primary sources of inflow to the Poe Project include: outflow from Cresta Powerhouse, flow from the Cresta Reach of the NFFR (i.e., the NFFR between Cresta Dam and Cresta Powerhouse), and minor tributaries.

## Table E2.3-1

### Summary of streamflow data associated with the Poe Project [1]

| Summary Statistics | Units | North Fork Feather River below Grizzly Creek, CA | Cresta Powerhouse near Pulga, CA | North Fork Feather River near Pulga, CA (pre-operation) | North Fork Feather River near Pulga, CA (post-operation) | Mill Creek near mouth | Flea Valley Creek near mouth | Poe Powerhouse near Jarbo Gap, CA |
|---|---|---|---|---|---|---|---|---|
| USGS Station Number | | 11404330 | 11404360 | 11404500 | 11404500 | temporary (Monitoring) | temporary (Monitoring) | 11404900 |
| Period of Record | water year | 1982-1996 | 1981-1996 | 1939-1957 | 1958-1996 | 1999-2000 | 1999-2000 | 1968-1996 |
| Watershed area | $miles^2$ | 1,914 | NA [2] | 1,953 | 1,953 | 6.2 | 3.3 | NA |
| Annual mean | cfs | 886 | 2,006 | 3,189 | 800 | NA | NA | 2,310 |
| Annual median | cfs | 89 | 1,910 | 2,210 | 62 | NA | NA | 2,180 |
| Highest annual mean | cfs | 3,115 (1995) | 3,212 (1983) | 5,320 (1952) | 4,120 (1958) | NA | NA | 3,510 (1974) |
| Lowest annual mean | cfs | 74 (1994) | 1,114 (1992) | 1,676 (1939) | 43 (1977) | NA | NA | 813 (1977) |
| Highest monthly mean | cfs | 2,492 (Mar) | 2,531 (Mar) | 5,542 (Apr) | 1,735 (Mar) | NA | NA | 3,172 (Mar) |
| Lowest monthly mean | cfs | 72 (Sep) | 1,617 (Aug) | 1,759 (Sep) | 57 (Aug) | NA | NA | 1,720 (Oct) |
| Highest daily mean | cfs | 48,200 (3/10/95) | 4,120 (3/29/89) | 59,800 (12/23/55) | 81,000 (2/18/86) | NA | NA | 5,200 (3/7/89) |
| Lowest daily mean | cfs | 28 (9/24/84) | 0 (10/15/95) | 259 (11/12/39) | 5 (9/18/77) | NA | NA | 0 (3/12/95) |
| **Daily Average Statistics** | | | | | | | | |
| 1999 WY min - max | cfs | 55 - 15,470 | 0 - 3,790 | NA | 85 - 19,274 | NA | NA | 0 - 3,525 |
| 1999 WY average | cfs | 518 | 2,470 | NA | 1,133 | NA | NA | 1,986 |
| June - Sep 1999 min - max | cfs | 58 - 681 | 348 - 2,978 | NA | 88 - 1,373 | 3.6 - 7.1 | 1.0 - 2.7 | 851 - 2,609 |
| June - Sep 1999 average | cfs | 128 | 1931 | NA | 147 | 5.5 | 1.8 | 1,786 |
| 2000 WY min - max | cfs | 54 - 15,247 | 57 - 3,671 | NA | 84 - 17,726 | NA | NA | 0 - 3,789 |
| 2000 WY average | cfs | 337 | 2,437 | NA | 393 | NA | NA | 2,293 |
| June - Sep 2000 min - max | cfs | 56 - 143 | 368 - 2,897 | NA | 97 - 460 | 3.7 - 9.0 | 1.4 - 3.0 | 309 - 3,442 |
| June - Sep 2000 average | cfs | 84 | 2,080 | NA | 113 | 5.8 | 2.2 | 1,898 |
| 2003 WY min - max | cfs | 97-8,284 | 450-3,652 | NA | 114-11,953 | NA | NA | 743-3,564 |
| 2003 WY average | cfs | 560 | 2,446 | NA | 495 | NA | NA | 2,435 |
| June - Sep 2003 min - max | cfs | 175-834 | 479-3,475 | NA | 119-145 | 3.7-20.4 | 1.3-9.1 | 769-3,246 |
| June - Sep 2003 average | cfs | 294 | 1,837 | NA | 130 | 7.7 | 3.0 | 1,812 |

1. USGS 2001, Pacific Gas and Electric Company 2000a.
2. NA = Not applicable.

### E2.3.1 Streamflow Conditions in 1999-2000

This Section will discuss the results of monitoring conducted by the Licensee during 1999-2000. A discussion of methods and monitoring locations is presented in Section E2.5.1.1.

#### E2.3.1.1 Cresta Powerhouse and Cresta Reach of NFFR

For the period 1981-1996, flow through Cresta Powerhouse (USGS Station 11404360) averaged 2,006 cfs. During the 1999 June-September period, daily average flow through Cresta Powerhouse ranged from 348 to 2,978 cfs, and averaged 1,931 cfs (Table E2.3-1). During the 2000 June-September period, Cresta Powerhouse daily average flows averaged 2,080 cfs, ranging from 368 to 2,897 cfs. Figure E2.3-1 compares 1999, 2000, and 2003 mean monthly flows from Cresta Powerhouse. Figure E2.3-2 compares daily average powerhouse flows for the June-September monitoring periods in 1999, 2000 and 2003.

The Cresta Reach of the NFFR is the secondary water source for the Poe Project area. In the Cresta Reach, a minimum flow of 50 cfs is required to be maintained below Grizzly Creek. The Licensee operates a streamflow gaging station on the NFFR downstream of Grizzly Creek to monitor minimum flows. For the period 1982-1996, the average annual flow in the NFFR below Grizzly Creek (USGS Station 11404330) was 886 cfs (Table E2.3-1). Mean monthly flows ranged from 2,492 cfs during March to 72 cfs in September. During the 1999 June-September period, average daily flow in the Cresta

Reach ranged from 58 to 681 cfs, and averaged 128 cfs. During the 2000 June-August period, average daily flows ranged from 56 to 143 cfs, and averaged 84 cfs. Figure E2.3-3 compares 1999, 2000, and 2003 mean monthly flows in the Cresta Reach. Figure E2.3-4 compares daily average flows in the Cresta Reach for the June-September monitoring periods in 1999, 2000, and 2003.

Total daily average inflow to Poe Reservoir during the 1999 June-September period ranged from 901 to 3,082 cfs, and averaged 2,059 cfs. The total daily average inflow for the 2000 June-September period ranged from 424 to 2,971 cfs, and averaged 2,163 cfs.

**E2.3.1.2 Poe Reservoir**

The Poe Project is the Licensee's lowermost hydroelectric development on the NFFR. Poe Reservoir was formed in 1958 by the construction of Poe Dam. Poe Reservoir functions primarily as a regulating forebay for hydroelectric operations. The reservoir is long and narrow, with a maximum width of about 400 ft near the dam and 150 ft near its upper end, and extends from Poe Dam upriver to a point just below the Cresta Powerhouse Tailrace, inundating about 1.7 miles of the NFFR. Because of its small size, with a maximum surface area of approximately 53 acres and a gross holding capacity of 1,203 acre-feet, the hydrologic characteristics of the reservoir are essentially run of the river. The water is well mixed in the reservoir and exhibits weak thermal gradients. Because of the reservoir's limited volume and high outflow capacity through Poe Powerhouse, the average residence time in the reservoir is short (estimated at 0.3 days [7 hours]). In addition, the small storage capacity and changing load demands at Poe

Powerhouse can cause significant daily fluctuations in reservoir water surface elevation. Under normal operation, the water surface elevation ranges between a normal maximum of 1,389.8 ft. (USGS datum) and a minimum of 1,380.2 ft. (USGS datum). During most of the year, with the exception of the winter-spring high runoff periods, the reservoir fluctuates daily by about 3 feet in elevation. However, the pattern is variable, particularly during very hot weather when demand for electricity is high.

Poe Reservoir receives the inflow from three tributaries that have perennial flow. These tributaries are Camp, Dogwood and Heinz creeks. Of these three, Camp Creek has the largest drainage area covering approximately 25 square miles. The Dogwood Creek watershed is similar in size to Mill Creek downstream of Poe Dam, with a drainage area of approximately 6.0 square miles. Heinz Creek is the smallest of the Poe Reservoir tributaries, having a drainage area of only 1.6 square miles. The Licensee did not attempt to monitor flow in these small streams tributary to Poe Reservoir. Comparing the watershed area of each of these streams with the known flow/watershed area ratio of Mill and Flea Valley Creeks indicates that the total combined flow into Poe Reservoir during the summer period (June-September) could range from 15 to 50 cfs. Flow in Camp Creek may be seasonally more significant due to a larger watershed area (25 square miles). Visual flow estimates made by the Licensee's Hydrographer on August 1, 2001, indicated that Camp, Dogwood, and Heinz creeks had flows of 4.0, 3.5 and 2.0 cfs, respectively. These tributary flows fully mix with the much higher single inflow of the NFFR (as released from Cresta Powerhouse). As a result, these flows represent a small fraction of the total flow into the Project.

During non-spill periods, the primary outflow from Poe Reservoir is the diversion of water through the Poe Powerhouse. From 1968 to 1996, annual flow through Poe Powerhouse (USGS Station 11404900) averaged 2,310 cfs (Table E2.3-1). Mean monthly flows ranged from 3,172 cfs during March to 1,720 cfs in October. During the 1999 June-September period, daily average flow through Poe Powerhouse ranged from 851 to 2,609 cfs, and averaged 1,786 cfs. During the same period in 2000, Poe Powerhouse daily flows averaged 1,898 cfs, and ranged from 309 to 3,442 cfs. Figure E2.3-5 compares 1999, 2000, and 2003 mean monthly flows from Poe Powerhouse. Figure E2.3-6 compares daily average flows at Poe Powerhouse for the June-September monitoring periods in 1999, 2000, and 2003.

**E2.3.1.3 Poe Reach of NFFR**

During non-spill periods, the principal source of inflow to the Poe Reach is the release from Poe Dam. Under the terms of the Project license, a minimum of 25 cfs must be released to the NFFR downstream of Poe Dam. The release must also be sufficient to maintain flows at 50 cfs as measured at the USGS gaging station near Pulga. This station is located on the NFFR downstream of the confluence with both Mill and Flea Valley creeks.

The Poe Reach encompasses approximately 7.6 miles of the NFFR from Poe Dam downstream to Poe Powerhouse. The river channel in the Poe Reach is characterized by a relatively wide, low gradient (0.7%) section immediately downstream of the dam. This section extends about 1.6 miles downstream to the Pulga gaging station. The river then flows into a narrow, high gradient (2.2%) canyon section that is confined in a bedrock channel with relatively large substrates. The canyon section extends downstream approximately 1.9 miles to the Bardees Bar area. At this point, the channel once again widens and develops a lower gradient (0.8%) morphology that extends to Poe Powerhouse. This wide, lower gradient section is approximately 4.1 miles long.

Mill Creek and Flea Valley Creek are the two major tributaries in the Poe Reach. These tributaries enter the NFFR approximately 0.5 mile downstream of Poe Dam. Historical data from June-September for 1981 and 1982 showed that flows in Mill Creek ranged from 3 to 36 cfs (Pacific Gas and Electric Company unpublished data). During the summer of 1985, Mill Creek added from 3.6 to 7.0 cfs to the NFFR (Woodward-Clyde 1986a). For June-September 1999, Mill Creek flows ranged from 3.6 to 7.1 cfs, and averaged 5.5 cfs (Table E2.3-1). Mill Creek flows for June-September 2000 ranged from 3.7 to 9.0 cfs, averaging 5.8 cfs. Figure E2.3-7 compares 1999, 2000, and 2003 estimated daily flows in Mill Creek.

For the period of June-September 1999, Flea Valley Creek flows ranged from 1.0 to 2.7 cfs, and averaged 1.8 cfs (Table E2.3-1). Flea Valley Creek flows for June-September 2000 ranged from 1.4 to 3.0 cfs, averaging 2.2 cfs. The 1999-2000 Flea Valley flows were 28 to 43% of flows measured in Mill Creek. This supports the previously estimated range of 15 to 60% of the flow of Mill Creek is represented by Flea Valley Creek (Kent Karge, Pacific Gas and Electric Company, personal communication, 1998). Figure E2.3-8 compares 1999, 2000, and 2003 estimated daily flows in Flea Valley Creek.

Hydrologic data have been collected in the Poe Reach at Pulga (USGS Station 11404500) from 1939 to the present. Data from 1939 to 1957 measured conditions prior to operation of the Poe Project. After the Poe Project went into operation, flow in the NFFR below Poe Dam averaged 800 cfs for the period 1959 to 1996 (Table E2.3-1). Mean yearly flows ranged from 4,120 cfs in 1958 to 43 cfs in 1977, the driest year on record. The Licensee received a special dry year exception on release flows in 1977 from FERC. Mean monthly flows ranged from 1,735 cfs during March to 57 cfs in August. The highest daily mean reported during this period was 81,000 cfs (February 18, 1986). During the 1999-2000 periods, daily average flow in the NFFR at Pulga ranged from 84 to 19,274 cfs, and averaged 763 cfs (Table E2.3-1). During the period June-September 1999, daily average flows in the Poe Reach ranged from 88 to 1,373 cfs, and averaged 147 cfs. Flows averaged 113 cfs for the same period in 2000, and ranged from 97 to 460 cfs. Figure E2.3-9 compares 1999, 2000, and 2003 mean monthly flows at the Pulga gaging station. Figure E2.3-10 compares daily average flows at the Pulga station for the June-September monitoring periods in 1999, 2000, and 2003.

During the 1999 June-September period (excluding natural spill events in early June), an average of 41 cfs was released in excess of the required 50 cfs minimum at the Pulga gage. This excess was exclusive of the tributary flow from Mill Creek and Flea Valley Creek. During the same period in 2000, an average of 48 cfs was over-released in the Poe Reach. This over-release was the result of leaks associated with the seals on the large radial gates at Poe Dam.

Time-of-travel studies in the Poe Reach were conducted as part of the *Rock Creek-Cresta Project Cold Water Feasibility Study* (Woodward-Clyde 1986a). The time of travel through the Poe Reach for 50 cfs (the normal flow for 1985) was 52 hours. The time of travel for 150 cfs was measured at 31.5 hours.

Lateral accretion flows in the Poe Reach (Exclusive of Mill and Flea Valley creeks) were estimated in 1999 using flow measurements in the NFFR upstream of Poe Powerhouse. The first measurement, made on August 4, 1999, was 90 cfs, compared to a 2-day average flow of 91 cfs at the Pulga gage. This indicated little or no accretion during this period. A second flow measurement, made on October 12, 1999, was 104 cfs, compared with a 2-day average flow of 101 cfs at the Pulga gage. This also indicated little measurable accretion flow below the Pulga gage. Observations in the watershed indicate that there are a few areas of small spring seeps and minor tributary inflows. These inflows are all considered minor and are estimated to contribute less than 2.0 cfs total. This small volume of accretion is not detectable with the accuracy limitations of periodic flow measurements. Total accretion flow in the Poe Project area for the summer period is estimated to be approximately 20 to 80 cfs depending on runoff conditions. This accretion occurs both above and below Poe Dam. Total lateral accretion above Poe Dam is estimated at 15 to 50 cfs (received by Poe Reservoir); lateral accretion below Poe Dam is approximately 5 to 30 cfs (Poe Reach).

**E2.3.2 Streamflow Conditions in 2003**

This section will discuss the results of monitoring conducted by the Licensee in 2003. A discussion of methods and monitoring locations is presented in Section E2.5.1.2.

### E2.3.2.1 Cresta Powerhouse and Cresta Reach of NFFR

A complete description of the operational characteristics of Cresta Powerhouse and the Cresta Reach is presented in Section E2.3.1.1. Cresta Powerhouse is the primary source of water into the Poe Project. Mean monthly flows through Cresta Powerhouse in 2003 ranged from 1,621 cfs in August to 3,518 cfs in May 2003. During the 2003 June through September period, daily average flow through Cresta Powerhouse ranged from 479 to 3,475 cfs, and averaged 1,837 cfs (Table E2.3-1). Figure E2.3-1 compares 2003 flow with 1999 and 2000 mean monthly flows from Cresta Powerhouse. Figure E2.3-2 compares daily average powerhouse flows for the June-September monitoring periods in 1999, 2000, and 2003.

The Cresta Reach of the NFFR is the secondary water source for the Poe Project area. During the 2003 June through September period, average daily flows ranged from 175 to 834 cfs, and averaged 294 cfs (Table E2.3-1). Figure E2.3-3 compares 2003 mean monthly flows in the Cresta Reach with those from 1999 and 2000. Figure E2.3-4 compares daily average flows in the Cresta Reach for the June-September monitoring periods in 1999, 2000, and 2003. Compared to 1999-2000, the flow increase in 2003 is the result of the minimum flow requirement stipulated in the new license condition under FERC 1962, issued October 24, 2001.

Total daily average inflow to Poe Reservoir during the 2003 June through September period ranged from 748 to 3,953 cfs, and averaged 2,131 cfs.

### E2.3.2.2 Poe Reservoir

A complete description of Poe Reservoir is presented in Section E2.3.1.2. Poe Powerhouse is the primary outflow from Poe Reservoir during non-spill periods. Mean monthly flows through Poe Powerhouse in 2003 ranged from 1,615 cfs in September to 3,395 cfs in May 2003. During the 2003 June through September period, daily average flow through Poe Powerhouse ranged from 769 to 3,246 cfs, and averaged 1,812 cfs (Table E2.3-1). Figure E2.3-5 compares 2003 mean monthly flows from Poe Powerhouse with those from 1999 and 2000. Figure E2.3-6 compares daily average flows at Poe Powerhouse for the June-September monitoring periods in 1999, 2000, and 2003.

### E2.3.2.3 Poe Reach of NFFR

A complete description of the Poe Reach is presented in Section E2.3.1.3. The first tributary of the NFFR downstream of Poe Dam is Mill Creek. For the June through September 2003 period, Mill Creek flows ranged from 3.7 to 20.4 cfs, and averaged 7.7 cfs (Table E2.3-1). Figure E2.3-7 compares 2003 estimated daily flows in Mill Creek with those from 1999 and 2000.

For the period June through September 2003, Flea Valley Creek flows ranged from 1.3 to 9.1 cfs, and averaged 3.0 cfs (Table E2.3-1). The 2003 Flea Valley flows were 35 to 45%

of flows measured in Mill Creek. Figure E2.3-8 compares 2003 estimated daily flows in Flea Valley Creek with those from 1999 and 2000.

During the 2003 period, daily average flow in the NFFR at Pulga ranged from 114 to 11,953 cfs, and averaged 495 cfs (Table E2.3-1). During the period June through September 2003, daily average flows in the Poe Reach ranged from 119 to 145 cfs, and averaged 130 cfs. Figure E2.3-9 compares 2003 mean monthly flows at the Pulga gaging station with those from 1999 and 2000. Figure E2.3-10 compares daily average flows at the Pulga station for the June-September monitoring periods in 1999, 2000, and 2003.

During the 2003 June through September period (excluding natural spill events in early June), an average of 69 cfs was released in excess of the required 50 cfs minimum at the Pulga gage. This excess was exclusive of the tributary flow from Mill Creek and Flea Valley Creek. This over-release was the result of leaks associated with the seals on the large radial gates at Poe Dam.

### E2.3.3 Full Natural Flow Estimate

A comparison of mean monthly flows in the NFFR near Pulga under natural flow conditions (1935-98) and under Project operation conditions (1958-98) is shown in Figure E2.3-11. Poe Powerhouse became operational in 1958. During Project operation, monthly mean flow ranges from 61 cfs in August to 1,692 cfs in March (Figure E2.3-11). Historic hydrologic data collected throughout the NFFR were used by the Licensee to generate a full natural flow estimate for the station at Pulga. The values used for natural flow are not based on actual measurements; rather they are an estimate of the "unimpaired" flow condition present in the NFFR at Pulga if the upstream hydroelectric storage and diversion operations including the Poe Project were not in place. This includes eliminating any storage effect from all upstream reservoirs (including Mt. Meadows, Lake Almanor, Butt Valley, Belden, Rock Creek, Cresta, and Bucks Creek). The estimated unimpaired flow in the NFFR at Pulga for the period 1935-1998 (Pacific Gas and Electric Company data base, 1994) ranged from 790 cfs in August to 6,162 cfs in April (Figure E2.3-11).

### E2.3.4 Hourly Operational Flow Variations (Ramping Rates)

In addition to the daily and seasonal variations in hydrologic conditions on the NFFR, the hourly fluctuation in flow rates under existing conditions was reviewed below Poe dam and below Poe Powerhouse. The Poe Dam controls the release of water to the NFFR by opening and closing large radial gates. The flow capacity of a single large gate is estimated to be 40,000 cfs. A review was made of the operation of these gates both during the spill season of a wet year (1998), and during spills that occurred during the non-spill season in recent years. During 1998 the Poe Reservoir spilled for a significant portion of the year. Table E2.3-2 shows the hourly readings (in cfs) for the NF-23 gage below Poe Dam on eight separate 15-hour periods. These were representative of periods when spill flows were changing significantly. The peak flow at NF-23 during 1998 was 21,700 cfs.

**Table E2.3-2**
**Selection of hourly flow readings in cfs below Poe Dam during 1998 spill season**

| 11/20/97<br>One unit @ Poe at constant full load. First spill of season | 1/11/98<br>Two units @ Poe at constant full load | 1/24/98<br>Two units @ Poe at constant full load | 2/27/98<br>Steady River Flow and one of two operate unit's trip offline. | 3/8/98<br>One unit @ Poe at a constant full load | 3/11/98<br>One unit @ Poe at a constant full load | 4/21/98<br>One unit at full load, then at partial load for 3 hours, then off for 9 hours. | 7/6/98<br>Operating with one unit and then second unit brought on line. Last day of spill. |
|---|---|---|---|---|---|---|---|
| 120 | 335 | 1040 | 1040 | 2630 | 204 | 2790 | 2200 |
| 120 | 366 | 953 | 786 | 2050 | 185 | 2820 | 1910 |
| 120 | 390 | 1060 | 910 | 1370 | 179 | 5460 | 2270 |
| 123 | 408 | 920 | 920 | 1920 | 157 | 5400 | 2930 |
| 250 | 413 | 1010 | 925 | 403 | 146 | 7620 | 2330 |
| 1140 | 427 | 998 | 925 | 504 | 160 | 5100 | 2700 |
| 1520 | 451 | 949 | 887 | 200 | 2140 | 5670 | 2580 |
| 2670 | 2510 | 842 | 3520 | 164 | 2730 | 5700 | 1730 |
| 2150 | 1780 | 934 | 3050 | 160 | 2480 | 5160 | 248 |
| 1080 | 2410 | 803 | 3130 | 2770 | 2320 | 7050 | 155 |
| 209 | 2970 | 769 | 2830 | 2290 | 2520 | 4990 | 211 |
| 140 | 3000 | 238 | 2920 | 2770 | 2560 | 5530 | 211 |
| 132 | 4240 | 183 | 2920 | 685 | 2420 | 4790 | 378 |
| 129 | 2800 | 175 | 2840 | 2710 | 2550 | 4420 | 176 |
| 126 | 3300 | 173 | 2870 | 2390 | 2440 | 3880 | 267 |

Spill flows occurred on three occasions at Poe Dam in recent years during the non-spill season (October 1995, July 1997, and September 1998). The recording gage at NF-23 was not in service during most of 1997, due to the flood of January 1, 1997, and accurate records from that spill event are not available. However, the hourly data from the events in 1995 and 1998 are presented in Table E2.3-3. During each of these time periods, one unit at Poe was operating at full load.

The Poe Powerhouse releases water into a confined tailrace channel that discharges to a wide river channel formed by the upper end of the Big Bend Reservoir. The generating units at Poe Powerhouse can increase generation from zero to full load within approximately 10 minutes. The increase in the water level in the tailrace from no load to full load on both units is approximately four feet. The broad nature of the river channel mitigates the rate of rise in the water surface beyond the end of the tailrace channel and down to Big Bend Dam. Additional information on Big Bend Dam and its performance is contained in Appendix E3-11.

**Table E2.3-3**

**Hourly flows below Poe Dam in cfs during non-spill season.**

| 10/6/95<br>Spill initiated | 10/8/95<br>Spill stopped | 9/8/98<br>Spill initiated | 9/9/98<br>Spill stopped |
|---|---|---|---|
| 58 | 929 | 124 | 385 |
| 57 | 1050 | 129 | 406 |
| 57 | 939 | 292 | 408 |
| 59 | 1020 | 939 | 419 |
| 60 | 1000 | 1370 | 616 |
| 62 | 1000 | 2030 | 551 |
| 1170 | 2050 | 1910 | 545 |
| 1120 | 1820 | 2240 | 588 |
| 1110 | 1300 | 2130 | 708 |
| 1190 | 1230 | 435 | 748 |
| 1100 | 1030 | 171 | 471 |
| 1210 | 1220 | 144 | 241 |
| 1200 | 315 | 457 | 146 |
| 1140 | 127 | 529 | 132 |
| 1170 | 88 | 641 | 130 |

A notch was cut into Big Bend dam when the Big Bend Powerhouse was taken out of service in the late 1960's. This notch allows the reservoir level to fluctuate with the loading of Poe Powerhouse and the flow in the NFFR. The lowest portion of the notch is at elevation 890 ft. and the normal water surface elevation of Big Bend Reservoir with Poe Powerhouse operating at full load is approximately 900 ft. As a result, the elevation of the reservoir may vary within this range during months in which Poe Dam is not spilling. At a flow of approximately 7,000 cfs the water level in Big Bend Reservoir reaches the crest of the dam and spill occurs along the entire face of the structure.

The notch in Big Bend Dam was created to dampen the rate at which the water surface elevation might rise downstream of Big Bend Dam when the stream channel below the dam is not inundated by Lake Oroville. This inundation occurs when the elevation of Lake Oroville is above approximate elevation 870 ft. (the toe of Big Bend Dam). Table E2.3-4 shows the periods during which the elevation of Lake Oroville was above elevation 870 ft. for years 1989-2000. No data is available on the historic rate of flow fluctuations below Big Bend Dam. The normal maximum water surface elevation of Lake Oroville is 900 ft.

**Table E2.3-4**

**Years when the elevation of Lake Oroville was above an elevation of 870 ft. for 1989-2000**

| Year | Period Lake Oroville above 870 ft. |
|---|---|
| 2000 | April 28 through June 7 |
| 1999 | April 15 through July 19 |
| 1998 | May 2 through August 28 |
| 1997 | April 17 through June 22 |
| 1996 | April 6 through July 27 |
| 1995 | April 29 through August 12 |
| 1994 | Oroville peaked at approx. elevation 840 on April 19 |
| 1993 | April 16 through August 2 |
| 1992 | Oroville peaked at approx. elevation 785 on May 5 |
| 1991 | Oroville peaked at approx. elevation 755 on June 2 |
| 1990 | Oroville peaked at approx. elevation 790 on April 1 |
| 1989 | April 10 through July 1 |

## E2.3.5 Meteorology

The NFFR basin has mild, dry summers and moderate to heavy precipitation during winter. Average air temperatures range from 0°C in winter to 20°C in summer. For June, July, August, and September, the monthly mean air temperatures equivalent to the location at Poe Powerhouse were 20.4, 23.8, 22.3 and 18.9°C, respectively. These data are based on a long-term data record (1948-2000) at Canyon Dam (from California Data Exchange Center) adjusted to Poe Powerhouse; the adjustment coefficients were from a linear regression analysis based on 1985 data (Woodward-Clyde 1986a).

### E2.3.5.1 Meteorological Conditions in 1999-2000

In the 1999 and 2000 monitoring programs, site-specific meteorological data were collected from the same meteorological station at Poe Powerhouse. Data from this station were used primarily as input to the water temperature computer model. This data is presented in Section E2.5.1.1.6.

Several long-term monitoring stations are operated in the regional area. Precipitation data from these stations were used to broadly describe ambient conditions during the monitoring period. Table E2.3-5 summarizes precipitation data from the available stations in the Project region. These stations define conditions in the upstream watersheds and immediate Project area. The available data indicate that region wide precipitation amounts were similar between the 1999 and 2000 monitoring periods. Total precipitation during the 1999 water year (October 1998 to September 1999) averaged 99% of normal (5 stations). Comparatively, total precipitation during the 2000 water year (October 1999 to September 2000) averaged 105% of normal (Table E2.3-5). Total precipitation in the Project area ranges from approximately 20 to 83 inches during the 1999-2000 monitoring period.

### E2.3.5.2 Meteorological Conditions in 2003

In the 2003 monitoring program, site-specific meteorological data were again collected from the meteorological station at Poe Powerhouse. These data are presented in Section E2.5.1.2.6.

The available data indicate that total region wide precipitation amounts in 2003 were higher than those during the 1999 and 2000 monitoring periods. Total precipitation during the 2003 water year (October 2002 to September 2003) averaged 116% of normal (5 stations). Total precipitation in the Project area during the 2003 water year ranged from approximately 21 to 90 inches (Table E2.3-5).

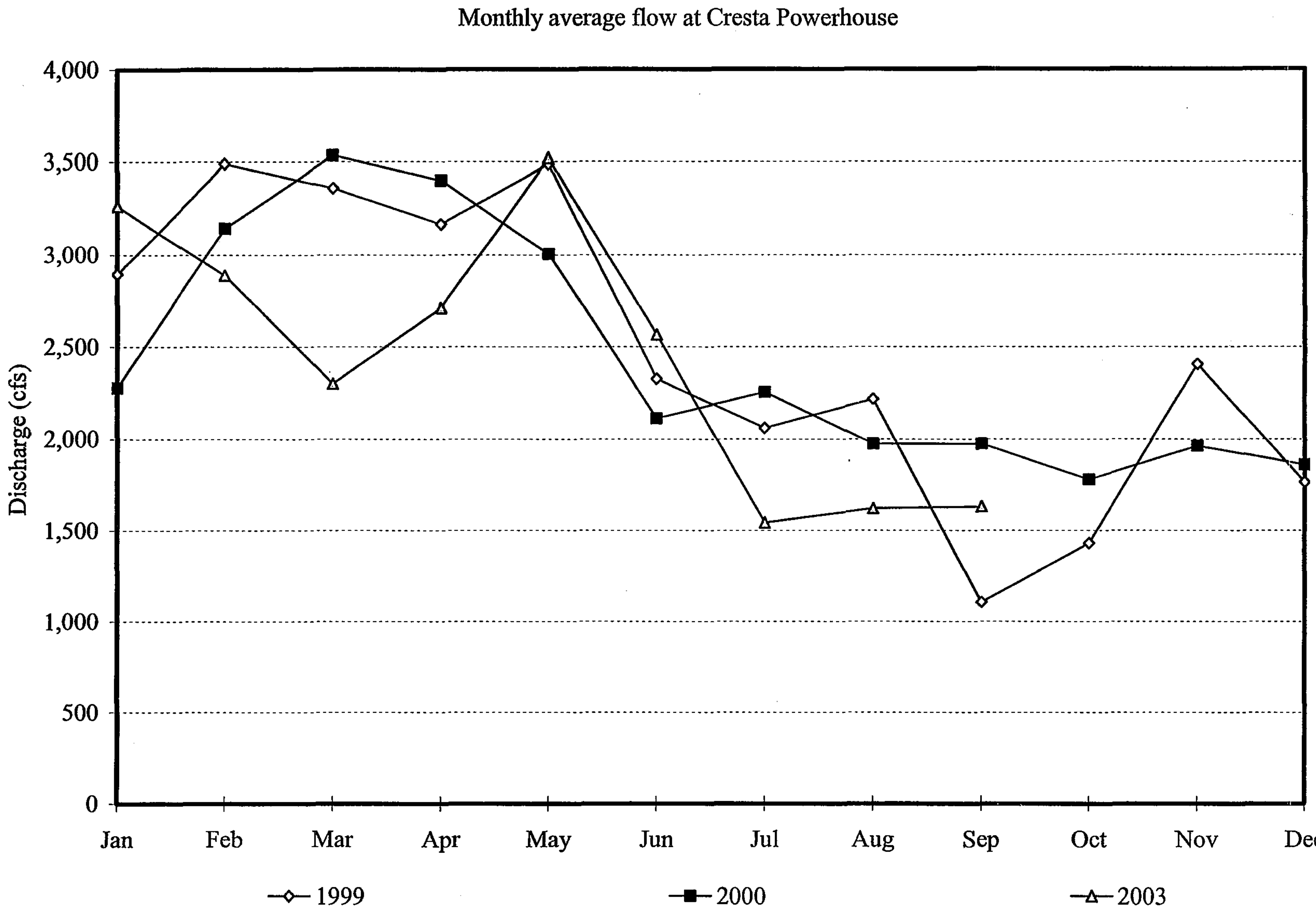



Figure E2.3-1 Comparison of mean monthly streamflows at Cresta Powerhouse for 1999, 2000, and 2003.

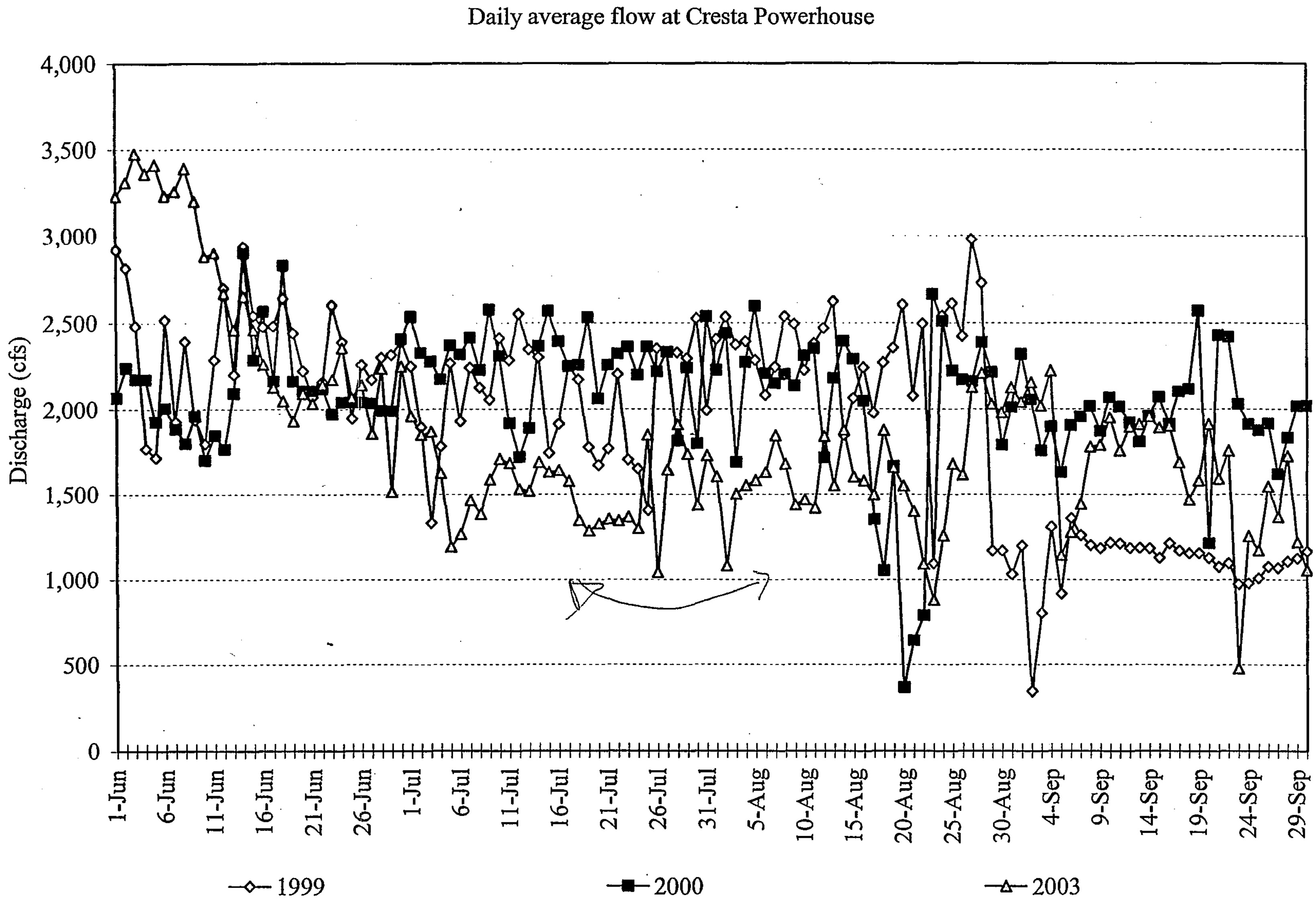



Figure E2.3-2 Comparison of daily average flows at Cresta Powerhouse for June-September period in 1999, 2000, and 2003.

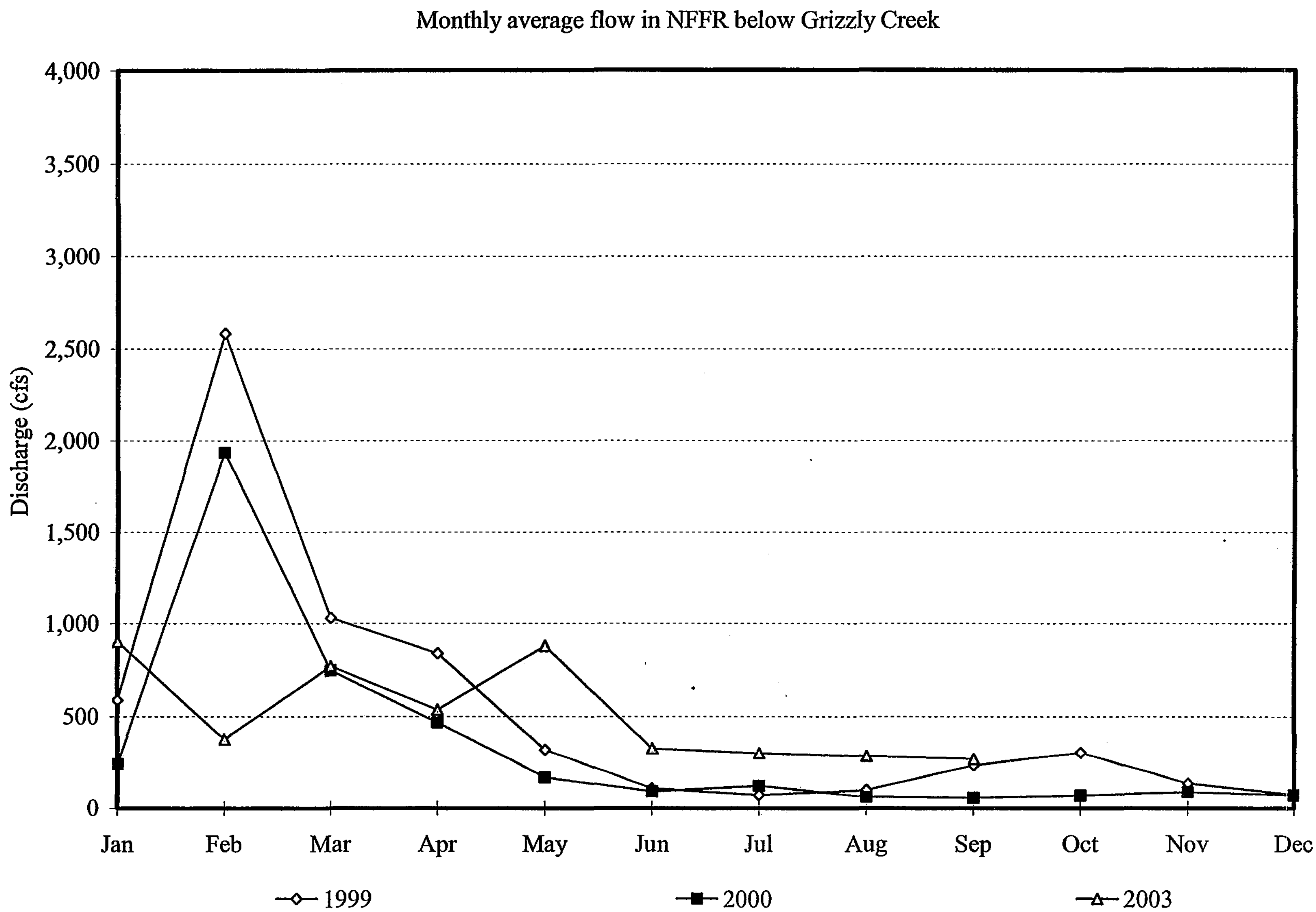



Figure E2.3-3 Comparison of mean monthly streamflows in NFFR below Grizzly Creek (Cresta Reach) for 1999, 2000, and 2003.

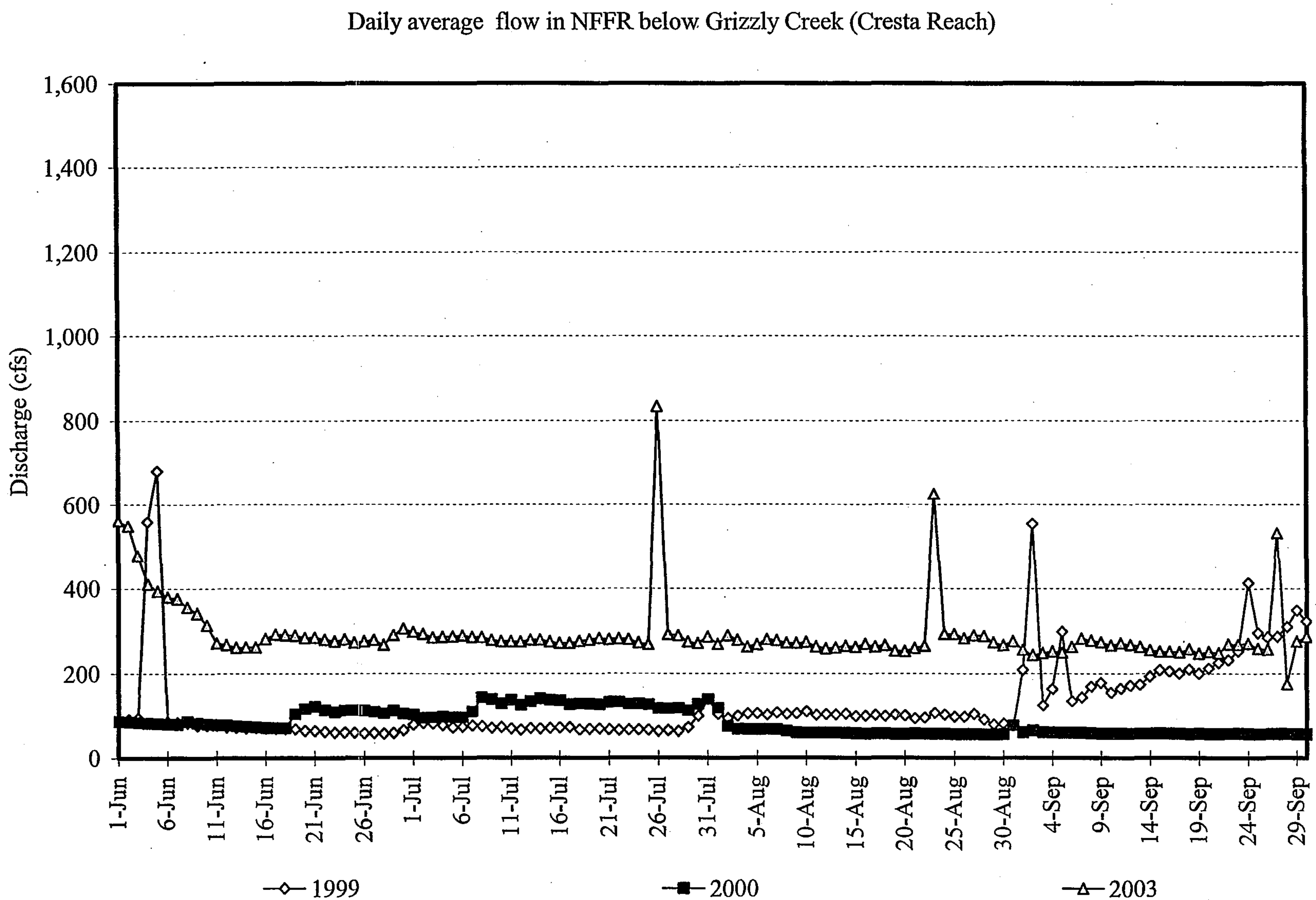



Figure E2.3-4 Comparison of daily average flows in NFFR below Grizzly Creek (Cresta Reach) for June-September period in 1999, 2000, and 2003.

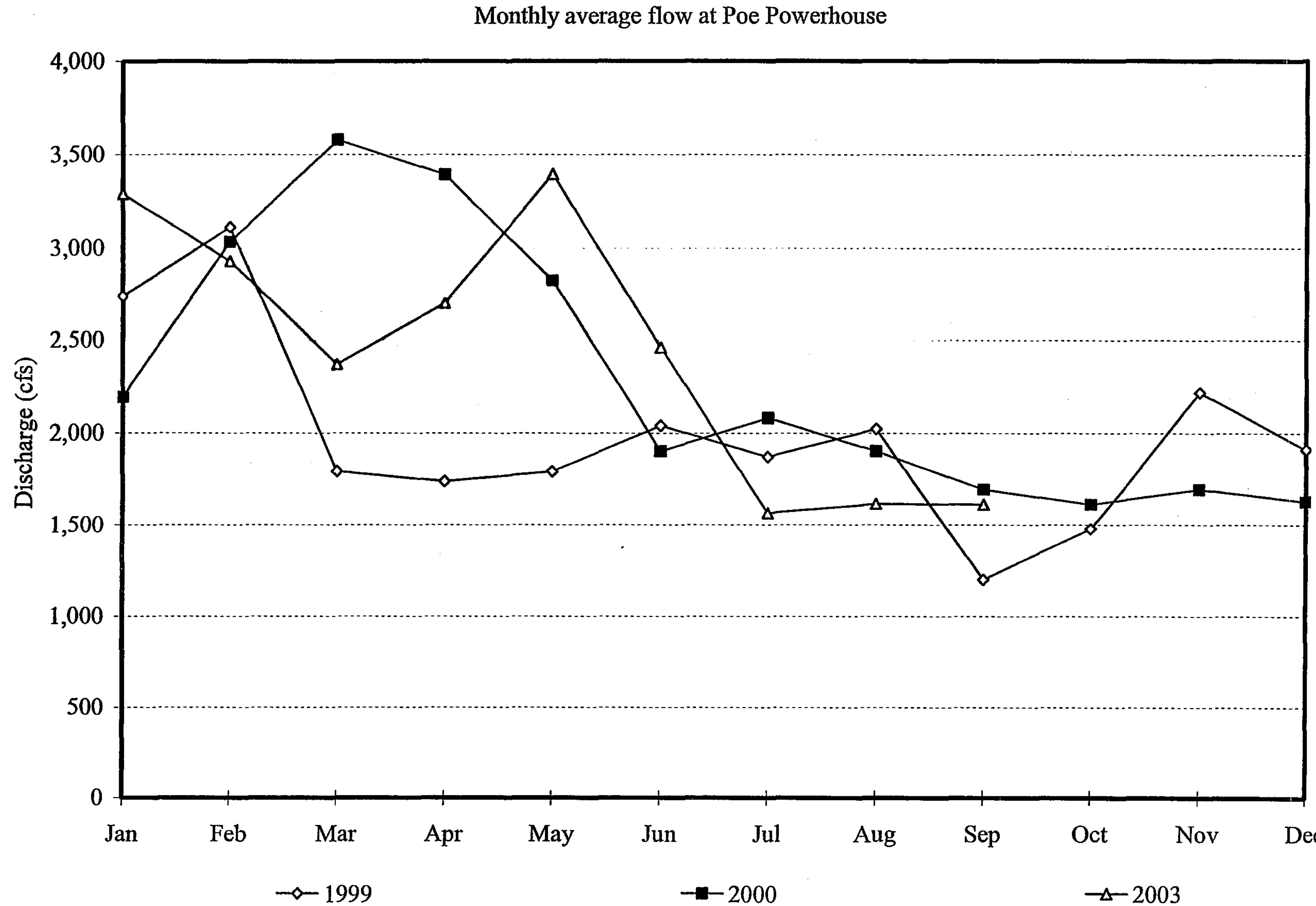



Figure E2.3-5 Comparison of mean monthly streamflows at Poe Powerhouse for 1999, 2000, and 2003.

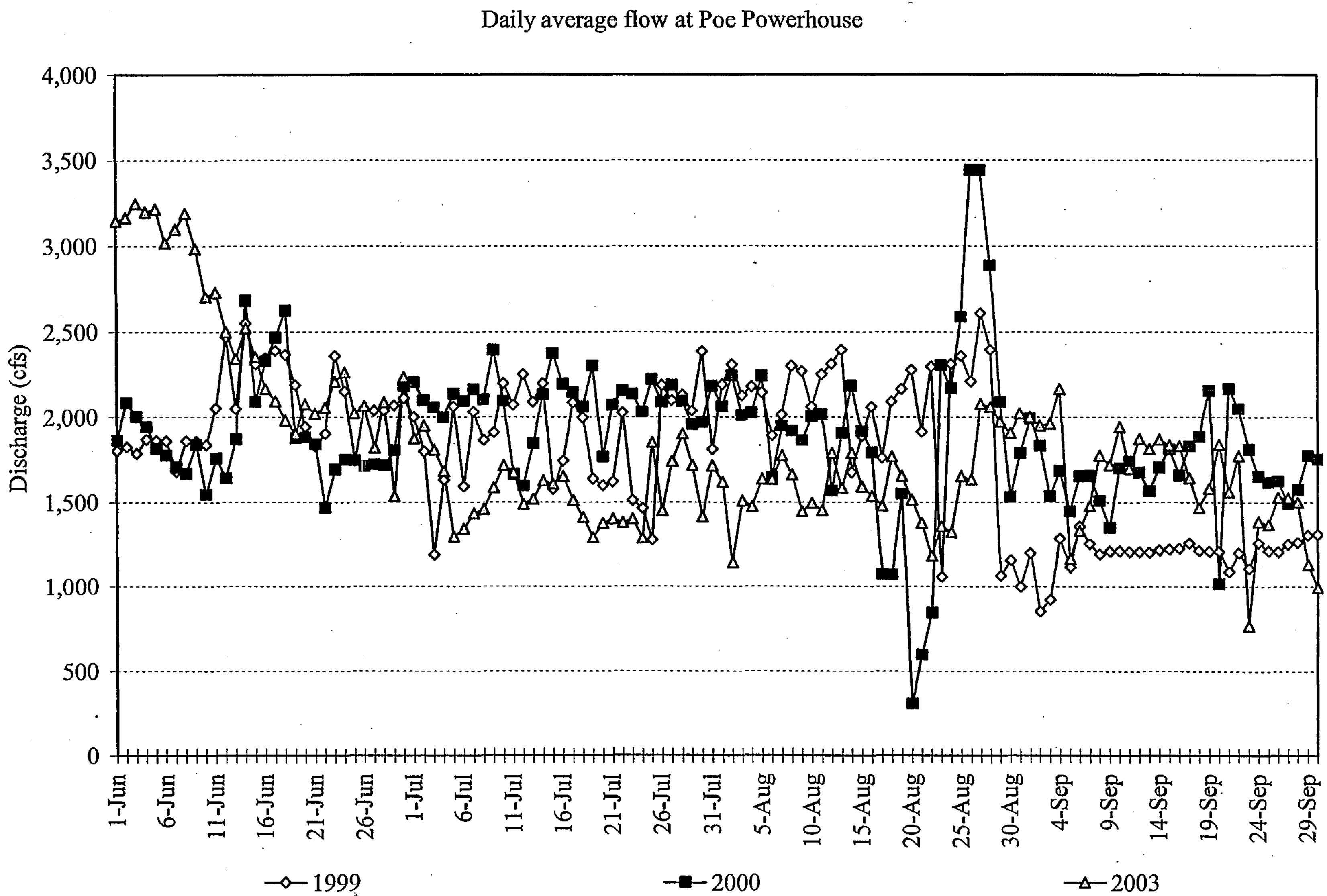



Figure E2.3-6 Comparison of daily average flows at Poe Powerhouse for June-September period in 1999, 2000, and 2003.

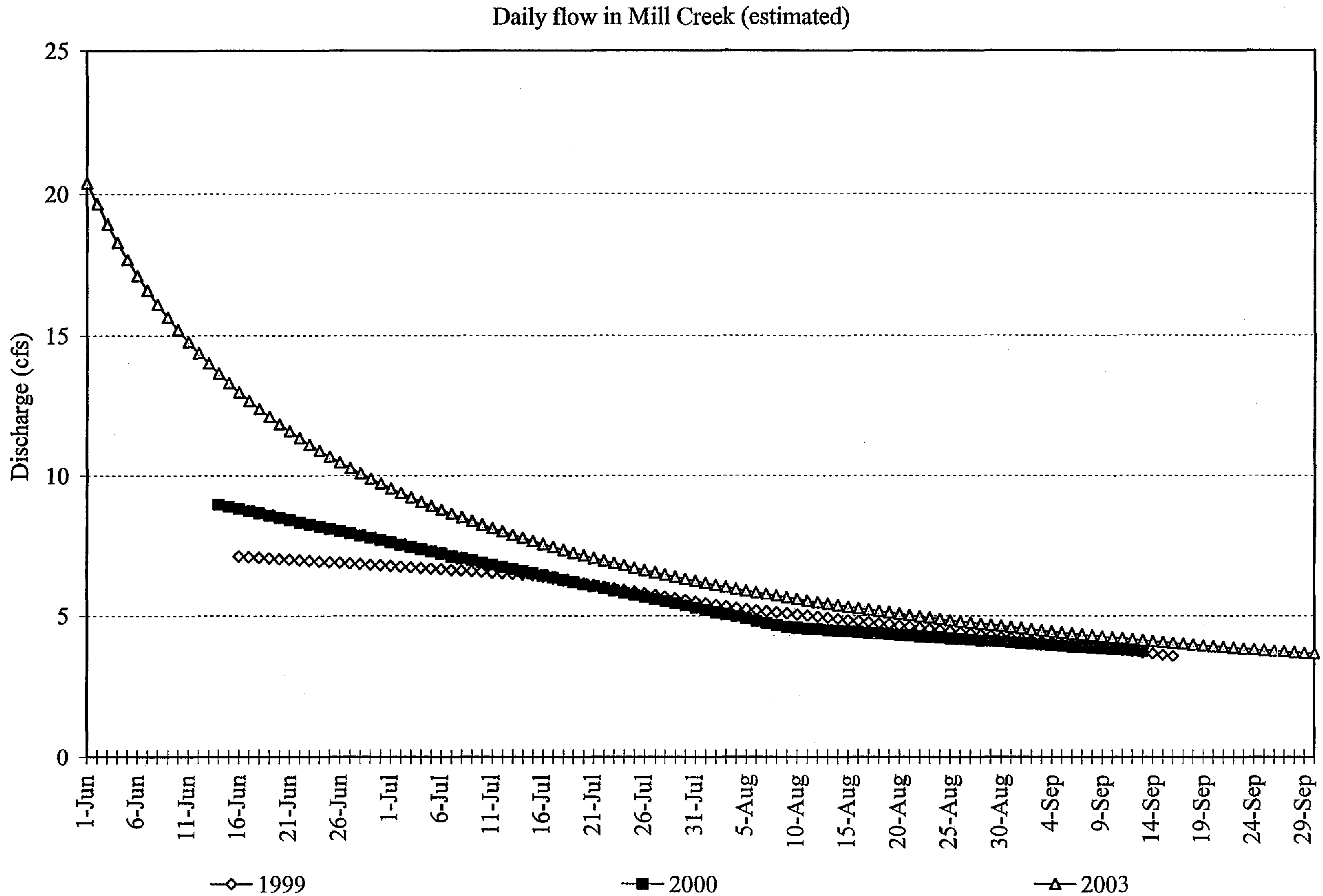



Figure E2.3-7 Comparison of daily average flows in Mill Creek for June-September period 1999, 2000, and 2003.

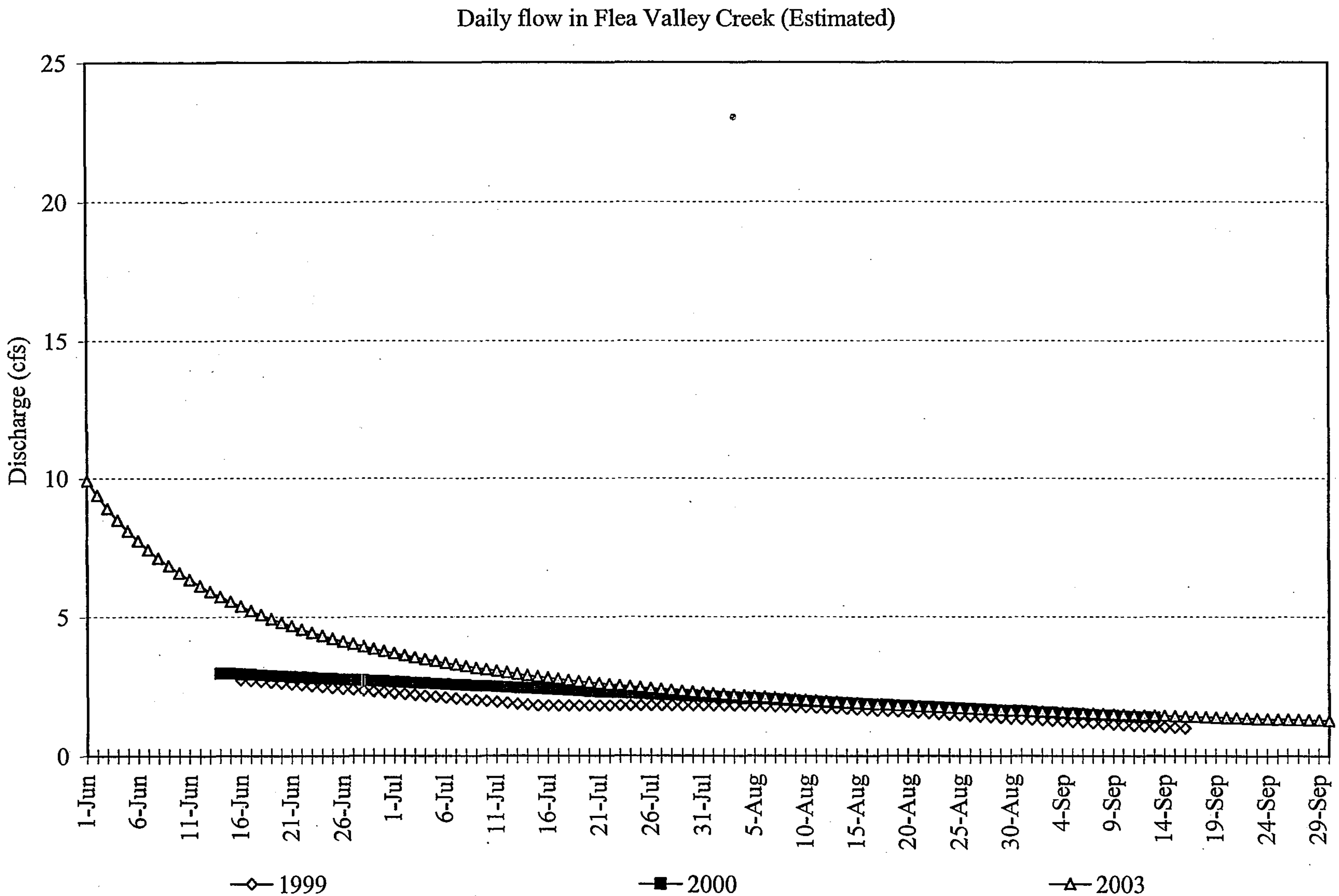



Figure E2.3-8 Comparison of daily average flows in Flea Valley Creek for June-September period in 1999, 2000, and 2003.

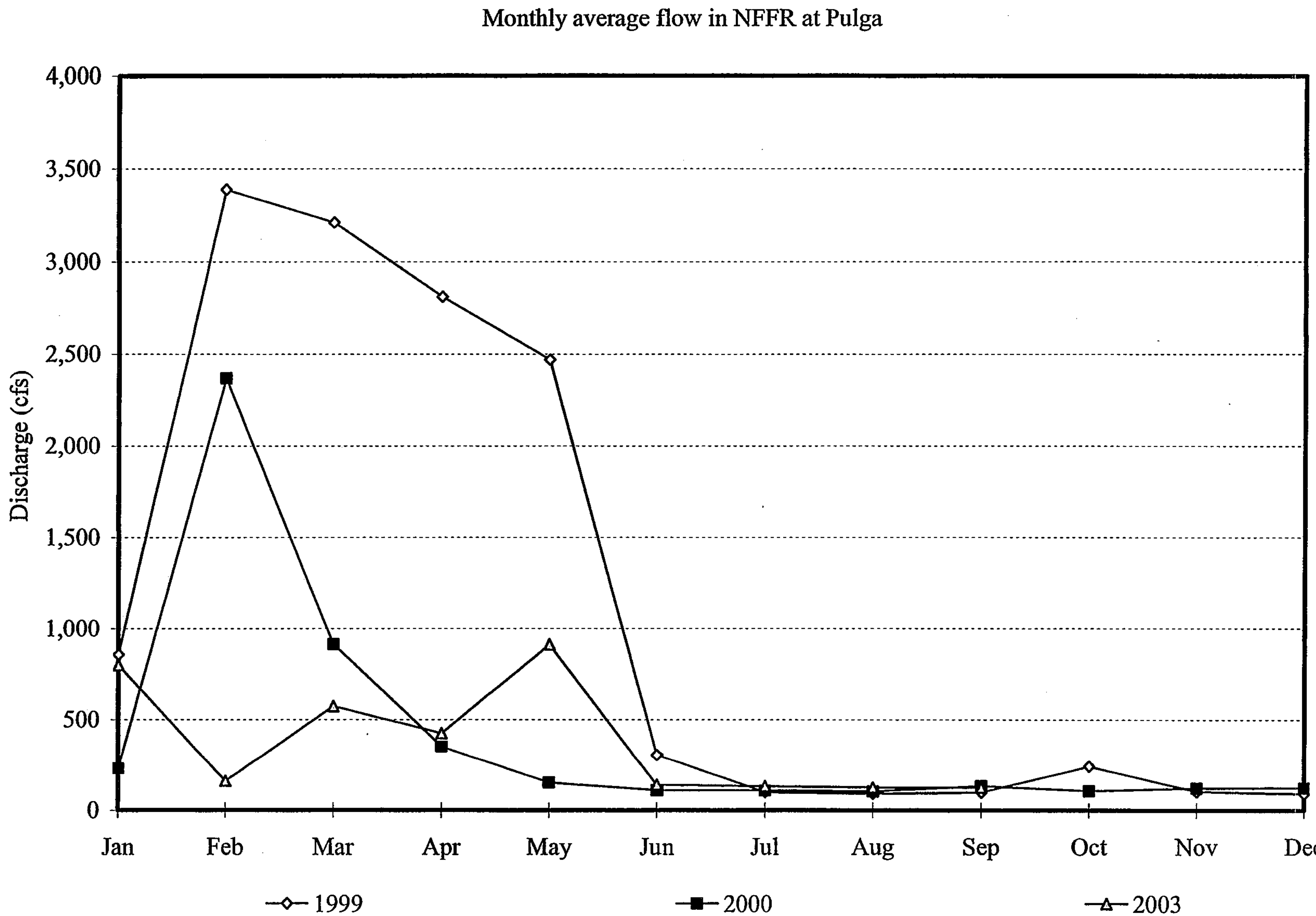



Figure E2.3-9 Comparison of mean monthly streamflows in NFFR at Pulga (Poe Reach) for 1999, 2000, and 2003.

Daily average flow in NFFR at Pulga (Poe Reach)

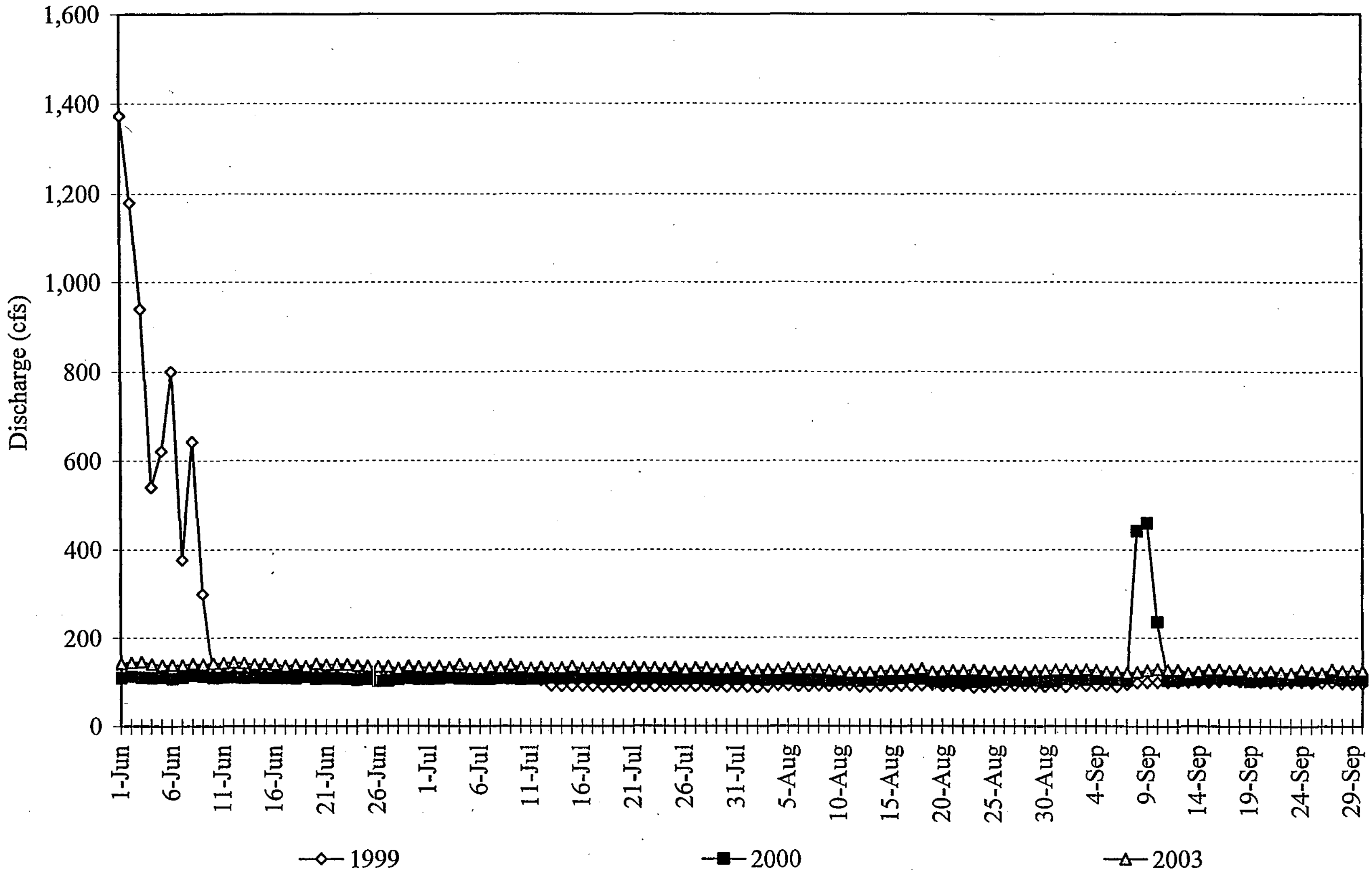



Figure E2.3-10 Comparison of daily average flows in NFFR at Pulga (Poe Reach) for June-September period in 1999, 2000, and 2003.

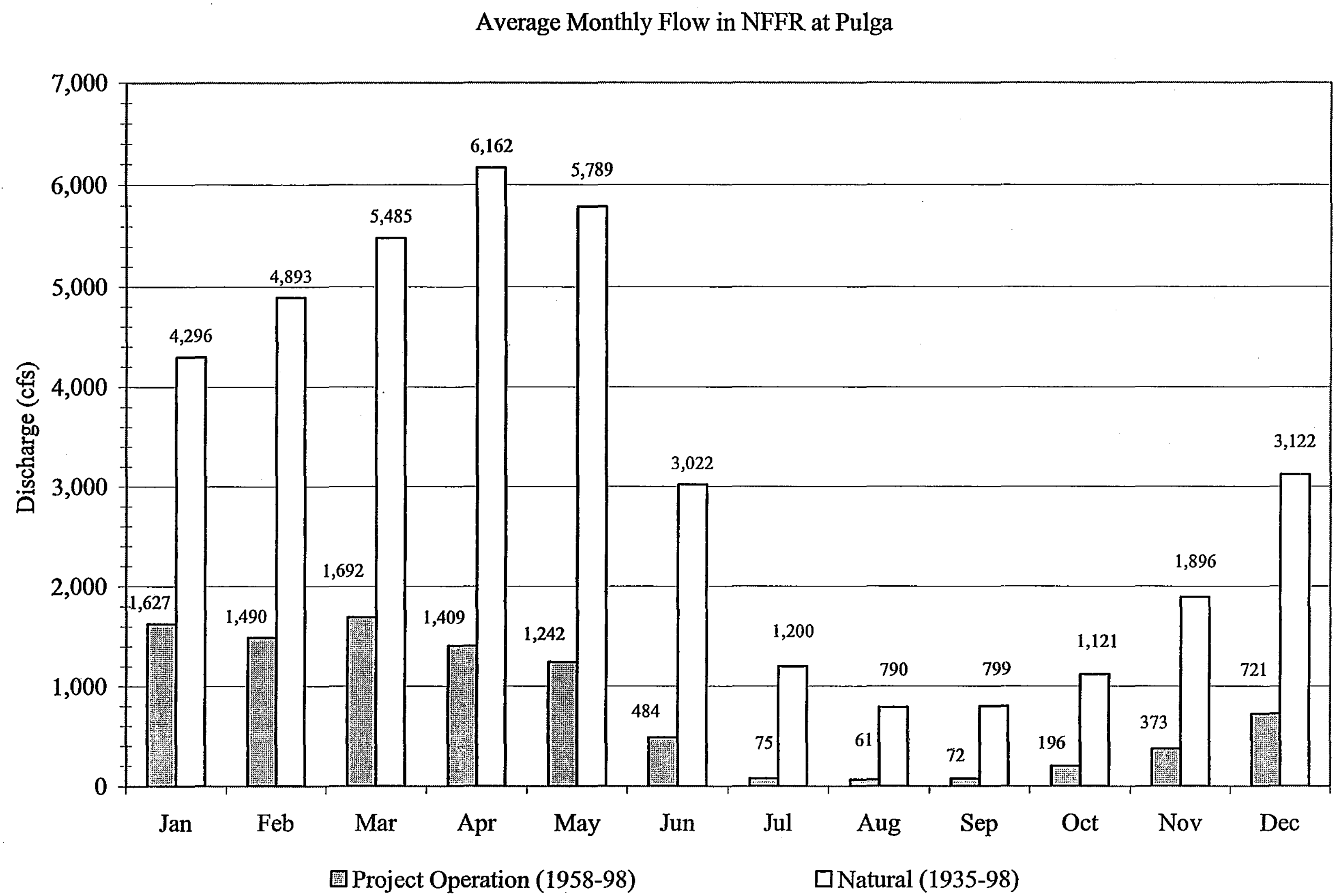



Figure E2.3-11 Comparison of mean monthly flows in the NFFR at Pulga under the natural flow and the Project operation conditions.

[redacted]

## E2.4 HISTORICAL WATER QUALITY

The water resources of the NFFR system are suitable for all beneficial uses identified by the CVRWQCB in its Water Quality Control Plan Report (CVRWQCB 1998). These uses include; municipal and domestic supply and contact and non-contact recreation, power production, cold freshwater habitat, cold water spawning, and wildlife habitat. These waters are suitable for domestic and municipal uses, although bacteriological quality is not satisfactory for untreated consumption. Bacteriological levels are below all standards for contact recreation.

Water quality monitoring programs have been conducted in the NFFR by various agencies for an extended period. Water quality data from USGS water quality station 11404500 in the NFFR near Pulga provide the most comprehensive coverage of conditions in the Project area (USGS 1972, 1977). The most recent water quality data associated with the Project vicinity were derived from relicensing and compliance monitoring efforts related to upstream projects operated by the Licensee. From 1982 to 1985, water quality data were collected as part of the *Rock Creek-Cresta Project Fisheries Management Study* (California Department of Fish and Game [CDF&G] 1988). Water temperatures in the Project area were recorded in 1985 as part of the *Rock Creek-Cresta Project Cold Water Feasibility Study* (Woodward-Clyde 1986a). All of this information was evaluated and summarized in the Licensee's First Stage Consultation Package for the Poe Project (Pacific Gas and Electric Company 1999). A complete presentation and discussion of historical water quality data for the Project vicinity can be found in that document. Table E2.4-1 summarizes the historical water quality data in the NFFR within the Project area and upstream of Poe Reservoir.

## Table E2.4-1

### Summary of historical water quality data in the NFFR in vicinity of Poe Project

| | Station | C-1 [1] | | C-4 [1] | | C-5 [1] | | U/S C-4 [1] | | NFFR at Pulga [2] | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Monitoring Period | Jun-82 | Sep-85 | Jun-82 | Sep-85 | Jun-82 | Sep-85 | Jun-82 | Sep-82 | Oct-71 | Sep-77 |
| **Parameter** | **Units** | *Maximum* | *Minimum* | *Maximum* | *Minimum* | *Maximum* | *Minimum* | *Maximum* | *Minimum* | *Maximum* | *Minimum* |
| Temperature | (°C) | 21.4 | 13.0 | 20.5 | 11.6 | 19.9 | 14.2 | 20.0 | 16.2 | 23.5 | 6.0 |
| Dissolved Oxygen | (mg/l) | 10.2 | 8.5 | 11.2 | 7.2 | 9.1 | 7.5 | 9.0 | 8.1 | 12.0 | 8.2 |
| Conductivity | (µmhos/cm) | 62 | 28 | 63 | 33 | NS [3] | NS | 84 | 39 | 147 | 74 |
| pH | (Units) | 7.5 | 6.9 | 7.9 | 7.1 | 7.5 | 7.2 | 7.6 | 7.3 | 8.3 | 7.7 |
| Hardness | (mg/l) | 43 | 28 | 43 | 27 | 47 | 47 | 39 | 39 | NS | NS |
| Iron | (mg/l) | 0.04 | 0.04 | 0.20 | 0.20 | 0.00 | 0.00 | 0.20 | 0.02 | NS | NS |
| Manganese | (mg/l) | 0.005 | 0.005 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.020 | NS | NS |
| Nitrate | (mg/l) | 0.12 | 0.12 | 0.30 | 0.05 | 0.00 | 0.00 | 0.65 | 0.05 | 38.00 | 0.01 |
| TKN [4] | (mg/l) | 0.00 | 0.00 | 0.12 | 0.12 | 0.00 | 0.00 | 0.16 | 0.05 | NS | NS |
| Alkalinity | (mg/l) | 122 | 119 | 122 | 119 | 0 | 0 | 170 | 170 | 74 | 38 |
| Total Phosphorus | (mg/l) | 0.02 | 0.02 | 0.14 | 0.01 | 0.00 | 0.00 | 0.12 | 0.05 | NS | NS |
| Calcium | (mg/l) | NS | NS | NS | NS | NS | NS | NS | NS | 15.0 | 6.8 |
| Magnesium | (mg/l) | NS | NS | NS | NS | NS | NS | NS | NS | 7.1 | 4.1 |
| Turbidity | (JTU) | NS | NS | NS | NS | NS | NS | NS | NS | 8 | 1 |
| Flow | (cfs) | NS | NS | NS | NS | NS | NS | NS | NS | 293 | 12 |
| Sodium | (mg/l) | NS | NS | NS | NS | NS | NS | NS | NS | 5.6 | 2.1 |
| Potassium | (mg/l) | NS | NS | NS | NS | NS | NS | NS | NS | 1.7 | 0.7 |
| Bicarbonate | (mg/l) | NS | NS | NS | NS | NS | NS | NS | NS | 90 | 46 |
| Sulfate | (mg/l) | NS | NS | NS | NS | NS | NS | NS | NS | 3.2 | 1.8 |
| Chloride | (mg/l) | NS | NS | NS | NS | NS | NS | NS | NS | 1.7 | 0.4 |
| Silica | (mg/l) | NS | NS | NS | NS | NS | NS | NS | NS | 16.0 | 9.3 |
| TDS [5] | (mg/l) | NS | NS | NS | NS | NS | NS | NS | NS | 82 | 61 |

1. CDFG 1988

   Station Key: C-1 = NFFR 1 mile upstream Cresta Powerhouse; C-4 = NFFR 4 miles upstream Cresta Powerhouse; C-5 = NFFR 5 miles upstream Cresta Powerhouse; U/S C-4 = NFFR upstream of the confluence with Grizzly Cr.

2. USGS 1972, 1977
3. NS = Not sampled.
4. TKN = Total Kjeldahl nitrogen
5. TDS = Total dissolved solids

# E2.5 EXISTING WATER QUALITY

## E2.5.1 Resource Monitoring Programs

As part of the Poe Project relicensing effort, the Licensee conducted two resource monitoring programs. The first monitoring program was conducted March 1999 through September 2000. The second monitoring program was conducted from March 2003 through November 2003.

### E2.5.1.1 Design of the 1999-2000 Monitoring Program

The Licensee conducted a water quality monitoring program in the Project area from March 1999 through September 2000 to supplement available historical data. The objective of the monitoring program was to define water quality conditions in the Project area under existing operational, hydrologic, and meteorological conditions, and determine the effect of various flow releases on NFFR temperatures.

The monitoring program consisted of the following elements, which are described in detail below: water quality monitoring, water temperature monitoring and modeling, streamflow monitoring, meteorological monitoring, and four special investigations.

[redacted]

#### E2.5.1.1.1 Water Quality Monitoring

A total of 12 stations were sampled for *in situ* water quality parameters during the 1999-2000 monitoring period. Table E2.5-1 lists the various stations, their location, and rationale for selection. Table E2.5-2 lists monitoring activities and sampling periods conducted during each monitoring year. Figure E2.5-1 is a schematic diagram of the selected monitoring locations. The water quality stations represented both background and affected conditions within the Project area. The various water samples were collected as grab samples from an accessible location at each site. Samples were typically collected over the course of two days during each sampling period. The *in situ* parameters (temperature, pH, dissolved oxygen [DO], turbidity, and electrical conductivity) were determined using appropriate water quality sensors or chemical methods.

**Table E2.5-1**

**Summary of Poe Project water quality monitoring station descriptions and locations**

| Station ID | Location | Monitoring Year | Rational |
|---|---|---|---|
| Poe-1A | NFFR at Poe Reservoir entrance | 1999, 2000, 2003 | Defines quality of water entering Project area. |
| Poe-1B | Cresta Powerhouse tailrace | 1999, 2000, 2003 | Defines quality of water entering through Powerhouse. |
| Poe-1C | NFFR above Cresta Powerhouse | 1999, 2000, 2003 | Defines quality of water entering through bypass reach. |
| Poe-2A | NFFR at NF-23 gage station | 1999, 2000, 2003 | Historical water quality station. Defines water quality downstream of major tributaries. |
| Poe-2B | ~1 mile downstream of NF-23 gage at Pluga | 1999 and 2000 | Defines conditions at the end of the high gradient transition section |
| Poe-3 | NFFR above Poe Powerhouse | 1999, 2000, 2003 | Defines water quality at end of Poe Reach. |
| Poe-4A | Poe Reservoir at dam near intake | 1999, 2000, 2003 | Defines water quality in Poe Reservoir. |
| Poe-4B | Poe Powerhouse tailrace | 1999, 2000, 2003 | Defines water quality at Poe Powerhouse, entering Lake Oroville. |
| Poe-5 | NFFR below Poe Dam | 1999, 2000, 2003 | Defines water quality at starting point of Poe Reach. |
| Poe-6 | NFFR near Bardees Bar | 1999, 2000, 2003 | Defines water quality at mid-point of Poe Reach. |
| Poe-7 | NFFR upstream of Big Bend Dam | 2003 | Defines water quality as it leaves Project area. |
| Mill Creek | Mill Creek near mouth | 1999, 2000, 2003 | Defines water quality in major tributary. |
| Flea Valley Creek | Flea Valley near mouth | 1999, 2000, 2003 | Defines water quality in major tributary. |

**Table E2.5-2**

**Summary of water quality monitoring activities conducted in 1999, 2000, and 2003.**

| Constituent or Parameter | Determined | Method | 1999 Monitoring Activities: No. of Stations | 1999 Monitoring Activities: Monitoring Period |
|---|---|---|---|---|
| Water temperature | Continuous | Digital recorder | 11 Stations | June through September |
| Stream flow | Periodic | Measurement | 3 Stations | June through September |
| Meteorology | Continuous | Digital recorder | Poe Powerhouse | June through September |
| | | | | |
| Water temperature | *In situ* | Digital probe | 11 Stations | March, June, July, Aug, Sept, Dec. |
| Dissolved oxygen | *In situ* | Digital probe | 11 Stations | March, June, July, Aug, Sept, Dec. |
| Specific conductivity | *In situ* | Digital probe | 11 Stations | March, June, July, Aug, Sept, Dec. |
| pH | *In situ* | Digital probe | 11 Stations | March, June, July, Aug, Sept, Dec. |
| Turbidity | *In situ* | Digital probe | 11 Stations | March, June, July, Aug, Sept, Dec. |
| | | | | |
| Trace Metals | Certified Lab. | Grab sample | 3 Stations | March, June, July, Aug, Sept, Dec. |
| General Mineral | Certified Lab. | Grab sample | 3 Stations | March, June, July, Aug, Sept, Dec. |
| General Physical | Certified Lab. | Grab sample | 3 Stations | March, June, July, Aug, Sept, Dec. |
| Nutrients | Certified Lab. | Grab sample | 3 Stations | March, June, July, Aug, Sept, Dec. |
| Coliform bacteria | Certified Lab. | Grab sample | 3 Stations | March, June, July, Aug, Sept, Dec. |
| Coliform bacteria (5/30) | Certified Lab. | Grab sample | --- | --- |
| PCB's aqueous | Certified Lab. | Grab sample | 1 Station (Poe-3) | March, June, July, Aug, Sept, Dec. |

| Constituent or Parameter | Determined | Method | 2000 Monitoring Activities: No. of Stations | 2000 Monitoring Activities: Monitoring Period |
|---|---|---|---|---|
| Water temperature | Continuous | Digital recorder | 11 Stations | June through September |
| Stream flow | Periodic | Measurement | 3 Stations | June through September |
| Meteorology | Continuous | Digital recorder | Poe Powerhouse | June through September |
| | | | | |
| Water temperature | *In situ* | Digital probe | 11 Stations | March, June through September |
| Dissolved oxygen | *In situ* | Digital probe | 11 Stations | March, June through September |
| Specific conductivity | *In situ* | Digital probe | 11 Stations | March, June through September |
| pH | *In situ* | Digital probe | 11 Stations | March, June through September |
| Turbidity | *In situ* | Digital probe | 11 Stations | March, June through September |
| | | | | |
| Trace Metals | Certified Lab. | Grab sample | 3 Stations | March |
| General Mineral | Certified Lab. | Grab sample | 3 Stations | March |
| General Physical | Certified Lab. | Grab sample | 3 Stations | March |
| Nutrients | Certified Lab. | Grab sample | 3 Stations | March |
| Coliform bacteria | Certified Lab. | Grab sample | 3 Stations | March |
| Coliform bacteria | Certified Lab. | Grab sample | 5 Stations | June through September |
| Coliform bacteria (5/30) | Certified Lab. | Grab sample | 1 Station (Poe-3) | May 21 to June 15 |
| PCB's aqueous | Certified Lab. | Grab sample | 1 Station (Poe-3) | --- |

**Table E2.5-2**
**(Continued)**

| Constituent or Parameter | Determined | Method | 2003 Monitoring Activities | |
|---|---|---|---|---|
| | | | **No. of Stations** | **Monitoring Period** |
| Water temperature | Continuous | Digital recorder | 11 Stations | June through September |
| Stream flow | Periodic | Measurement | 2 Stations | June through September |
| Meteorology | Continuous | Digital recorder | Poe Powerhouse | June through September |
| | | | | |
| Water temperature | *In situ* | Digital probe | 11 Stations | March, May, July, October |
| Dissolved oxygen | *In situ* | Digital probe | 11 Stations | March, May, July, October |
| Specific conductivity | *In situ* | Digital probe | 11 Stations | March, May, July, October |
| pH | *In situ* | Digital probe | 11 Stations | March, May, July, October |
| Turbidity | *In situ* | Digital probe | 11 Stations | March, May, July, October |
| | | | | |
| Trace Metals | Certified Lab. | Grab sample | 7 Stations | March, May, July, October |
| General Mineral | Certified Lab. | Grab sample | 7 Stations | March, May, July, October |
| General Physical | Certified Lab. | Grab sample | 7 Stations | March, May, July, October |
| Nutrients | Certified Lab. | Grab sample | 7 Stations | March, May, July, October |
| Coliform bacteria (5/30) | Certified Lab. | Grab sample | 1 Station (Poe-6) | July 1 to July 31 |

Calibration of the *in situ* instrumentation was conducted in accordance with manufacturer's specifications. Accuracy verification was performed by comparing instrument output to appropriate reference standards. Temperature and conductivity were measured *in situ* using a standard electrometric probe. Dissolved oxygen samples were collected and fixed in the field as Winkler samples for later analysis in the field laboratory (American Public Health Association [APHA] 1995). Turbidity and pH samples were collected in the field for later analysis in the field laboratory. Turbidity and pH were analyzed the same day as they were collected (within 6 to 8 hours). The pH samples were allowed to come to room temperature before being measured. This method of "air equilibration" removes the variability in measurement caused by differences in water temperature and solute concentration between stations and the subsequent changes that these differences cause in the response of the sensor probe.

Three river stations were sampled for analytical constituents during the 1999-2000 monitoring period. Table E2.5-3 presents a list of the analytical constituents and *in situ* parameters determined at each station during both the 1999-2000 and 2003 studies. Different analytical methods and method detection limits were used in the 2003 study compared to the 1999-2000 study in order to better meet the regulatory criteria which were updated after the completion of the 1999-2000 study. Lower detection limits and ultra-clean technology were required for the analysis of dissolved metals samples in 2003 for accurate comparison to the regulatory criteria.

## Table E2.5-3

**Summary of water quality parameters, laboratory methods, detection limits (1999-2000)**

| Constituent | Method | Method Detection Limit |
|---|---|---|
| Arsenic | 7470A - 6010B | 0.0032 mg/L |
| Barium | 7470A - 6010B | 0.00039 mg/L |
| Cadmium | 7470A - 6010B | 0.00036 mg/L |
| Chromium | 7470A - 6010B | 0.00047 mg/L |
| Copper | 7470A - 6010B | 0.00040 mg/L |
| Iron | 7470A - 6010B | 0.0028 mg/L |
| Lead | 7470A - 6010B | 0.0013 mg/L |
| Manganese | 7470A - 6010B | 0.00046 mg/L |
| Mercury | 7470A - 6010B | 0.0002 mg/L |
| Nickel | 7470A - 6010B | 0.00046 mg/L |
| Selenium | 7470A - 6010B | 0.0042 mg/L |
| Silver | 7470A - 6010B | 0.00036 mg/L |
| Zinc | 7470A - 6010B | 0.0013 mg/L |
| Total coliform | SM 18th ed., 9221BC | 2 MPN/100mL |
| Fecal coliform | SM 18th ed., 9221CE | 2 MPN/100mL |
| Calcium | 7470A - 6010B | 0.0082 mg/L |
| Magnesium | 7470A - 6010B | 0.0023 mg/L |
| Manganese | 7470A - 6010B | 0.00046 mg/L |
| Sodium | 7470A - 6010B | 0.1 mg/L |
| Potassium | 7470A - 6010B | 0.1 mg/L |
| TDS | 160.1 | 10 mg/L |
| TSS | 160.2 | 1 mg/L |
| Bicarbonate | 2320B | 10 mg/L |
| Carbonate | 2320B | 10 mg/L |
| Total Alkalinity | 1210B | 10 mg/L |
| Ammonia | 350.2 | 0.1 mg/L |
| Boron | 200.7 | 0.1 mg/L |
| Chloride | 300.0 | 0.2 mg/L |
| Hardness | 200.7 | 1 mg/L |
| Surfactant (MBAS) | 425.1 | 0.05 mg/L |
| Nitrate ($NO_3$) | 300.0 | 0.1 mg/L |
| Ortho Phosphate (P) | 365.2 | 0.01 mg/L |
| Total Phosphorus | 365.2 | 0.01 mg/L |
| Sulfate | 300.0 | 0.2 mg/L |
| Silica | 200.7 | 2 mg/L |
| Total Kjeldahl Nitrogen | 351.3 | 0.2 mg/L |
| Total Organic Nitrogen | 300.0/351.3 | 0.2 mg/L |

## Table E2.5-3 (Continued)
## Summary of water quality parameters, laboratory methods, detection limits (2003)

| Analytical Constituent | Method | Method Detection Limit |
|---|---|---|
| | **General mineral** | |
| Calcium | USEPA 1638 Modified | 0.07 mg/L |
| Sodium | USEPA 1638 Modified | 0.02 mg/L |
| Potassium | USEPA 1638 Modified | 0.03 mg/L |
| Magnesium | USEPA 1638 Modified | 0.001 mg/L |
| Sulfate | EPA 300 | 0.4 mg/L |
| Chloride | EPA 300 | 0.2 mg/L |
| Alkalinity | QC10303311A | 1.6 mg/L |
| Total Dissolved Solids | SM 2540 | 10 mg/L |
| Hardness | USEPA 130.2 | 1.0 mg/L |
| | **Trace metals** | |
| ***Total Metals*** | | |
| Aluminum | SM 3113B | 0.009 mg/L |
| Arsenic | USEPA 1638 Modified | 0.0001 mg/L |
| Barium | USEPA 1638 Modified | 0.0002 mg/L |
| Cadmium | USEPA 1638 Modified | 0.00002 mg/L |
| Chromium | 6010B/7470A | 0.0002 mg/L |
| Copper | USEPA 1638 Modified | 0.000003 mg/L |
| Iron | EPA 236.2 | 0.0012 mg/L |
| Lead | USEPA 1638 Modified | 0.000002 mg/L |
| Manganese | USEPA 1638 Modified | 0.00001 mg/L |
| Mercury | USEPA 1631E | 2.0E-7 mg/L |
| Nickel | USEPA 1638 Modified | 0.000006 mg/L |
| Selenium | USEPA 1638 Modified | 0.0001 mg/L |
| Silver | USEPA 1638 Modified | 0.000008 mg/L |
| Zinc | USEPA 1638 Modified | 0.00002 mg/L |
| ***Dissolved Metals*** | | |
| Arsenic | USEPA 1638 Modified | 0.0001 mg/L |
| Cadmium | USEPA 1638 Modified | 0.00002 mg/L |
| Chromium (measured as Total) | 6010B/7470A | 0.0002 mg/L |
| Copper | USEPA 1638 Modified | 0.000003 mg/L |
| Iron | 6010B/7470A | 0.0012 mg/L |
| Lead | USEPA 1638 Modified | 0.000002 mg/L |
| Mercury | USEPA 1631E | 2.0E-7 mg/L |
| Nickel | USEPA 1638 Modified | 0.000006 mg/L |
| Silver | USEPA 1638 Modified | 0.000008 mg/L |
| Zinc | USEPA 1638 Modified | 0.00002 mg/L |
| | **Nutrients** | |
| Nitrate (Nitrate + Nitrite) | QC10107041B | 0.005 mg as N/L |
| Ammonia | EPA 350.3 | 0.05 mg as N/L |
| Total phosphorus | QC10115011D | 0.03 mg/L |
| Ortho-phosphate | QC10115011M | 0.005 mg as P/L |
| Chlorophyll - *a* | 10200H | 0.000045 mg/L |
| Total suspended solid (TSS) | SM2540C | 1.0 mg/L |
| | ***In situ* Parameter** | |
| Synoptic temperature | *In situ* measurement | 0.1°C |
| Continuous temperature | Digital thermograph | 0.1°C |
| Dissolved oxygen | *In situ* measurement | 0.1 mg/L |
| pH | *In situ* measurement | 0.1 |
| Electrical conductivity | *In situ* measurement | 1 µmhos/cm |
| Turbidity | *In situ* measurement | 0.2 NTU |

QC = Lachat Quikchem Flow Injection Analyzer Method; USEPA = U.S. Environmental Protection Service

In 1999, samples were collected in March, monthly June through September, and December. Samples were only collected in March 2000 for the full suite of analytical constituents. After consultation with the State Water Resources Control Board (SWRCB), the Licensee modified the monitoring program to continue sampling only for coliform during the remainder of the 2000 program. Coliform samples were collected from five stations during the June-September 2000 period (Table E2.5-2).

All samples were collected as grab samples from an accessible location at each site. Analytical samples were collected on the same day, within a four-hour time frame. All sample collection, preservation, and analyses were conducted in accordance with established protocols and methodology (APHA 1995). All samples that were sent to the state-certified analytical laboratory under contract with the Licensee were preserved, cooled, and shipped for over-night delivery.

Samples for trace metals analysis were collected and preserved as unfiltered samples during 1999-2000. As a result, trace metals concentrations reported for 1999-2000 in this document represent total values and are therefore a more conservative estimate of concentrations within the Poe Project. The regulatory criteria referenced later in this document have been updated for the 1999-2000 dataset to reflect the recently derived criteria for total concentrations (for both the California Toxics Rule and USEPA). However, it should be noted that the detection limits specified for 1999-2000 which were adequate for that time period, may not be adequate for comparison to the updated criteria referenced later in this document. Samples for trace metals analyses during 2003 were collected for both total and dissolved analyses as discussed in Section E2.5.1.2.1.

The trace metal concentrations in Project waters during 1999-2000 and periodically during 2003 were often less than the standard laboratory reporting limits. Consequently, using standard reporting limits did not allow for useful interpretation of data. As a result, the analytical laboratory was requested to use analytical methods that would achieve the best reporting limits (RL), and also report concentrations to the method detection limit (MDL). The RL is not rigorously defined but is generally considered as the minimum concentration of a constituent that, under normal operating conditions, can be reported with relatively good certainty (plus or minus 15 to 20% error) that the result is valid (APHA 1995). The MDL, however, is rigorously defined (40 CFR 136) and represents the minimum concentration that can be reported with 95% confidence as different from zero. The analytical laboratory sets the RL to approximately three to five times the MDL. Concentrations of the analytes that are less than the RL but greater than the MDL are flagged as either 'J' values (during 1999-2000) that represent estimated concentrations or as 'DNQ' values (during 2003) that represent detection of the analytes without quantification due to the low concentration (DNQ values were for metals samples analyzed by ultra-clean methodology). Concentrations reported at the MDL can be subject to considerable variability (approximately 60% error). Table E2.5-3 presents the laboratory method reference and method detection limits during both the 1999-2000 and 2003 studies.

#### E2.5.1.1.2 Poe Reservoir Water Quality Profiles

During the period June-September 1999, vertical profiles were collected from Poe Reservoir near the dam to determine the magnitude and seasonal development of thermal gradients. Profiles were defined using 5-ft vertical spacing from surface to bottom. Sampling consisted of profiling at one station near the dam for *in situ* parameters only. Temperature, conductivity, turbidity, and pH were measured using electrometric probes. Dissolved oxygen was measured using a depth-segregating sampler and chemical titration (Modified Winkler). In general, the same quality control, measurement methods, and instrument calibration techniques described for instream grab samples were used for the reservoir profiles as well. All sample collection, preservation, and analyses were conducted in accordance with established protocols and methodology (APHA 1995).

#### E2.5.1.1.3 Temperature Monitoring

Stream temperatures were monitored continuously using digital thermographs placed *in situ* at 11 locations (Table E2.5-1). Stream temperature sensors were deployed in well-mixed areas with elevated velocity and turbulent flow to ensure representative measurements.

Continuous temperature data were recorded as hourly averages based on readings taken at 5-minute intervals. Temperatures were recorded using Omnidata Model DP112 recorders. The hourly-average data were reduced to daily minimum, maximum, and mean values. To verify the operation and accuracy of the temperature recorders, the units

Temp Monitoring / modeling
protocol 1999-2000

were calibrated using an American Society for Testing and Materials (ASTM) reference thermometer, both prior to and following removal from the *in situ* deployment. The typical instrument error is between 0.1 and 0.2°C.

In 1999, continuous monitoring of temperature was conducted from June through September (Table E2.5-2). In 2000, temperature monitoring was conducted from May through September at Poe-5, Poe-2A, and Poe-3 stations, and from June through September at the remainder of the stations.

**E2.5.1.1.4 Temperature Modeling**

The objective of the temperature modeling study was to validate previous modeling efforts and simulate the response of the Poe Reach to a range of increased release flows. As part of the *Rock Creek-Cresta Project Cold Water Feasibility Study* (Woodward-Clyde 1986a), the stream network water temperature model (SNTEMP) was used to predict the daily average water temperature for the Poe Reach. This model, developed by the Instream Flow and Aquatic Systems Group of the U.S. Fish and Wildlife Service (Theurer, Voos, and Miller 1984), computes heat fluxes among all significant heat sources and accounts for the shade effect from topography and riparian vegetation. It routes water through the stream channel taking into consideration stream geometry and travel time, and predicts the longitudinal, cross-sectionally averaged temperatures at specified time increments at any point along the stream course. This model is a public domain product and has a proven record in past applications.

The initial application of the SNTEMP model to this reach of the NFFR was calibrated and validated using data collected in 1985 (Woodward-Clyde 1986a). This original version of the model was referred to as the WCC-SNTEMP model. The average bias of the WCC-SNTEMP model was –0.1°C, and the probable error (on the 50% confidence level) was ± 0.5°C. Additional model validation efforts were completed by the Licensee with data obtained in 1999 and 2000, and a newly recalibrated model was produced. This involved providing input data for hydrology, meteorology, and stream geometry including shading parameters. Flow data in the Poe Reach were available from the USGS gauging station at Pulga (USGS 11404500), while flows from major tributaries (Mill Creek and Flea Valley Creek) were independently monitored during the study period. Meteorological data were monitored with a weather station installed at Poe Powerhouse. The stream geometry was field surveyed. Finally, temperatures in the NFFR immediately below Poe Dam, which are needed as starting temperatures to the model, were measured continuously. It is noteworthy that a 2-day interval was used to predict average water temperatures in the Poe Reach due to the long travel time measured in the reach at a flow release of 50 cfs.

**E2.5.1.1.5 Streamflow Monitoring**

Streamflow was measured at three stations in the Project area (the NFFR above Poe Powerhouse, Mill Creek, and Flea Valley Creek). This monitoring was done independently of the Licensee's operation of the official USGS flow monitoring station located on the NFFR at Pulga. The objective of the supplemental river and tributary flow monitoring effort was to define accretion flows occurring in various subsections of the

Poe Reach. The results of the flow monitoring were previously discussed in Section E2.3.

Each of the supplemental flow monitoring stations consisted of a stage pin placed in-stream. During routine site visits, stream stage was recorded and flow measurements were made to define the stage-flow relationship. Streamflow measurements were made at transects located near each station using USGS approved streamflow measurement techniques (Buchanan, et al. 1980). All measurements were made using a Price AA-type flow meter, and 5-foot top-setting wading rod. The measurements made in the river transects had an accuracy of 10 to 15% due to the large substrate and large amount of vegetation in the channel control. Measurements made in the tributary streams had an error range estimated at 8 to 10%. The primary objective of the routine flow measurements was to cover the range of observed flows and develop a flow rating equation. Streamflow monitoring in 1999 and 2000 was performed during the period June-September.

#### E2.5.1.1.6 Meteorological Monitoring

Local meteorology was monitored at Poe Powerhouse from June through September in 1999 and 2000. This location represents conditions in the middle and lower portion of the Project area. Hourly average wind speed and direction, air temperature, relative humidity, and solar radiation were measured at this station. The primary purpose of the meteorological monitoring effort was to provide input to the stream temperature model to improve analysis of the water quality dynamics.

#### E2.5.1.1.7 Special Investigations

The Licensee conducted six special investigations to refine understanding of the water quality dynamics in the Project area. These investigations were primarily the result of requests made during consultation with the SWRCB in 1999-2000.

**Diel Oxygen Cycle**

The first of these investigations was to determine the magnitude of diel dissolved oxygen cycling in the Poe Reach. Diel monitoring was conducted at a station in the lower portion of the Poe Reach in August 1999. Monitoring was performed using a digital oxygen meter with data logging capabilities. The meter was calibrated using Winkler samples collected at the beginning and end of each test. The test was conducted over a period of two days to capture a full diel period. Figure E2.5-2 identifies the location of the dissolved oxygen cycle monitoring location.

**Spoil Pile Investigations**

The second investigation involved the determination of trace metal concentrations in runoff from spoil piles associated with the Project. During meetings with the SWRCB in the first quarter of 2000, the Licensee was asked to sample runoff from the two spoil piles containing rock material associated with the construction of the Poe Powerhouse diversion tunnel. The sampling was requested to verify whether the spoil piles were leaching excessive levels of trace metals into the lower NFFR system. It was initially requested that the Licensee sample the spoil pile associated with the Adit No. 1 near Bardees Bar. This site was selected primarily because it is located immediately adjacent to the NFFR. However, access and safety issues prevented this site from being sampled during periods of adequate runoff. The second spoil pile, associated with Adit No. 2, was located approximately 1 mile upstream of Poe Powerhouse, and adjacent to the railroad grade that is about 200 vertical feet above the NFFR. A leakage bypass conduit from the Poe diversion tunnel passes under the spoil pile and railroad grade and discharges to an open channel that flows downhill to the NFFR.

On April 14, 2000, the drainage culvert of the second spoil pile and three stations in the NFFR were sampled for various trace metals and selected *in situ* parameters. Figure E2.5-2 identifies the location of the spoil pile sampling stations. Samples were collected following a period of moderate rainfall (on 4/13/00 rainfall equaled 0.87 inches, and on 4/14/00 rainfall equaled 0.05 inches at the Paradise Fire Station). Samples were collected from the tunnel culvert as it discharged to the open ditch above the NFFR (Poe S-1), the NFFR upstream of the pool that received the discharge (Poe S-2), the NFFR immediately downstream of the same pool (Poe S-3), and the NFFR upstream of Poe Powerhouse (Poe S-4). Samples for trace metals analyses were collected as unfiltered samples and placed in plastic containers containing nitric acid preservative. These samples were placed in an ice chest and maintained at near 4°C for shipment to the Certified Analytical Laboratory under Chain of Custody. *In situ* parameters were measured on-site using calibrated field probes.

On March 5, 2001, following a period of heavy rainfall (2.29 inches for the period 3/2 – 3/5/2001 at the Paradise Fire Station), water quality constituents associated with the runoff from the No. 2 spoil pile were re-surveyed. Samples were collected from the following locations, the tunnel culvert as it discharged to the open ditch above the NFFR (Poe S-1A), surface runoff at the toe of the spoil pile before it entered the culvert (Poe S-1B), the NFFR upstream of the pool that received the discharge (Poe S-2), the NFFR immediately downstream of the same pool (Poe S-3), the NFFR upstream of Poe Powerhouse (Poe S-4), and the tailrace of Poe Powerhouse (Poe S-5). The same sampling protocol and trace metals analyses were followed as for the April 2000 effort.

Following completion of the first spoil pile monitoring effort, the SWRCB requested that the Licensee conduct more comprehensive evaluation on both spoil piles. The Licensee conducted this evaluation in 2002 following consultation with the SWRCB and CVRWQCB. A complete presentation of the 2002 spoil pile monitoring effort is presented in Appendix E2-1.

The primary purpose of the 2002 Poe Project Spoil Pile evaluation was to determine the hazardous waste status of the two spoil piles located within the Poe Project. In addition, the leachate quality of the spoil material was determined and the effect of runoff from the spoil sites on the water quality of the NFFR was evaluated. Monitoring was divided into soil and water sampling phases. Phase I consisted of characterizing the spoil material contained in the spoil piles located adjacent to Adit No. 1 and Adit No. 2. The spoil material was evaluated for 17 (CAM-17) trace metals using the Total Threshold Limit Concentration (TTLC) and Soluble Threshold Limit Concentration (STLC) methodologies. Phase II involved the evaluating the effect of spoil pile runoff on the

NFFR in the immediate vicinity of the two spoil piles. Two surface water-sampling efforts were conducted as part of the Phase II investigation. The first sampling effort was conducted during dry conditions (base flow, low runoff) and another effort was conducted during wet conditions (elevated flows, higher runoff). The Phase II sampling results were used to characterize trace metal concentrations, as well as selected general chemistry constituents and *in situ* parameters associated with the NFFR and runoff from the spoil piles under different conditions.

The resultant data from both phases of the evaluation were to be used by the CRWQCB to define the hazardous waste status of the spoil piles and evaluate the impact of runoff from Project-related spoil piles on trace metal concentrations in the NFFR.

**Thermal Gradients in Large Pools**

A third investigation involved the evaluation of thermal gradients in the larger pools associated with the Poe Reach. This investigation involved collecting temperature profiles at various locations within each of three large pools. These pools were located in the upper, middle, and lower sections of the reach and were sampled over the course of two days in August 1999. Figure E2.5-3 identifies the location of each of the test pools.

**Test Flows Releases**

The fourth special investigation was a series of test flow releases made from Poe Dam. The first test flow release was made in May 2000 to evaluate boating conditions in the Poe Reach. The second test flow release was made in September 2000 as part of an instream flow fisheries study. Both of these test flows provided an opportunity to evaluate the effect of increased flows on the temperature regime in the bypass reach.

**Sediment Incipient Motion Study**

A fifth investigation involved an incipient motion study of sediment in the Poe Reach. A complete presentation of the incipient motion study is presented in Appendix E2-2. The Licensee initiated the incipient motion study of the lower NFFR in order to provide specific flow-sediment information in support of resource use and optimized instream flow releases. The study covered the Poe Reach in the lower NFFR. A total of 31 river cross-sections (transects) were surveyed in the reach. The Poe Reach of the NFFR extends from south of the Poe Dam to just north of the Poe Powerhouse and is divided into three sub-reaches. The Pulga Sub-Reach of the NFFR extends from the Poe Dam to the Pulga stream gage station. The second sub-reach encompasses the mid-section of Poe Reach up to the Bardees Bar area, which is located at an anomalous U-shaped bend in the river. The third sub-reach, Poe Powerhouse, covers the lower section of Poe Reach and ends just upstream of the Poe Powerhouse Bridge.

A hydraulic analysis was performed to establish the flow characteristics at each river transect. The Licensee conducted four test flow releases and measured the corresponding flow velocities, water surface elevations and slopes for each transect. The hydraulic flow characteristics, such as channel velocities and Manning's n values, were calibrated using these field data. Once the stage-flow values were developed, the mathematical relationship for each transect was extrapolated to determine a wider range of flows for use in the incipient motion analysis.

The incipient motion analysis determines the flow threshold of sediment motion for a range of specific sizes of sediments varying from very fine gravel (3 mm) to very coarse gravel (4-8 mm).

**5/30 Coliform Sampling Program**

The final special investigation consisted of monitoring the impacts of recreation on coliform levels at two locations within the Project. The monitoring consisted of collecting five grab samples within a 30-day period from selected locations. Sampling was typically conducted prior to and following a major Holiday (Memorial Day or Independence Day Holiday) to capture worst-case conditions. Sampling was conducted at the Poe Powerhouse beach in 2001 and at the Bardees Bar beach in 2003 (at the request of the SWRCB in a letter dated March 12, 2003).

### E2.5.1.2 Design of the 2003 Monitoring Program

#### E2.5.1.2.1 Water Quality Monitoring

A total of 12 stations were sampled for *in situ* water quality parameters during the 2003 monitoring period. Table E2.5-1 lists the various stations, their location, and a summary of monitoring activities conducted at each site. Figure E2.5-1 is a schematic diagram of the selected monitoring locations.

The water quality stations represented both background and affected conditions within the

Project area. The various water samples were collected as grab samples from an accessible location at each site. Sampling was typically conducted over the course of two days during each sampling effort.

The *in situ* parameters (temperature, pH, DO, turbidity, and electrical conductivity) were measured using an electrometric water quality probe (Hydrolab DataSonde 3). Calibration of the *in situ* instrumentation was conducted in accordance with manufacturer's specifications. Accuracy verification was performed by comparing instrument output to appropriate reference standards.

The data program in 2003 was designed to supplement the existing information obtained in the 1999-2000 data program. The data coverage of 2003 was extended further downstream, from the NFFR above Poe Powerhouse to the Big Bend Dam. Trace metals were determined as both total and dissolved fractions at all locations during 2003. Additionally, analytical methods used for detection of trace metals were revised to meet the detection levels necessary to define regulatory compliance promulgated since 2000. Ultra clean field sampling techniques outlined in USEPA Method 1669: *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* were used to collect water quality samples during 2003 (see Appendix E2-4). Ultra clean metals concentrations were determined using USEPA Method 1638: *Determination of Trace Metals in Ambient Waters by Inductively Coupled Plasma – Mass Spectrometry,* and EPA Method 1631, Revision E: *Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry* (see Appendix E2-4).

Temperature Monitoring / Modeling protocols 2003

Seven stations were sampled for analytical constituents during the 2003 monitoring period. Table E2.5-2 presents a list of the analytical constituents and *in situ* parameters determined at each station. In 2003, samples were collected in March, May, July, and October. All samples were collected as grab samples from an accessible location at each site. Analytical samples were collected on the same day, within a six-hour time frame. All sample collection, preservation, and analyses were conducted in accordance with established protocols and methodology (APHA 1995). All samples sent to the analytical laboratory were preserved, cooled, and shipped for over-night delivery to the state-certified laboratory under contract with the Licensee.

#### E2.5.1.2.2 Poe Reservoir Water Quality Profiles

Vertical profiles were not collected from Poe Reservoir during June-September 2003.

#### E2.5.1.2.3 Temperature Monitoring

Stream temperatures were monitored continuously using digital thermographs placed *in situ* at 12 locations (Table E2.5-1) including the Poe-7 station at Big Bend Dam, which was added in 2003. Stream temperature sensors were deployed in well-mixed areas with elevated velocity and turbulent flow to ensure representative measurements.

Continuous temperature data were recorded as instantaneous readings taken at 15-minute intervals using Seamon Mini recorders. These data were then reduced to hourly-average data, which were used to generate the daily statistics. To verify the operation and accuracy of the temperature recorders, the units were calibrated using an ASTM reference thermometer, both prior to and following removal from the *in situ* deployment. The typical instrument error for the Seamon Mini is less than 0.1°C. In 2003, continuous monitoring of temperature was conducted from June through September.

**E2.5.1.2.4 Temperature Modeling**

As described in Section E2.5.1.1.4, initial model calibration and validation was done using data collected in 1985 (Woodward-Clyde 1986a). This original version of the model was referred to as the WCC-SNTEMP model. Additional model validation efforts were completed by the Licensee with data obtained in 1999 and 2000, and a newly recalibrated model was produced.

The model was again validated using water temperature, hydrology, and meteorology data collected in 2003. No model parameters were changed for the 2003 simulations, and, as with the 1999 and 2000 simulations (Section 2.5.1.1.4), the model was run with a 2-day time step.

Model performance was assessed graphically and with statistical evaluation of the differences between simulated and measured temperatures. Statistics used in the validation process are bias error (the average difference between the model predictions and the observed data), and probable error (0.6745 times the standard deviation). The mean plus or minus the probable error contains 50% of the values if they are normally distributed.

In a letter dated March 13, 2003 the California Department of Fish and Game (CDF&G) requested that the model predict minimum, maximum, and average daily water temperatures for various locations throughout the Poe Reach. SNTEMP is a reliable tool to predict the water temperature averaged over the specified time step that is equal to or greater than the travel time through the study reach. The travel time required for the Poe Reach at Q = 50 cfs is approximately 2 days, therefore the model time step used a 2-day interval. The diel prediction for a 2-day prediction is meaningless, hence diel fluctuation is not used. The diel fluctuation data can be obtained from actual data provided in Table E2.5-4. The diel change associated with higher flows is discussed in Section E2.5.2.1.5. The daily range of temperatures (minimum, maximum, and average) temperatures are reported for the instream temperature data that were collected in 1999-2000 and 2003 in Section E2.5.2. The daily range associated with this data is also presented in Section E2.5.2.

#### E2.5.1.2.5 Streamflow Monitoring

Streamflow was measured at two stations in the Project area during the 2003 monitoring effort (Mill Creek, and Flea Valley Creek). This monitoring was done independent of the Licensee's operation of the official USGS flow monitoring station located on the NFFR at Pulga. The objective of the supplemental river and tributary flow monitoring effort was to define accretion flows occurring in various subsections of the Poe Reach. The results of the flow monitoring were previously discussed in Section E2.3. The same methods used to collect flow measurements in 1999-2000 were used in 2003 and are described in Section E2.5.1.1.5.

### E2.5.1.2.6 Meteorological Monitoring

Local meteorology was monitored at Poe Powerhouse from May through September in 2003. Hourly average wind speed and direction, air temperature, relative humidity, and solar radiation were measured.

## E2.5.2 Results of Water Temperature Monitoring

Water temperature greatly influences the suitability of a water body to achieve its identified beneficial use. Temperature affects various physical properties of water such as density, viscosity, and the solubility of gases and other chemical constituents. The metabolic rate of aquatic organisms is also affected by changes in water temperature.

### E2.5.2.1 Results of the 1999-2000 Monitoring

Continuous monitoring of water temperatures (sampled at 5-minute intervals with recorded averages over a one-hour period) was conducted during the period June-September 1999 and 2000. Appendix E2-3 presents a summary of hourly average data in a hard copy table. For consistency with the temperature objective specified for the Licensee's Rock Creek Cresta Project (FERC 1962) (Pacific Gas and Electric Company 2000b), daily average data are used throughout this document unless otherwise specified. Table E2.5-4 summarizes all daily average water temperature data collected during the 1999-2000 programs. For the purpose of comparative analysis, the water temperature discussion in the following section will focus on the two warmest months, July and August.

[redacted]

# Table E2.5-4

**Summary of 1999 and 2000 daily average water temperature data - Poe Project area.**

| Station | Year | Month | Water Temperature (°C) [1] Max. | Min. | Mean | Diel Cycle (°C) [2] Max. | Min. | Mean | Data Days |
|---|---|---|---|---|---|---|---|---|---|
| NFFR above Cresta PH (Poe-1C) | 1999 | June | 20.6 | 16.2 | 18.6 | 3.1 | 2.3 | 2.7 | 18 |
| | 1999 | July | 22.5 | 18.9 | 20.2 | 3.0 | 2.0 | 2.4 | 31 |
| | 1999 | Aug | 20.7 | 17.8 | 19.6 | 2.0 | 0.9 | 1.6 | 31 |
| | 1999 | Sept | 18.2 | 16.7 | 17.6 | 2.7 | 0.9 | 1.6 | 14 |
| | 2000 | June | 21.7 | 18.5 | 20.1 | 3.2 | 1.8 | 2.5 | 16 |
| | 2000 | July | 20.6 | 18.3 | 19.6 | 2.7 | 1.2 | 2.1 | 31 |
| | 2000 | Aug | 22.1 | 18.0 | 19.9 | 2.3 | 1.0 | 1.9 | 31 |
| | 2000 | Sept | 18.0 | 15.6 | 16.4 | 2.0 | 1.0 | 1.9 | 16 |
| | 2003 | June | 18.9 | 14.4 | 17.2 | 3.7 | 2.3 | 2.9 | 30 |
| | 2003 | July | 22.7 | 17.7 | 20.1 | 3.4 | 2.1 | 2.9 | 31 |
| | 2003 | Aug | 22.1 | 19.5 | 20.2 | 2.9 | 0.6 | 2.4 | 31 |
| | 2003 | Sept | 20.6 | 16.5 | 18.3 | 2.7 | 0.9 | 2.1 | 30 |
| NFFR below Cresta PH (Poe-1A) | 1999 | June | 19.2 | 16.8 | 17.9 | 1.2 | 0.4 | 0.9 | 14 |
| | 1999 | July | 20.2 | 18.7 | 19.3 | 1.8 | 0.2 | 0.8 | 28 |
| | 1999 | Aug | 19.9 | 18.4 | 19.2 | 0.8 | 0.3 | 0.6 | 27 |
| | 1999 | Sept | 18.4 | 17.8 | 18.1 | 2.2 | 0.5 | 0.8 | 10 |
| | 2000 | June | 20.3 | 18.1 | 18.9 | 2.1 | 0.6 | 1.1 | 12 |
| | 2000 | July | 20.2 | 17.9 | 19.2 | 1.4 | 0.3 | 0.7 | 31 |
| | 2000 | Aug | 21.2 | 18.6 | 19.9 | 2.6 | 0.3 | 0.8 | 31 |
| | 2000 | Sept | 19.0 | 16.8 | 17.3 | 1.4 | 0.5 | 1.0 | 12 |
| | 2003 | June | 18.5 | 13.9 | 16.8 | 1.5 | 0.6 | 1.0 | 30 |
| | 2003 | July | 22.3 | 17.4 | 19.7 | 1.8 | 0.5 | 1.0 | 31 |
| | 2003 | Aug | 22.0 | 19.4 | 20.1 | 1.3 | 0.4 | 0.8 | 31 |
| | 2003 | Sept | 20.2 | 16.9 | 18.3 | 1.3 | 0.4 | 0.8 | 30 |
| Cresta PH Internal (Poe-1B) | 1999 | June | --- | --- | --- | --- | --- | --- | --- |
| | 1999 | July | 20.6 | 19.2 | 19.6 | 1.5 | 0.5 | 0.8 | 17 |
| | 1999 | Aug | 20.1 | 18.7 | 19.4 | 1.7 | 0.3 | 0.7 | 31 |
| | 1999 | Sept | 19.0 | 17.2 | 18.3 | 1.4 | 0.3 | 0.7 | 14 |
| | 2000 | June | --- | --- | --- | --- | --- | --- | --- |
| | 2000 | July | --- | --- | --- | --- | --- | --- | --- |
| | 2000 | Aug | --- | --- | --- | --- | --- | --- | --- |
| | 2000 | Sept | --- | --- | --- | --- | --- | --- | --- |
| | 2003 | June | 18.5 | 13.9 | 16.8 | 1.6 | 0.5 | 1.0 | 30 |
| | 2003 | July | 22.3 | 17.4 | 19.7 | 1.4 | 0.3 | 0.8 | 31 |
| | 2003 | Aug | 22.0 | 19.5 | 20.2 | 1.4 | 0.3 | 0.7 | 31 |
| | 2003 | Sept | 20.1 | 17.0 | 18.3 | 1.4 | 0.4 | 0.8 | 30 |

38

10 stations exceed

## Table E2.5-4 (Continued)

| Station | Year | Month | Water Temperature (°C) [1] Max. | Min. | Mean | Diel Cycle (°C) [2] Max. | Min. | Mean | Data Days |
|---|---|---|---|---|---|---|---|---|---|
| NFFR below Poe Dam (Poe-5) | 1999 | June | 19.4 | 12.9 | 17.0 | 2.2 | 0.5 | 1.4 | 22 |
| | 1999 | July | 20.5 | 18.6 | 19.4 | 1.7 | 0.4 | 1.1 | 31 |
| | 1999 | Aug | 20.0 | 18.6 | 19.3 | 1.4 | 0.5 | 0.9 | 31 |
| | 1999 | Sept | 18.3 | 16.9 | 17.9 | 1.3 | 0.3 | 0.7 | 14 |
| | 2000 | May | 15.6 | 11.4 | 14.4 | 2.0 | 0.7 | 1.2 | 14 |
| | 2000 | June | 20.6 | 14.2 | 17.5 | 1.9 | 0.3 | 1.0 | 30 |
| | 2000 | July | 20.0 | 18.1 | 19.2 | 1.4 | 0.7 | 1.1 | 31 |
| | 2000 | Aug | 21.0 | 18.4 | 19.9 | 1.3 | 0.2 | 0.8 | 31 |
| | 2000 | Sept | 18.8 | 16.8 | 17.2 | 1.0 | 0.4 | 0.7 | 12 |
| | 2003 | June | 18.7 | 14.1 | 17.0 | 1.6 | 0.5 | 1.1 | 30 |
| | 2003 | July | 22.5 | 17.6 | 19.9 | 1.2 | 0.4 | 0.7 | 31 |
| | 2003 | Aug | 22.2 | 19.5 | 20.3 | 1.0 | 0.2 | 0.6 | 31 |
| | 2003 | Sept | 20.2 | 17.0 | 18.4 | 1.2 | 0.2 | 0.7 | 30 |
| NFFR at Pulga Bridge (Poe-2A) | 1999 | June | --- | --- | --- | --- | --- | --- | --- |
| | 1999 | July | 20.7 | 19.1 | 19.5 | 4.1 | 3.7 | 3.9 | 17 |
| | 1999 | Aug | 20.2 | 18.5 | 19.5 | 4.1 | 1.5 | 3.2 | 31 |
| | 1999 | Sept | 18.5 | 17.0 | 17.8 | 3.0 | 1.0 | 2.4 | 16 |
| | 2000 | May | 16.5 | 12.9 | 15.3 | 4.5 | 2.1 | 3.5 | 13 |
| | 2000 | June | 21.1 | 14.8 | 17.9 | 4.4 | 0.8 | 3.6 | 30 |
| | 2000 | July | 20.5 | 18.2 | 19.5 | 4.1 | 2.4 | 3.6 | 31 |
| | 2000 | Aug | 21.2 | 18.5 | 20.0 | 3.8 | 0.9 | 3.0 | 31 |
| | 2000 | Sept | 18.2 | 16.6 | 17.1 | 3.3 | 0.7 | 1.9 | 12 |
| | 2003 | June | 18.8 | 14.9 | 17.3 | 4.0 | 2.3 | 3.5 | 30 |
| | 2003 | July | 22.6 | 17.8 | 20.2 | 3.7 | 2.3 | 3.3 | 31 |
| | 2003 | Aug | 22.2 | 19.7 | 20.4 | 3.4 | 0.9 | 2.7 | 31 |
| | 2003 | Sept | 20.5 | 16.9 | 18.4 | 3.0 | 0.7 | 2.3 | 30 |
| NFFR below Pulga Bridge (Poe-2B) | 1999 | June | 19.9 | 13.5 | 17.4 | 4.0 | 2.3 | 3.6 | 22 |
| | 1999 | July | 21.1 | 18.8 | 19.6 | 4.1 | 2.8 | 3.6 | 31 |
| | 1999 | Aug | 20.3 | 18.2 | 19.4 | 3.7 | 1.4 | 2.9 | 31 |
| | 1999 | Sept | 18.4 | 16.8 | 17.8 | 3.1 | 1.7 | 2.5 | 16 |
| | 2000 | June | 21.5 | 18.7 | 20.0 | 3.8 | 3.2 | 3.6 | 15 |
| | 2000 | July | 20.7 | 18.5 | 19.7 | 3.9 | 2.2 | 3.4 | 31 |
| | 2000 | Aug | 21.5 | 18.7 | 20.1 | 3.5 | 1.3 | 2.9 | 31 |
| | 2000 | Sept | 18.3 | 16.7 | 17.2 | 3.2 | 0.7 | 2.0 | 12 |
| | 2003 | June | --- | --- | --- | --- | --- | --- | --- |
| | 2003 | July | --- | --- | --- | --- | --- | --- | --- |
| | 2003 | Aug | --- | --- | --- | --- | --- | --- | --- |
| | 2003 | Sept | --- | --- | --- | --- | --- | --- | --- |

## Table E2.5-4 (Continued)

Daily M̄

| Station | Year | Month | Water Temperature (°C) [1] Max. | Min. | Mean | Diel Cycle (°C) [2] Max. | Min. | Mean | Data Days |
|---|---|---|---|---|---|---|---|---|---|
| NFFR at Bardees Bar (Poe-6) | 1999 | June | 20.3 | 13.7 | 17.8 | 4.0 | 2.6 | 3.4 | 22 |
| | 1999 | July | 21.6 | 19.0 | 19.9 | 3.9 | 2.2 | 3.1 | 31 |
| | 1999 | Aug | 20.7 | 18.0 | 19.6 | 3.3 | 1.2 | 2.5 | 31 |
| | 1999 | Sept | 18.5 | 16.8 | 17.7 | 2.4 | 1.5 | 2.1 | 13 |
| | 2000 | June | 22.0 | 18.9 | 20.4 | 3.7 | 2.8 | 3.4 | 15 |
| | 2000 | July | 20.9 | 18.8 | 20.0 | 3.7 | 2.0 | 3.1 | 31 |
| | 2000 | Aug | 21.8 | 18.7 | 20.2 | 3.6 | 1.1 | 2.8 | 31 |
| | 2000 | Sept | 18.3 | 16.6 | 17.1 | 3.2 | 0.6 | 2.2 | 12 |
| | 2003 | June | 19.4 | 15.8 | 18.0 | 4.2 | 2.7 | 3.5 | 30 |
| | 2003 | July | 23.2 | 18.2 | 20.7 | 4.3 | 2.2 | 3.6 | 31 |
| | 2003 | Aug | 22.6 | 19.7 | 20.6 | 3.7 | 0.9 | 2.9 | 31 |
| | 2003 | Sept | 20.9 | 16.9 | 18.6 | 3.0 | 1.6 | 2.5 | 30 |
| NFFR above Poe PH (Poe-3) | 1999 | June | 21.8 | 16.9 | 19.9 | 4.1 | 3.0 | 3.7 | 19 |
| | 1999 | July | 23.4 | 20.5 | 21.5 | 3.9 | 2.5 | 3.3 | 31 |
| | 1999 | Aug | 22.2 | 18.7 | 20.9 | 3.4 | 1.8 | 2.7 | 31 |
| | 1999 | Sept | 19.5 | 17.6 | 18.4 | 2.8 | 1.5 | 2.1 | 13 |
| | 2000 | May | 20.0 | 15.0 | 17.8 | 4.3 | 2.2 | 3.2 | 14 |
| | 2000 | June | 23.9 | 17.1 | 20.3 | 4.4 | 2.8 | 3.6 | 30 |
| | 2000 | July | 22.7 | 20.2 | 21.4 | 3.8 | 2.5 | 3.3 | 29 |
| | 2000 | Aug | 23.4 | 19.5 | 21.2 | 3.4 | 1.4 | 2.8 | 29 |
| | 2000 | Sept | 19.0 | 17.2 | 17.8 | 2.9 | 1.1 | 2.3 | 12 |
| | 2003 | June | 21.0 | 17.6 | 19.7 | 3.6 | 2.2 | 3.0 | 30 |
| | 2003 | July | 24.5 | 19.6 | 22.1 | 3.3 | 2.2 | 3.0 | 31 |
| | 2003 | Aug | 23.5 | 20.5 | 21.5 | 3.1 | 0.6 | 2.6 | 31 |
| | 2003 | Sept | 21.9 | 17.0 | 19.2 | 2.8 | 1.1 | 2.2 | 30 |
| Poe Powerhouse Tailrace (Poe-4B) | 1999 | June | 19.8 | 14.7 | 17.8 | 1.9 | 1.5 | 2.0 | 15 |
| | 1999 | July | 20.4 | 18.6 | 19.4 | 1.8 | 1.1 | 1.2 | 24 |
| | 1999 | Aug | 20.0 | 17.7 | 19.2 | 1.4 | 0.8 | 0.8 | 31 |
| | 1999 | Sept | 18.3 | 16.9 | 17.8 | 1.1 | 0.6 | 0.9 | 10 |
| | 2000 | June | 20.7 | 18.2 | 19.3 | 1.6 | 0.7 | 1.1 | 15 |
| | 2000 | July | 20.3 | 18.3 | 19.4 | 1.2 | 0.4 | 0.7 | 31 |
| | 2000 | Aug | 21.1 | 18.6 | 20.2 | 1.6 | 0.3 | 0.7 | 31 |
| | 2000 | Sept | 19.2 | 17.6 | 18.4 | 1.4 | 0.6 | 1.0 | 30 |
| | 2003 | June | 18.6 | 14.0 | 16.9 | 1.4 | 0.4 | 0.9 | 30 |
| | 2003 | July | 22.7 | 17.7 | 20.0 | 1.4 | 0.3 | 0.7 | 31 |
| | 2003 | Aug | 22.4 | 19.6 | 20.4 | 1.1 | 0.4 | 0.8 | 31 |
| | 2003 | Sept | 20.3 | 17.1 | 18.6 | 1.2 | 0.4 | 0.8 | 30 |

Downstream point of Poe diverted reach = Poe-3

Temp. Data: Poe Reach

See Vol. III, Appendix E2-3 for summary of hourly T. data

## Table E2.5-4 (Continued)

| Station | Year | Month | Water Temperature (°C)[1] Max. | Min. | Mean | Diel Cycle (°C)[2] Max. | Min. | Mean | Data Days |
|---|---|---|---|---|---|---|---|---|---|
| NFFR at Big Bend Dam (Poe-7) | 2003 | June | 19.2 | 16.7 | 17.7 | 1.5 | 0.7 | 1.1 | 24 |
| | 2003 | July | 22.8 | 17.9 | 20.2 | 2.5 | 0.5 | 1.4 | 31 |
| | 2003 | Aug | 22.4 | 19.6 | 20.5 | 2.2 | 0.5 | 1.1 | 31 |
| | 2003 | Sept | 20.5 | 17.1 | 18.5 | 2.0 | 0.4 | 1.2 | 30 |
| Flea Valley Creek (FVC) | 1999 | June | 15.3 | 11.0 | 13.6 | 3.3 | 2.4 | 2.9 | 22 |
| | 1999 | July | 16.4 | 13.7 | 14.7 | 3.5 | 2.2 | 2.9 | 31 |
| | 1999 | Aug | 16.1 | 13.8 | 14.9 | 3.0 | 1.1 | 2.3 | 31 |
| | 1999 | Sept | 14.9 | 13.1 | 14.2 | 2.4 | 1.4 | 2.0 | 15 |
| | 2000 | June | 16.8 | 15.2 | 15.8 | 3.2 | 2.6 | 2.9 | 16 |
| | 2000 | July | 16.1 | 14.4 | 15.3 | 3.2 | 1.9 | 2.7 | 31 |
| | 2000 | Aug | 17.0 | 14.6 | 15.6 | 3.0 | 0.8 | 2.4 | 31 |
| | 2000 | Sept | 14.5 | 13.0 | 13.7 | 2.6 | 0.7 | 2.1 | 12 |
| | 2003 | June | 15.0 | 13.2 | 14.2 | 3.0 | 1.6 | 2.5 | 30 |
| | 2003 | July | 17.3 | 13.7 | 15.6 | 3.1 | 1.8 | 2.6 | 31 |
| | 2003 | Aug | 16.6 | 14.6 | 15.4 | 2.8 | 0.5 | 2.2 | 31 |
| | 2003 | Sept | 16.3 | 13.8 | 14.8 | 2.3 | 0.7 | 1.9 | 30 |
| Mill Creek (MC) | 1999 | June | 15.7 | 10.2 | 13.6 | 3.4 | 2.4 | 2.9 | 22 |
| | 1999 | July | 17.3 | 13.7 | 15.0 | 3.4 | 2.0 | 2.8 | 31 |
| | 1999 | Aug | 16.3 | 13.5 | 14.9 | 2.6 | 1.2 | 1.9 | 31 |
| | 1999 | Sept | 14.8 | 12.6 | 13.7 | 1.9 | 1.0 | 1.5 | 14 |
| | 2000 | June | 17.4 | 15.1 | 16.0 | 3.4 | 2.4 | 3.0 | 16 |
| | 2000 | July | 16.3 | 14.1 | 15.3 | 3.2 | 1.7 | 2.6 | 31 |
| | 2000 | Aug | 17.6 | 14.4 | 15.6 | 2.4 | 0.9 | 1.9 | 31 |
| | 2000 | Sept | 14.3 | 12.0 | 12.9 | 1.9 | 0.7 | 1.5 | 12 |
| | 2003 | June | 15.2 | 12.6 | 14.0 | 3.3 | 1.8 | 2.7 | 30 |
| | 2003 | July | 18.3 | 13.4 | 15.9 | 3.3 | 1.6 | 2.7 | 31 |
| | 2003 | Aug | 17.5 | 14.4 | 15.5 | 2.5 | 0.4 | 1.9 | 31 |
| | 2003 | Sept | 16.6 | 12.6 | 14.3 | 1.8 | 0.7 | 1.3 | 30 |

1. Monthly values are based on daily average data, and represent the maximum, minimum, and mean of the daily average temperatures recorded in each month. The daily average is based on hourly average temperatures recorded during each day.

2. Diel cycle is calculated based on the daily maximum temperature minus the daily minimum temperature. Monthly statistics are based on the computed daily values.

#### E2.5.2.1.1 Cresta Powerhouse and Cresta Reach of the NFFR

As discussed in Section E2.3, the majority of flow occurring in the Poe Project originates from the NFFR diversion through Cresta Powerhouse. All of the flow of the NFFR passes through Poe Reservoir, with the majority passing downstream through Poe Powerhouse.

Temperatures were monitored in 1999 and 2000 at the lower end of the Cresta Reach of the NFFR at station Poe-1C. This station was located in the NFFR upstream of any backwater influence from the Cresta Powerhouse Tailrace and Poe Reservoir. During the 1999 program, daily average temperatures at station Poe-1C ranged from 17.8 to 22.5°C, and averaged 19.9°C (Table E2.5-4). The diel fluctuation in temperature ranged from 0.9 to 3.0°C, and averaged 2.0°C in 1999. Daily average temperatures in 2000 at this station ranged from 18.0 to 22.1°C, and averaged 19.8°C (Table E2.5-4). The diel fluctuation at station Poe-1C in 2000 ranged from 1.0 to 2.7°C, and averaged 2.0°C. Figure E2.5-4 compares 1999, 2000, and 2003 daily average water temperatures occurring in the NFFR above Cresta Powerhouse (Poe-1C). The maximum hourly average temperature recorded at this station during the 1999-2000 monitoring program was 23.5°C measured in July 1999 (Appendix E2-3).

Under the Rock Creek-Cresta Relicensing Settlement Agreement (Pacific Gas and Electric Company 2000b), a daily average water temperature of 20°C is specified as the water temperature objective. For this reason, a comparison to this objective level was made at applicable locations and the results are shown in Table E2.5-5. At station Poe-1C, daily average temperatures exceeded 20°C on 26 of 62 days (42%) during the 1999 July through August period, and exceeded 20°C on 22 of 62 days (35%) during the 2000 July through August period (Table E2.5-5).

Due to the large fluctuation in water level and high velocity present in the tailrace of Cresta Powerhouse, deployment of recorders in the tailrace was not feasible. As a result, temperatures at Cresta Powerhouse (Poe-1B) were monitored inside the powerhouse in 1999. During 1999, daily average temperatures in Cresta Powerhouse ranged from 18.7 to 20.6°C and averaged 19.5°C (Table E2.5-4). The diel fluctuation in temperatures was 0.3 to 1.7°C and averaged 0.8°C in 1999. Daily average temperatures at Cresta Powerhouse were compared with temperatures at the Poe-1A station (NFFR above Poe Reservoir, also referred to as NFFR below Cresta Powerhouse). The difference between these two stations in 1999 averaged ± 0.2°C during periods of powerhouse operation.

## Table E2.5-5

**Summary of daily average temperature comparison with 20°C objective.**

| Station | Month | 1999 Number of days Greater than 20°C | 1999 Number of days Total Days | 1999 Number of days Percent | 2000 Number of days Greater than 20°C | 2000 Number of days Total Days | 2000 Number of days Percent | 2003 Number of days Greater than 20°C | 2003 Number of days Total Days | 2003 Number of days Percent |
|---|---|---|---|---|---|---|---|---|---|---|
| NFFR above Cresta PH (Poe-1C) | June | 2 | 18 | 11% | 6 | 16 | 38% | 0 | 30 | 0% |
| | July | 16 | 31 | 52% | 9 | 31 | 29% | 18 | 31 | 58% |
| | August | 10 | 31 | 32% | 13 | 31 | 42% | 14 | 31 | 45% |
| | Sept | 0 | 14 | 0% | 0 | 12 | 0% | 5 | 30 | 17% |
| NFFR below Cresta PH (Poe-1A) | June | 0 | 14 | 0% | 2 | 12 | 17% | 0 | 30 | 0% |
| | July | 3 | 28 | 11% | 1 | 31 | 3% | 12 | 31 | 39% |
| | August | 0 | 27 | 0% | 16 | 31 | 52% | 12 | 31 | 39% |
| | Sept | 0 | 10 | 0% | 0 | 12 | 0% | 2 | 30 | 7% |
| NFFR below Poe Dam (Poe-5) | June | 0 | 22 | 0% | 3 | 30 | 10% | 0 | 30 | 0% |
| | July | 4 | 31 | 13% | 2 | 31 | 6% | 15 | 31 | 48% |
| | August | 1 | 31 | 3% | 16 | 31 | 52% | 19 | 31 | 61% |
| | Sept | 0 | 14 | 0% | 0 | 12 | 0% | 5 | 30 | 17% |
| Mill Creek | June | 0 | 22 | 0% | 0 | 16 | 0% | 0 | 30 | 0% |
| | July | 0 | 31 | 0% | 0 | 31 | 0% | 0 | 31 | 0% |
| | August | 0 | 31 | 0% | 0 | 31 | 0% | 0 | 31 | 0% |
| | Sept | 0 | 14 | 0% | 0 | 12 | 0% | 0 | 30 | 0% |
| Flea Valley Creek | June | 0 | 22 | 0% | 0 | 16 | 0% | 0 | 30 | 0% |
| | July | 0 | 31 | 0% | 0 | 31 | 0% | 0 | 31 | 0% |
| | August | 0 | 31 | 0% | 0 | 31 | 0% | 0 | 31 | 0% |
| | Sept | 0 | 15 | 0% | 0 | 12 | 0% | 0 | 30 | 0% |
| NFFR at Pulga Bridge (Poe-2A) | June | ---- | ---- | ---- | 5 | 30 | 17% | 0 | 30 | 0% |
| | July | 2 | 17 | 12% | 6 | 31 | 19% | 19 | 31 | 61% |
| | August | 4 | 31 | 13% | 18 | 31 | 58% | 21 | 31 | 68% |
| | Sept | 0 | 13 | 0% | 0 | 12 | 0% | 6 | 30 | 20% |

## Table E2.5-5

## (Continued)

| Station | Month | 1999 Number of days Greater than 20°C | 1999 Total Days | 1999 Percent | 2000 Number of days Greater than 20°C | 2000 Total Days | 2000 Percent | 2003 Number of days Greater than 20°C | 2003 Total Days | 2003 Percent |
|---|---|---|---|---|---|---|---|---|---|---|
| NFFR below Pulga Bridge (Poe-2B) | June | 0 | 22 | 0% | 6 | 15 | 40% | --- | --- | --- |
| | July | 8 | 31 | 26% | 9 | 31 | 29% | --- | --- | --- |
| | August | 5 | 31 | 16% | 18 | 31 | 58% | --- | --- | --- |
| | Sept | 0 | 16 | 0% | 0 | 12 | 0% | --- | --- | --- |
| NFFR at Bardees Bar (Poe-6) | June | 2 | 22 | 9% | 9 | 15 | 60% | 0 | 30 | 0% |
| | July | 12 | 31 | 39% | 20 | 31 | 65% | 21 | 31 | 68% |
| | August | 10 | 31 | 32% | 18 | 31 | 58% | 23 | 31 | 74% |
| | Sept | 0 | 13 | 0% | 0 | 12 | 0% | 6 | 30 | 20% |
| NFFR above Poe PH (Poe-3) | June | 10 | 19 | 53% | 17 | 30 | 57% | 12 | 30 | 40% |
| | July | 31 | 31 | 100% | 29 | 29 | 100% | 28 | 31 | 90% |
| | August | 30 | 31 | 97% | 20 | 29 | 69% | 31 | 31 | 100% |
| | Sept | 0 | 13 | 0% | 0 | 12 | 0% | 7 | 30 | 23% |
| Poe Powerhouse Tailrace (Poe-4B) | June | 0 | 20 | 0% | 4 | 15 | 27% | 0 | 30 | 0% |
| | July | 4 | 31 | 13% | 4 | 31 | 13% | 15 | 31 | 48% |
| | August | 1 | 31 | 3% | 18 | 31 | 58% | 22 | 31 | 71% |
| | Sept | 0 | 11 | 0% | 0 | 30 | 0% | 6 | 30 | 20% |
| NFFR at Big Bend (Poe-7) | June | --- | --- | --- | --- | --- | --- | 0 | 24 | 0% |
| | July | --- | --- | --- | --- | --- | --- | 20 | 31 | 65% |
| | August | --- | --- | --- | --- | --- | --- | 21 | 31 | 68% |
| | Sept | --- | --- | --- | --- | --- | --- | 5 | 30 | 17% |

Data from Poe-1B were not collected in 2000 due to instrumentation problems within the powerhouse. However, *in situ* temperature comparisons between the Cresta Powerhouse Tailrace and the Poe-1A station indicated that there was effectively no measurable difference between the two stations when the powerhouse was operating. Any difference between these two stations is attributed to mixing with NFFR water from the Cresta Reach, which contributes about 4-6% additional flow (warmer by about 1-3°C) to the discharge of Cresta Powerhouse; a lag in exchange of water within the cooling water system to which the temperature recorders were attached; and normal recorder accuracy. The data indicate that conditions in the NFFR above Poe Reservoir (Poe-1A) are driven by releases from Cresta Powerhouse.

During the 1999 program, daily average temperatures in the NFFR upstream of Poe Reservoir (Poe-1A) ranged from 18.4 to 20.2°C, with a mean of 19.3°C (Table E2.5-5). The diel fluctuation in temperature at this station was small, reflecting the large flow volume and short retention time in upstream reservoirs; diel fluctuation ranged from 0.2 to 1.8°C, and averaged 0.7°C. In 2000, daily average temperatures at Poe-1A ranged from 17.9 to 21.2°C, with a mean of 19.6°C (Table E2.5-5). The diel fluctuation ranged from 0.3 to 2.6°C, averaging 0.8°C. Figure E2.5-5 compares 1999, 2000, and 2003 daily average water temperatures in the NFFR downstream of Cresta Powerhouse (Poe-1A). The maximum hourly average temperature recorded at this station during the 1999-2000 monitoring program was 21.9°C measured in August 2000 (Appendix E2-3).

The daily average temperatures at station Poe-1A exceeded 20°C on 3 of 55 days (5%)

during the 1999 July-August period (Table E2.5-5) and 17 of 62 days (27%) during the 2000 July-August period. These temperatures represent the initial conditions for the Poe Project.

### E2.5.2.1.2 Poe Reservoir

As discussed above, Poe Reservoir receives all of the inflow from Cresta Powerhouse and the Cresta Reach of the NFFR. For the period June-September 1999 synoptic temperatures in Poe Reservoir (Poe-4A) ranged from 17.0 to 21.0°C. Figure E2.5-6 compares temperature profiles from the Poe Dam station during the 1999 monitoring effort. Thermal stratification in Poe Reservoir was evaluated in 1999 using profile measurements made near the dam. The typical depth at the dam was between 35 and 40 ft. Thermal gradients (maximum profile temperature minus minimum profile temperature) in Poe Reservoir during the June-August 1999 period were minimal. Profile data indicated that the greatest thermal gradient was 1.0°C in June. During the July-September period the thermal gradient averaged less than 0.2°C. The lack of thermal gradients is related to the very short retention time (on the order of 7 hours).

Reservoir profiles were not measured in 2000 due to the lack of gradients observed in 1999 and the presence of monitoring stations located immediately upstream and downstream of the reservoir. These upstream and downstream stations confirmed the absence of change in temperature within the reservoir and validated the assumption that the reservoir is well mixed. In 1999, the daily average temperatures in the NFFR below Poe Dam (Poe-5) averaged 0.1°C warmer than in the NFFR above Poe Reservoir (Poe-

1A). On average, there was no measurable difference between stations in 2000.

Temperatures in the Poe Powerhouse Tailrace (Poe-4B) were monitored in 1999 and 2000. During the 1999 program, daily average temperatures at Poe-4B ranged from 17.7 to 20.4°C, and averaged 19.3°C (Table E2.5-4). Diel fluctuations in temperature were low to moderate at this station, ranging from 0.8 to 1.8°C, and averaged 1.0°C. Daily average temperatures in 2000 at this station ranged from 18.3 to 21.1°C, and averaged 19.8°C. The diel fluctuation at this station in 2000 ranged from 0.3 to 1.6°C, averaging 0.7°C. Figure E2.5-7 compares 1999, 2000, and 2003 daily average water temperatures measured at Poe Powerhouse (Poe-4B). The maximum hourly average temperature recorded at this station during the 1999-2000 monitoring program was 21.5°C measured in August 2000 (Appendix E2-3).

The daily average temperatures at station Poe-4B exceeded 20°C on 5 of 62 days (8%) during the 1999 July-August period and 22 of 62 days (35%) during the 2000 July-August period (Table E2.5-5).

A comparison of daily average temperatures from the NFFR upstream of Poe Reservoir (Poe-1A) with those from Poe Powerhouse (Poe-4B) was used to further define the thermal structure in Poe Reservoir. The daily average temperatures in the Poe Powerhouse Tailrace (Poe-4B) averaged 0.2°C warmer in 1999, and 0.2°C cooler in 2000, than the NFFR above Poe Reservoir (Poe-1A). These differences are within the accuracy range of the instrumentation and indicate no appreciable change in temperature attributable to residence time in Poe Reservoir.

**E2.5.2.1.3 Poe Reach of NFFR**

Initial conditions in the Poe Reach were measured in the NFFR immediately downstream of Poe Dam (Poe-5) during the 1999-2000 periods. During the 1999 program, daily average temperatures in the NFFR downstream of Poe Dam ranged from 18.6 to 20.5°C, and averaged 19.4°C (Table E2.5-4). The diel fluctuation in temperature ranged from 0.4 to 1.7°C, and averaged 1.0°C. These changes were similar to those observed at Poe-4B (Poe Powerhouse), and are indicative of conditions in Poe Reservoir. Daily average temperatures at Poe-5 in 2000 ranged from 18.1 to 21.0°C, and averaged 19.6°C. The diel fluctuation at this station ranged from 0.2 to 1.4°C, averaging 1.0°C in 2000. Figure E2.5-8 compares 1999, 2000, and 2003 daily average water temperatures in the NFFR downstream of Poe Dam (Poe-5). The daily average temperatures at station Poe-5 exceeded 20°C on 5 of 62 days (8%) during the 1999 July through August period and 18 of 62 days (29%) during the 2000 July-August period (Table E2.5-5). The maximum hourly average temperature recorded at this station during the 1999-2000 monitoring program was 21.6°C measured in August 2000 (Appendix E2-3).

Temperatures in Mill Creek (MC) were monitored above the Highway 70 road culvert during 1999-2000. Daily average temperatures in 1999 ranged from 13.5 to 17.3°C, and averaged 15.0°C (Table E2.5-4). Diel fluctuations in temperature were moderate at this station reflecting the natural (unregulated) flow conditions; diel cycles ranged from 1.2 to

3.4°C, and averaged 2.4°C. Daily average temperatures in 2000 ranged from 14.1 to 17.6°C, and averaged 15.5°C. The diel fluctuation ranged from 0.9 to 3.2°C, averaging 2.3°C. Figure E2.5-9 compares 1999, 2000, and 2003 daily average water temperatures in Mill Creek.

Temperatures in Flea Valley Creek (FVC) were monitored downstream of the railroad trestle during the 1999-2000 period. Daily average temperatures in 1999 ranged from 13.7 to 16.4°C, and averaged 14.8°C (Table E2.5-4). Diel fluctuations in temperature were moderate at this station reflecting the natural (unregulated) flow conditions; diel cycles ranged from 1.1 to 3.5°C, and averaged 2.6°C. Daily average temperatures in 2000 ranged from 14.4 to 17.0°C, and averaged 15.5°C. The diel fluctuation ranged from 0.8 to 3.2°C, averaging 2.6°C. Figure E2.5-10 compares 1999, 2000, and 2003 daily average water temperatures in Flea Valley Creek.

Conditions in the Poe Reach immediately downstream of the primary tributaries were monitored near the Pulga gage station (Poe-2A) during the 1999-2000 period. During the 1999 program, daily average temperatures in the NFFR at Pulga ranged from 18.5 to 20.7°C, and averaged 19.5°C (Table E2.5-4). The diel fluctuation in temperature ranged from 1.5 to 4.1°C, and averaged 3.6°C. Daily average temperatures at this station in 2000 ranged from 18.2 to 21.2°C, and averaged 19.8°C. The diel fluctuation ranged from 0.9 to 4.1°C, averaging 3.3°C.

Figure E2.5-11 compares 1999, 2000, and 2003 daily average water temperatures in the NFFR at Pulga (Poe-2A). The daily average temperatures at station Poe-2A exceeded 20°C on 6 of 48 days (13%) during the 1999 July-August period and 24 of 62 days (39%) during the 2000 July-August period (Table E2.5-5). The maximum hourly average temperature recorded at this station during the 1999-2000 monitoring program was 23.3°C measured in August 2000 (Appendix E2-3).

The daily average change in temperature in the NFFR between Poe Dam (Poe-5) and Pulga (Poe-2A) was evaluated for the period July-August. The daily average temperature at Poe-2A averaged 0.2°C warmer in both 1999 and 2000 than at Poe-5. These values calculate to approximately than 0.1°C per mile increase in temperature in this section of the Poe Reach. The small difference in daily average temperature between these points is indicative of insignificant solar heating in this section and the cooling provided by the two tributary streams. These data indicate that the two small tributaries may act to dampen temperature increases in the upper bypass section. However, the combined flow volume represented only about 8% of the total flow in 1999 and 2000, thus minimizing the temperature effect of these tributaries.

Due to significant topographic shading in the narrow canyon section (Pulga Gorge) below Pulga, conditions in the Pulga Gorge were monitored during the 1999-2000 period. The Poe-2B station was located approximately 1 mile downstream of the Poe-2A station (at Pulga Bridge). During the 1999 program, daily average temperatures in the NFFR at Poe-2B ranged from 18.2 to 21.1°C, and averaged 19.5°C (Table E2.5-4). The diel fluctuation in temperature at this station ranged from 1.4 to 4.1°C, and averaged 3.3°C. Daily average temperatures at Poe-2B in 2000 ranged from 18.5 to 21.5°C, and averaged 19.9°C. The diel fluctuation ranged from 1.3 to 3.9°C, averaging 3.2°C. Figure E2.5-12 compares 1999, 2000, and 2003 daily average water temperatures in the NFFR downstream of Pulga Bridge (Poe-2B). The maximum hourly average temperature recorded at this station during the 1999-2000 monitoring program was 23.3°C measured in June 2000 (Appendix E2-3). At station Poe-2B, daily average temperatures exceeded 20°C on 13 of 62 days (21%) during the 1999 July-August period and 27 of 62 days (44%) during the 2000 July-August period (Table E2.5-5).

The daily average temperature at Poe-2B averaged 0.1°C cooler in 1999, and 0.2°C warmer in 2000, than at Poe-2A. These values calculate to less than 0.1°C per mile change in temperature in this section of the Poe Reach. The small amount of change between the two stations is within the accuracy range of the instrumentation and is indicative of the short travel time and significant topographic shading present in Pulga Gorge.

Intermediate conditions in the Poe Reach were monitored in the NFFR at Bardees Bar (Poe-6) during the 1999-2000 periods. This station is approximately 2 miles downstream from Pulga, and 1 mile downstream from Poe-2B. During the 1999 program, daily average temperatures at Poe-6 ranged from 18.0 to 21.6°C, and averaged 19.8°C (Table E2.5-4). The diel fluctuation in temperature ranged from 1.2 to 3.9°C, and averaged 2.8°C. Daily average temperatures at this station in 2000 ranged from 18.7 to 21.8°C, and averaged 20.1°C. The diel fluctuation ranged from 1.1 to 3.7°C, averaging 3.0°C. Figure E2.5-13 compares 1999, 2000, and 2003 daily average water temperatures occurring in the NFFR at Bardees Bar (Poe-6). The maximum hourly average temperature recorded at this station during the 1999-2000 monitoring program was 23.4°C measured in June 2000 (Appendix E2-3). The daily average temperatures at Station Poe-6 exceeded 20°C on 22 of 62 days (35%) during the 1999 July-August period and 38 of 62 days (61%) during the 2000 July-August period (Table E2.5-5).

The daily average temperature at Poe-6 averaged 0.3°C warmer in 1999, and 0.2°C warmer in 2000, than at Poe-2B. These values calculate to approximately 0.2°C per mile increase in temperature in this section of the Poe Reach. The water temperature-warming rate in this section is about twice as much as compared to the upper section with a rate of 0.1°C per mile.

The warmest daily temperatures recorded in the Poe Reach during the 1999-2000 period typically occurred in the NFFR upstream of Poe Powerhouse (Poe-3). During the 1999 program, daily average temperatures ranged from 18.7 to 23.4°C, and averaged 21.2°C (Table E2.5-4). The diel fluctuations in temperatures at this station were similar to those observed at the Bardees Bar station (Poe-6), ranging from 1.8 to 3.9°C (3.0°C average). The daily average temperatures in 2000 ranged from 19.5 to 23.4°C, with an average of 21.3°C. Diel fluctuation ranged from 1.4 to 3.8°C, and averaged 3.1°C.

Figure E2.5-14 compares 1999, 2000, and 2003 daily average water temperatures in the

NFFR upstream of Poe Powerhouse (Poe-3). The maximum hourly average temperature recorded at this station during the 1999 - 2000 monitoring program was 25.6°C measured in June 2000 (Appendix E2-3). The daily average temperatures at station Poe-3 exceeded 20°C on 61 of 62 days (98%) during the 1999 July-August period and 49 of 58 days (84%) during the 2000 July-August period (Table E2.5-5).

The daily average temperature at Poe-3 (NFFR upstream of Poe Powerhouse) averaged 1.4°C warmer in both 1999 and 2000 than at Poe-6 (Bardees Bar). These values calculate to a 0.3°C per mile increase in temperature and represented the largest heat gain-per-mile in the Poe Reach.

To compare the relative change in temperature occurring through the entire bypass reach, a two-day average temperature was generated. This was done to account for the long travel time associated with the full length of the reach when the instream flow release is about 50 cfs. The 2-day average temperatures at Poe-3 (upstream of Poe Powerhouse) averaged 1.9°C warmer in 1999, and 1.8°C warmer in 2000, than at Poe-5 (below Poe Dam). These values represent the average heating occurring through the entire Poe Reach and calculate to a 0.3 and 0.2°C per mile increase in temperature for 1999 and 2000, respectively. Figure E2.5-15 compares the 2-day average temperatures at the five stations located in the Poe Reach for 1999. Figure E2.5-16 compares the 2-day average temperatures at the five stations located in the Poe Reach for 2000. These data were used to fine tune and validate the temperature model discussed in Section E2.5.2.7.

#### E2.5.2.1.4 Thermal Gradients in Large Pools

The Licensee conducted a monitoring program in 1999 to evaluate the presence of thermal gradients in large pools located in the Poe Reach. Temperature profiles were measured in three large pools on August 17 and 18, 1999. These pools were located in the upper, middle, and lower end of the reach to characterize the entire reach. Figure E2.5-3 identifies the locations of each of the test pools in the NFFR. Pool 1 was located approximately 0.25 miles downstream of Poe Dam. This pool was approximately 615 ft long with an average width of 100 ft. The thalwag depths ranged from 5 to 18 ft, with an estimated average depth of 8 ft. Based on these measurements, the retention time in Pool 1 was estimated at 1.5 hours. Pool 2 was located at Bardees Bar approximately 3.5 miles downstream of Poe Dam. This pool was approximately 660 ft long with an average width of 107 ft. The thalwag depths ranged from 3 to 18.5 ft, with and estimated average depth of 8 ft. Based on these measurements, the retention time in Pool 2 was estimated at 1.7 hours. Pool 3 was located upstream of Poe Powerhouse approximately 4.0 miles downstream of Poe Dam. This pool was approximately 780 ft long with an average width of 210 ft. The thalwag depths ranged from 3 to 9.5 ft, with and estimated average depth of 5 ft. Based on these measurements, the retention time in Pool 3 was estimated at 2.5 hours.

Results of the gradient monitoring are summarized in Table E2.5-6. As indicated by the data, the vertical change in temperature within any of the pools was less than 0.8°C (maximum profile temperature minus minimum profile temperature).

## Table E2.5-6

**Results of thermal gradient profiles in three large pools in the Poe Reach of NFFR.**

**Physical Characteristics**

| Pool | Location | Pool Size[1] (ft) | Estimated Volume[2] (Ac-ft) | Residence Time[3] (hours) | Profile Station Data ID | Profile Station Data Position[4] |
|---|---|---|---|---|---|---|
| Pool-1 | NFFR below Poe Dam | 615 x 100 | 11.3 | 1.5 | 1A | 0+225 |
| Pool-2 | NFFR at Bardees Bar | 660 x 107 | 13.0 | 1.7 | 2A | 0+330 |
| | | | | | 2B | 0+450 |
| Pool-3 | NFFR upstream of Poe Powerhouse | 780 x 210 | 18.8 | 2.5 | 3A | 0+255 |
| | | | | | 3B | 0+375 |

1. Length and width estimated using an optical range finder
2. Volume calculated using the length and width measurements and an estimated average depth.
3. Residence time based on estimated volume calculations and a flow rate of 92 cfs.
4. Distance measured in feet from the upstream end of the pool

## Table E2.5-6 (continued)

### Profile Data

| Station | Date | Depth (ft) | Temperature (C) | Dissolved Oxygen (mg/l) |
|---|---|---|---|---|
| Pool-1A | 08/18/99 | 0.0 | 18.2 | 8.9 |
| | | 4.0 | 18.1 | 8.9 |
| | | 8.0 | 18.1 | 8.9 |
| | | 12.0 | 18.0 | 8.9 |
| | | 16.0 | 18.0 | 8.9 |
| | | 18.0 | 18.0 | 8.9 |
| | | 18.0 Bottom | | |
| | | Gradient | 0.2 | 0.0 |
| Pool-2A | 08/18/99 | 0.0 | 18.1 | 9.4 |
| | | 4.0 | 18.0 | 9.4 |
| | | 8.0 | 17.9 | 9.4 |
| | | 12.0 | 17.8 | 9.3 |
| | | 16.0 | 17.6 | 9.3 |
| | | 18.5 Bottom | | |
| | | Gradient | 0.5 | 0.1 |
| Pool-2B | 08/18/99 | 0.0 | 18.1 | 9.5 |
| | | 3.0 | 18.0 | 9.5 |
| | | 6.0 | 17.9 | 9.5 |
| | | 9.0 | 17.9 | 9.5 |
| | | 12.0 | 17.7 | 9.6 |
| | | 13.0 Bottom | | |
| | Gradient | | 0.4 | 0.1 |
| Pool-3A | 08/17/99 | 0.0 | 18.8 | 9.1 |
| | | 3.0 | 18.5 | 9.1 |
| | | 6.0 | 18.2 | 9.1 |
| | | 9.0 | 18.2 | 9.2 |
| | | 9.0 Bottom | | |
| | | Gradient | 0.6 | 0.1 |
| Pool-3B | 08/17/99 | 0.0 | 18.8 | 9.1 |
| | | 3.0 | 18.2 | 9.1 |
| | | 6.0 | 18.2 | 9.1 |
| | | 9.0 | 18.1 | 9.0 |
| | | 9.5 Bottom | | |
| | | Gradient | 0.7 | 0.1 |

During the gradient evaluation, flows in the bypass reach averaged approximately 92 cfs, which is 42 cfs more than the 50-cfs minimum required at the Pulga gage station. Field observations with regard to channel morphology suggest that the pool located at the Bardees Bar site might exhibit larger gradients at lower flows due to increased residence time. However, based on the fact that the retention times in these pools are still relatively short compared with Poe Reservoir, thermal gradients are not expected to develop at lower flows.

TEMP. EXCEED

#### E2.5.2.1.5 Instream Test Flow Release

During the 2000 monitoring period, two test flow releases were made from Poe Dam, providing the opportunity to monitor water temperatures under higher than normal flow conditions. The first test release was on May 19 through 21, and the second test release was conducted September 8 through 10. Table E2.5-7 summarizes the results of the temperature monitoring conducted during the test flow releases.

## Table E2.5-7

**Evaluation of temperature effects associated with test flow releases in Poe Reach.**

| Station | Date | Daily Water Temperature | | | Diel | Mean Daily | Condition |
|---|---|---|---|---|---|---|---|
| | | Maximum | Minimum | Mean | Cycle | Flow [1] | |
| Poe 5 | 05/17/00 | --- | --- | --- | --- | 122 | Normal |
| | 05/18/00 | 12.4 | 10.4 | 11.4 | 2.0 | 120 | Normal |
| | 05/19/00 | 13.2 | 11.7 | 12.5 | 1.5 | 282 | Test |
| | 05/20/00 | 13.7 | 12.9 | 13.4 | 0.8 | 423 | Test |
| | 05/21/00 | 14.4 | 13.6 | 14.1 | 0.8 | 633 | Test |
| | 05/22/00 | 15.1 | 14.0 | 14.6 | 1.1 | 118 | Normal |
| | 05/23/00 | 15.6 | 14.4 | 15.0 | 1.2 | 116 | Normal |
| Poe 2A | 05/17/00 | --- | --- | --- | --- | 122 | Normal |
| | 05/18/00 | 14.6 | 10.2 | 12.0 | 4.4 | 120 | Normal |
| | 05/19/00 | 14.3 | 11.5 | 12.9 | 2.8 | 282 | Test |
| | 05/20/00 | 14.7 | 12.5 | 13.7 | 2.2 | 423 | Test |
| | 05/21/00 | 15.4 | 13.3 | 14.4 | 2.1 | 633 | Test |
| | 05/22/00 | 17.8 | 13.6 | 15.3 | 4.2 | 118 | Normal |
| | 05/23/00 | 18.6 | 14.1 | 16.0 | 4.5 | 116 | Normal |
| Poe 3 | 05/17/00 | --- | --- | --- | --- | 122 | Normal |
| | 05/18/00 | 16.6 | 13.2 | 15.5 | 3.4 | 120 | Normal |
| | 05/19/00 | 16.0 | 13.8 | 15.0 | 2.2 | 282 | Test |
| | 05/20/00 | 17.0 | 14.6 | 15.6 | 2.4 | 423 | Test |
| | 05/21/00 | 17.2 | 14.5 | 15.9 | 2.7 | 633 | Test |
| | 05/22/00 | 19.7 | 15.4 | 17.2 | 4.3 | 118 | Normal |
| | 05/23/00 | 21.3 | 17.1 | 18.9 | 4.2 | 116 | Normal |

1: Flows are those recorded in the NFFR at Pulga (NF-23).

7day x̄ = 12.06

7day x̄ = 13.63

7day x̄ = 15.4

## Table E2.5-7
## Continued

| Station | Date | Daily Water Temperature Maximum | Minimum | Mean | Diel Cycle | Mean Daily Flow[1] | Condition |
|---|---|---|---|---|---|---|---|
| Poe 5 | 09/06/00 | 17.1 | 16.4 | 16.8 | 0.7 | 105 | Normal |
| 7day x̄ | 09/07/00 | 17.6 | 16.7 | 17.1 | 0.9 | 103 | Normal |
| 17.34 | 09/08/00 | 17.3 | 16.6 | 16.9 | 0.7 | 442 | Test |
| | 09/09/00 | 17.3 | 16.4 | 16.9 | 0.9 | 460 | Test |
| | 09/10/00 | 17.3 | 16.5 | 17.0 | 0.8 | 236 | Test |
| | 09/11/00 | 17.2 | 16.6 | 17.0 | 0.6 | 103 | Normal |
| | 09/12/00 | 17.6 | 16.6 | 17.1 | 1.0 | 103 | Normal |
| Poe 2A | 09/06/00 | 18.6 | 15.7 | 16.7 | 2.9 | 105 | Normal |
| 7day x̄ = | 09/07/00 | 19.1 | 15.8 | 17.0 | 3.3 | 103 | Normal |
| 18.29 | 09/08/00 | 17.4 | 16.3 | 16.8 | 1.1 | 442 | Test |
| | 09/09/00 | 17.5 | 16.6 | 17.0 | 0.9 | 460 | Test |
| | 09/10/00 | 17.9 | 16.4 | 17.0 | 1.5 | 236 | Test |
| | 09/11/00 | 18.9 | 16.2 | 17.2 | 2.7 | 103 | Normal |
| | 09/12/00 | 18.6 | 16.1 | 17.1 | 2.5 | 103 | Normal |
| Poe 3 | 09/06/00 | 18.6 | 15.9 | 17.2 | 2.7 | 105 | Normal |
| 7day x̄ = | 09/07/00 | 19.2 | 16.3 | 17.6 | 2.9 | 103 | Normal |
| 19.03 | 09/08/00 | 18.6 | 16.4 | 17.6 | 2.2 | 442 | Test |
| | 09/09/00 | 18.8 | 16.4 | 17.6 | 2.4 | 460 | Test |
| | 09/10/00 | 18.7 | 16.0 | 17.4 | 2.7 | 236 | Test |
| | 09/11/00 | 19.5 | 17.1 | 18.2 | 2.4 | 103 | Normal |
| | 09/12/00 | 19.8 | 17.2 | 18.4 | 2.6 | 103 | Normal |

1: Flows are those recorded in the NFFR at Pulga (NF-23).

Figure E2.5-17 compares the change in the diel temperature cycle of three monitoring stations during the course of the May 2000 test. An increasing trend in temperature was observed at all three stations during the test. For the two days prior to the test releases, daily average flow in the bypass reach ranged from 120 to 122 cfs (Table E2.5-7). During the test releases, daily average flows measured at the Pulga gage ranged from 282 to 633 cfs. Following the test, flows returned to the pre-test condition (~116 cfs). This trend was present at all stations and was apparent prior to and following the test releases. This trend is therefore attributed to the normal seasonal increase in temperatures.

Figure E2.5-18 compares the change in the diel temperature cycle at three monitoring stations during the course of the September 2000 test. For the two days prior to the test releases, daily average flows in the bypass reach ranged from 103 to 105 cfs (Table E2.5-7). During the test releases, daily average flows measured at the Pulga gage ranged from 236 to 460 cfs. Following the test, flows returned to the pre-test condition (~103 cfs). There was no apparent trend in temperature at any of stations during the September test flow releases. Little variation in the daily average temperatures was observed during the test flow as compared with the pre-test and post-test conditions.

The higher flow releases showed a noticeable effect on the magnitude of the diel fluctuation at certain distances downstream. As indicated by these data, the diel temperature cycle at the starting station immediately downstream of the dam (Poe-5) showed little or no effect from the increased flows. The station at Pulga (Poe-2A) showed the greatest effect from the higher releases; this is related to the shorter travel time between this station and the dam (and hence less solar heating). The diel temperature cycle under pre-test release conditions was between 2 and 3°C. At the pre-test flow release of approximately 100 cfs, the travel time was more than 24 hours, or one full solar heating cycle. During the peak portion of the release, the travel time was reduced significantly such that the water was not exposed to a full solar heating cycle. As a result, the diel fluctuation was reduced to less than 1°C, which was similar to the values observed at the upstream station (Poe-5). The station further downstream at the end of the bypass reach (Poe-3) showed only a slight change in the magnitude of the diel cycle during the test. This indicates that moderately elevated flows do not effectively alter the diel pattern in the lower portion of the bypass reach. As a result, the normal pattern of heating in the lower part of the bypass reach was maintained during the test releases.

In general, increased flow releases in the Poe Reach did not lower the daily average temperatures. Increased releases did tend to reduce the diel cycle (lower maximum temperature and/or raise the minimum temperature) at stations close to the release point. Stations that were located at the end of the reach showed little or no effect from the increased flows. Both of the 2000 test release events were conducted during periods of mild meteorological conditions (May and September). The effects of increased flows on temperatures during the warmer June-August period are best evaluated using the temperature model results presented in Section E2.5.2.7.

**E2.5.2.1.6 Stream Temperature Model Validation**

The original Poe WCC-SNTEMP model was established using 1985 data (Woodward-Clyde 1986a). A meteorological evaluation was conducted by the Licensee that ranked monthly average air temperatures (10, 50, and 90-percentile) at Canyon Dam for the period 1948 to 2000. This evaluation, summarized in Table E2.5-8, revealed that the summer of 1985 had an unusual weather pattern distribution: the warmest June on record, a relatively warm July (89.7 percentile), followed by a normal August (44.6 percentile), and a relatively cold September (6.7 percentile).

The WCC-SNTEMP model was further tested with data from 1999 and 2000, which had different climatological conditions than those observed in 1985 (Table E2.5-8). Mean monthly air temperatures in June 1999 were ranked as normal (50-percentile); July and August 1999 were slightly below normal (34- and 40-percentile, respectively); and September 1999 was above normal (80-percentile). In comparison, mean monthly air temperatures in June 2000 were ranked significantly above normal (96-percentile); July and September 2000 were below normal (26- and 24-percentile, respectively); and August 2000 was above normal (70-percentile).

## Table E2.5-8

**Summary of monthly average air temperature ranking at Poe Powerhouse from data period 1948-2003**

| Month | Mean Air Temperature (°F) | (°C) | Percentile Ranking | Reference Year |
|---|---|---|---|---|
| June | 66.2 | 19.0 | 10.0 | |
| | 68.6 | 20.3 | 50.0 | |
| | 71.0 | 21.6 | 90.0 | |
| | *68.6* | *20.3* | *50.0* | *1999* |
| | *71.4* | *21.9* | *96.0* | *2000* |
| | *73.2* | *22.9* | *100.0* | *1985* |
| | *71.9* | *22.2* | *98.6* | *2003* |
| July | 73.1 | 22.9 | 10.0 | |
| | 74.8 | 23.8 | 50.0 | |
| | 76.6 | 24.8 | 90.0 | |
| | *73.9* | *23.3* | *26.0* | *2000* |
| | *74.3* | *23.5* | *34.0* | *1999* |
| | *76.6* | *24.8* | *89.7* | *1985* |
| | *77.2* | *25.1* | *98.0* | *2003* |
| August | 70.9 | 21.6 | 10.0 | |
| | 72.2 | 22.3 | 50.0 | |
| | 73.5 | 23.0 | 90.0 | |
| | *71.8* | *22.1* | *40.0* | *1999* |
| | *71.9* | *22.2* | *44.6* | *1985* |
| | *72.6* | *22.6* | *70.0* | *2000* |
| | *72.5* | *22.5* | *67.0* | *2003* |
| September | 63.0 | 17.2 | 10.0 | |
| | 66.0 | 18.9 | 50.0 | |
| | 67.7 | 19.8 | 90.0 | |
| | *62.5* | *16.9* | *6.7* | *1985* |
| | *64.2* | *17.9* | *24.0* | *2000* |
| | *67.5* | *19.7* | *80.0* | *1999* |
| | *68.5* | *20.3* | *95.0* | *2003* |

Data Source: Data from California Data Exchange Center (CDEC) at Canyon Dam station, adjusted to the equivalent location at Poe Powerhouse. The adjustment coefficients are from the regression analysis of 1985 data (Woodward-Clyde 1986a).

The WCC-SNTEMP model over-predicted the 2-day average water temperature at the NFFR above Poe Powerhouse by as much as 2°C when tested against data from 1999. The accuracy statistics indicated that the model exhibited a relatively large bias error of 0.8°C. The bias error is the average difference between the model predictions and the observed data. Ideally, this error value should approach zero. The probable error of the WCC-SNTEMP model was 0.4°C, which is acceptable since it is within the calibrated accuracy range of 0.5°C. The probable error is 0.6745 times the standard deviation. The mean value plus or minus the probable error contains 50% of the values if they are normally distributed.

The WCC-SNTEMP model was recalibrated with modifications in two major categories. These modifications consisted of updating the stream geometry parameters using information obtained from the recent Instream Flow/Habitat Mapping study (see Section E3.1.8), and adjusting meteorological correlation coefficients based on 1999-2000 data and the reach's channel shading parameters. The WCC-SNTEMP model was recalibrated using 1999 temperature data, and then the new model was validated using 2000 temperature data. The modified model was termed the PG&E-WCC-SNTEMP model and will be referred to as the SNTEMP model throughout the remainder of the Exhibit E unless it is otherwise specified.

The recalibrated model provided better agreement with observed values. The new model has an overall bias error of 0.22°C and a probable error of 0.21°C for 1999 data (Table E2.5-9). Agreement with the 2000 data was reasonable, and modeling accuracy was consistent with that established with the 1999 data.

Figures E2.5-19, E2.5-20, and E2.5-21 compare model predictions with the observed 2-day average temperatures at three stations in the Poe Reach for 1999, 2000: Poe-2B, Poe-6 and Poe-3, respectively. Poe-2B is about 2 miles below Poe Dam and marks the end of gorge near Pulga Bridge. Poe-6 is approximately 3.3 miles below Poe Dam and is a mid-point station in the Poe Reach. Poe-3 is about 7.6 miles below Poe Dam and is above Poe Powerhouse, representing the end of the reach. Figures E2.5-19 to E2.5-21 demonstrate that there is good agreement between predicted and observed temperature values.

## Table E2.5-9

## PG&E-WCC-SNTEMP Model Calibration and Validation Statistics

| Station ID | Description | Calibration | Validation | Validation |
|---|---|---|---|---|
| | | 1999 | 2000 | 2003 |
| Poe-2A | at Pulga Gaging Station | --- | --- | -0.17°C ± 0.05°C [1] |
| Poe-2B | 1 mile below Pulga Gage | 0.12°C ± 0.1°C [1] | 0.14°C ± 0.1°C [1] | --- |
| Poe-6 | Bardees Bar | 0.28°C ± 0.16°C [1] | 0.03°C ± 0.15°C [1] | -0.20°C ± 0.12°C [1] |
| Poe-3 | Above Poe Powerhouse | 0.27°C ± 0.3°C [1] | -0.12°C ± 0.1°C [1] | -0.40°C ± 0.23°C [1] |
| ----- | Overall | 0.22°C ± 0.21°C [1] | -0.07°C ± 0.21°C [1] | -0.25°C ± 0.17°C [1] |

1. Model accuracy, expressed as bias ± probable error

Longitudinal temperature gradients at the various stations were relatively well represented by the model. Figure E2.5-22 compares model predictions with observed temperatures over distance on four different days in 1999. Figure E2.5-23 compares model predictions with observed temperatures over distance on five different days in 2000. It is noteworthy that the predicted profile on September 9, 2000 exhibits a nearly flat gradient. This is an expected result from the combined effects of high flows (200 to 480 cfs were released on September 8-10, 2000 during the Instream Flow Study) and the relatively cool climatic conditions typical in late summer. Figure E2.5-23 also includes the profile of September 3rd, representing conditions in the system prior to the high flow release. The nearly identical flat gradient shown for profiles on September 3rd and 9th suggest that there is little change in water temperature with increasing volume of water under mild climatic conditions.

**E2.5.2.2 Results of the 2003 Monitoring**

Continuous monitoring of water temperatures (sampled at 15-minute intervals with recorded temperatures averaged over a one-hour period) was conducted during the period June-September 2003. Appendix E2-3 presents a summary of hourly average data in a hard copy table. For consistency with the temperature objective specified for the Licensee's Rock Creek Cresta Project (FERC 1962) (Pacific Gas and Electric Company 2000b), daily average data are used throughout this document unless otherwise specified. Table E2.5-4 summarizes all daily average water temperature data collected during the 2003 program. For the purpose of comparative analysis, the water temperature discussion in the following section will focus on the two warmest months, July and August.

#### E2.5.2.2.1 Cresta Powerhouse and Cresta Reach of NFFR

As discussed in Section E2.3, the majority of flow occurring in the Poe Project originates from the NFFR diversion through Cresta Powerhouse. All of the flow of the NFFR passes through Poe Reservoir, with the majority passing downstream through Poe Powerhouse.

Temperatures were monitored in 2003 at the lower end of the Cresta Reach of the NFFR (Poe-1C). This station was located in the NFFR upstream of any backwater influence from the Cresta Powerhouse Tailrace and Poe Reservoir. During the 2003 program, daily average temperatures at station Poe-1C ranged from 17.7 to 22.7°C, and averaged 20.1°C (Table E2.5-4). The diel fluctuation in temperature ranged from 0.6 to 3.4°C, and averaged 2.6°C in 2003. Figure E2.5-4 compares 2003 daily average water temperatures occurring in NFFR above Cresta Powerhouse (Poe-1C) with those from 1999 and 2000. The maximum hourly average temperature recorded at this station during the 2003 monitoring program was 23.9°C measured on July 30, 2003 (Appendix E2-3). At station Poe-1C, daily average temperatures exceeded 20°C on 32 of 62 days (52%) during the 2003 July through August period (Table E2.5-5).

Due to the large fluctuation in water level and high velocity present in the tailrace of Cresta Powerhouse, deployment of recorders in the tailrace was not feasible. As a result, temperatures at Cresta Powerhouse (Poe-1B) were monitored inside the powerhouse in 2003. Daily average temperatures at Cresta Powerhouse were compared with temperatures at the Poe-1A station (NFFR above Poe Reservoir, also referred to as NFFR below Cresta Powerhouse). On average, there was no measurable difference between these two stations in 2003 during periods of powerhouse operation. The data indicate that conditions in the NFFR above Poe Reservoir (Poe-1A) are driven by releases from Cresta Powerhouse.

During the 2003 program, daily average temperatures in the NFFR upstream of Poe Reservoir (Poe-1A) ranged from 17.4 to 22.3°C, with a mean of 19.9°C (Table E2.5-4). The diel fluctuation in temperature at this station was small, reflecting the large flow volume and short retention time in upstream reservoirs; diel fluctuation ranged from 0.4 to 1.8°C, and averaged 0.9°C. Figure E2.5-5 compares 2003 daily average water temperatures in the NFFR downstream of Cresta Powerhouse (Poe-1A) with daily average temperatures measured in 1999 and 2000. The maximum hourly average temperature recorded at this station during the 2003 monitoring program was 22.7°C measured in July 30, 2003 (Appendix E2-3).

The daily average temperatures at station Poe-1A exceeded 20°C on 24 of 62 days (39%) during the 2003 July-August period (Table E2.5-5). These temperatures represent the initial conditions for the Poe Project.

**E2.5.2.2.2 Poe Reservoir**

As discussed previously, Poe Reservoir receives all of the inflow from Cresta Powerhouse and the Cresta Reach of the NFFR. Reservoir profiles were not measured in 2003 due to the lack of gradients observed in 1999 and the presence of monitoring stations located immediately upstream and downstream of the reservoir. These upstream and downstream stations confirmed the absence of change in temperature within the reservoir and validated the assumption that the reservoir is well mixed. In 2003, the daily average temperatures in the NFFR below Poe Dam (Poe-5) averaged 0.2°C warmer than the NFFR above Poe Reservoir (Poe-1A).

Temperatures in the Poe Powerhouse Tailrace (Poe-4B) were monitored internally in 2003. During the 2003 program, daily average temperatures at Poe-4B ranged from 17.7 to 22.7°C, and averaged 20.2°C (Table E2.5-4). Diel fluctuations in temperature were low to moderate at this station, ranging from 0.3 to 1.4°C, and averaged 0.8°C. Figure E2.5-7 compares 2003 daily average water temperatures measured at Poe Powerhouse (Poe-4B) with those from 1999 and 2000. The maximum hourly average temperature recorded at this station during the 2003 monitoring program was 22.9°C measured on July 30, 2003 (Appendix E2-3). The daily average temperatures at station Poe-4B exceeded 20°C on 37 of 62 days (60%) during the 2003 July-August period (Table E2.5-5).

Comparison of daily average temperatures from the NFFR upstream of Poe Reservoir (Poe-1A) with those from Poe Powerhouse (Poe-4B) was used to further define the thermal structure in Poe Reservoir. The daily average temperatures in the Poe Powerhouse Tailrace (Poe-4B) averaged 0.2°C warmer in 2003, than the NFFR above Poe Reservoir (Poe-1A). These differences are within the accuracy range of the instrumentation and indicate no appreciable change in temperature attributable to residence time in Poe Reservoir.

### E2.5.2.2.3 Poe Reach of NFFR

Initial conditions in the Poe Reach were measured in the NFFR immediately downstream of Poe Dam (Poe-5) during 2003. During the 2003 program, daily average temperatures in the NFFR downstream of Poe Dam ranged from 17.6 to 22.5°C, and averaged 20.1°C (Table E2.5-4). The diel fluctuation in temperature ranged from 0.2 to 1.2°C, and averaged 0.6°C. These changes were similar to those observed at Poe-4B (Poe Powerhouse), and are indicative of conditions in Poe Reservoir. Figure E2.5-8 compares 2003 daily average water temperatures in the NFFR downstream of Poe Dam (Poe-5) with those from 1999 and 2000. The daily average temperatures at station Poe-5 exceeded 20°C on 34 of 62 days (55%) during the 2003 July through August period (Table E2.5-5). The maximum hourly average temperature recorded at this station during the 2003 monitoring program was 22.8°C measured in July 31, 2003 (Appendix E2-3).

Temperatures in Mill Creek (MC) were monitored above the Highway 70 road culvert during 2003. Daily average temperatures in 2003 ranged from 13.4 to 18.3°C, and averaged 15.7°C (Table E2.5-4). Diel fluctuations in temperature were moderate at this station reflecting the natural (unregulated) flow conditions; diel cycles ranged from 0.4 to 3.3°C, and averaged 2.3°C. Figure E2.5-9 compares 2003 daily average water temperatures occurring in Mill Creek with those from 1999 and 2000.

Temperatures in Flea Valley Creek (FVC) were monitored downstream of the railroad trestle during 2003. Daily average temperatures in 2003 ranged from 13.7 to 17.3°C, and averaged 15.5°C (Table E2.5-4). Diel fluctuations in temperature were moderate at this station reflecting the natural (unregulated) flow conditions; diel cycles ranged from 0.5 to 3.1°C, and averaged 2.4°C. Figure E2.5-10 compares 2003 daily average water temperatures occurring in Flea Valley Creek with those from 1999 and 2000.

Conditions in the Poe Reach immediately downstream of the primary tributaries were monitored near the Pulga gage station (Poe-2A) during 2003. During the 2003 program, daily average temperatures in the NFFR at Pulga ranged from 17.8 to 22.6°C, and averaged 20.3°C (Table E2.5-4). The diel fluctuation in temperature ranged from 0.9 to 3.7°C, and averaged 3.0°C. Figure E2.5-11 compares 2003 daily average water temperatures occurring in the NFFR at Pulga (Poe-2A) with those from 1999 and 2000. The daily average temperatures at station Poe-2A exceeded 20°C on 40 of 62 days (65%) during July-August 2003 (Table E2.5-5). The maximum hourly average temperature recorded at this station during the 2003 monitoring program was 24.3°C measured July 30, 2003 (Appendix E2-3).

The daily average change in temperature in the NFFR between Poe Dam (Poe-5) and Pulga (Poe-2A) was evaluated for the period July-August. The daily average temperature at Poe-2A averaged 0.18°C warmer than at Poe-5 in 2003. These values calculate to approximately 0.11°C per mile increase in temperature in this section of the Poe Reach.

The small difference in daily average temperature between these points is indicative of insignificant solar heating in this section and the cooling provided by the two tributary streams. These data indicate that the two small tributaries may act to dampen temperature increases in the upper bypass section. However, the combined flow volume represented only about 9% of the total flow in 2003, thus minimizing the temperature effect of these tributaries.

Intermediate conditions in the Poe Reach were monitored in the NFFR at Bardees Bar (Poe-6) during 2003. This station is approximately 2 miles downstream from the NF-23 Pulga gage. During the 2003 program, daily average temperatures at Poe-6 ranged from 18.2 to 23.2°C, and averaged 20.6°C (Table E2.5-4). The diel fluctuation in temperature ranged from 0.9 to 4.3°C, and averaged 3.2°C. Figure E2.5-13 compares 2003 daily average water temperatures occurring in the NFFR at Bardees Bar (Poe-6) with those from 1999 and 2000. The maximum hourly average temperature recorded at this station during the 2003 monitoring program was 24.5°C measured on July 29, 2003 (Appendix E2-3). The daily average temperatures at Station Poe-6 exceeded 20°C on 44 of 62 days (71%) during July-August 2003 (Table E2.5-5).

The daily average temperature at Poe-6 averaged 0.38°C warmer in 2003 than at Poe-2A. These values calculate to approximately 0.20°C per mile increase in temperature in this section of the Poe Reach. The water temperature-warming rate in this section is about twice as much as compared to the upper section with a rate of 0.1°C per mile.

The warmest daily temperatures recorded in the Poe Reach during the 2003 period typically occurred in the NFFR upstream of Poe Powerhouse (Poe-3). During the 2003 program, daily average temperatures ranged from 19.6 to 24.5°C, and averaged 21.8°C (Table E2.5-4). The diel fluctuations in temperatures at this station were similar to those observed at the Bardees Bar station (Poe-6), ranging from 0.6 to 3.3°C (2.8°C average).

Figure E2.5-14 compares 2003 daily average water temperatures occurring in the NFFR upstream of Poe Powerhouse (Poe-3) with those from 1999 and 2000. The maximum hourly average temperature recorded at this station during the 2003 monitoring program was 26.0°C measured July 30, 2003 (Appendix E2-3). The daily average temperatures at station Poe-3 exceeded 20°C on 59 of 62 days (95%) during the 2003 July-August period (Table E2.5-5).

The daily average temperature at Poe-3 (NFFR upstream of Poe Powerhouse) averaged 1.14°C warmer in 2003 than at Poe-6 (Bardees Bar). These values calculate to a 0.28°C per mile increase in temperature and represented the largest heat gain-per-mile in the Poe Reach.

To compare the relative change in temperature occurring through the entire bypass reach, a two-day average temperature was generated. This was done to account for the long travel time associated with the full length of the reach when the instream flow release is about 50 cfs. The 2-day average temperatures at Poe-3 (upstream of Poe Powerhouse) averaged 1.9°C warmer in 2003, than at Poe-5 (below Poe Dam). These values represent the average heating occurring through the entire Poe Reach and calculate to a 0.22°C per mile increase in temperature for 2003. Figure E2.5-24 compares the 2-day average temperatures at the four stations located in the Poe Reach for 2003. These data were used to fine tune and validate the temperature model discussed in Section E2.5.2.7.

The effective end of the Poe Project occurs at the inflow to Lake Oroville, the demarcation between the NFFR and Lake Oroville occurs at Big Bend Dam. As previously discussed in Section E2.3, Big Bend Dam is the remnant diversion facility once used to divert water to the Big Bend Powerhouse. The Big Bend Powerhouse was submerged by Lake Oroville, but the dam is still used to provide elevation control for the tailrace of Poe Powerhouse.

During the 2003 monitoring effort a recorder was located on the upstream face of the Big Bend Dam (Poe-7). Daily average temperatures ranged from 17.9 to 22.8°C, and averaged 20.4°C during July-August 2003 (Table E2.5-4). The diel fluctuations in temperatures at this station ranged from 0.5 to 2.5°C, with a 1.3°C average.

Figure E2.5-25 presents 2003 daily average water temperatures occurring in the NFFR at Big Bend Dam (Poe-7). The maximum hourly average temperature recorded at this station during the 2003 monitoring program was 23.1°C measured on July 30, 2003 (Appendix E2-3). The daily average temperatures at station Poe-7 exceeded 20°C on 41 of 62 days (66%) during the 2003 July-August period (Table E2.5-5).

The daily average temperature at Poe-7 (NFFR at Big Bend Dam) averaged 0.2°C warmer in 2003 than at Poe-4B (Poe PH tailrace). This is essentially within the accuracy of the instruments. The daily average temperature at Poe-7 (NFFR at Big Bend Dam) averaged 1.4°C cooler in 2003 than at Poe-3 (upstream of Poe PH).

**E2.5.2.2.4 Stream Temperature Model Validation**

The SNTEMP model of the Poe reach of the North Fork of the Feather River was evaluated for its ability to match measured temperatures from 1985, 1999, and 2000. Evaluation of model performance using 2003 data provided additional confidence in the ability of the model to simulate average water temperatures in the Poe reach.

The WCC-SNTEMP model was further tested with data from 2003, which had different climatological conditions than those observed in previous validation years (Table E2.5-8). Mean monthly air temperatures in 2003 were consistently warmer than any of the other monitored periods (1985, 1999, and 2000). Mean monthly air temperatures in June and July 2003 both were ranked as above normal (98-percentile); August 2003 was slightly above normal (67-percentile); with September 2003 being above normal (95-percentile).

The SNTEMP model was able to accurately simulate the 2-day average water temperatures for 2003. Model performance was similar to model performance for the 1999 and 2000 simulations (Figures E2.5-19, E2.5-20, and E2.5-21). These figures demonstrate that there is relatively good agreement between predicted and observed temperature values. For 2003, the overall bias error was 0.25°C. The bias errors at the

Pulga gaging station (Poe-2A), Bardees Bar (Poe-6), and above Poe Powerhouse (Poe-3) were 0.17°C, 0.20°C, and 0.40°C, respectively. The probable errors were relatively small, with an overall value of 0.17°C.

Longitudinal temperature gradients at the various stations were relatively well represented by the model. The ability of the SNTEMP model to properly simulate the increase in temperature as water moved downstream is shown in Figure E2.5-26. Evaluation of four selected dates from the summer 2003 (i.e., June 15, July 15, August 15, and September 15) shows that the model was able to properly match the longitudinal increase in temperature between Poe Dam and the Poe Powerhouse. The measured longitudinal warming tended to decrease through the June–September sampling period. One indicator of the model's ability to simulate temperatures was its ability to match this trend. For example, on June 15, 2003, the dam-to-powerhouse warming was measured as 2.7°C and simulated as 2.8°C. On September 15, the warming was smaller: measured as 0.7°C and simulated as 0.2°C.

### E2.5.3 Results of Water Chemistry Monitoring

The NFFR within the Poe Project area has been the subject of several water quality studies (USGS 1972, 1977; CDFG 1988; Woodward-Clyde 1986a). In combination, these studies provide long-term data for the system. The following assessment of water quality in the Project vicinity is based on historical data identified in the First Stage Consultation Package for the Poe Project (Pacific Gas and Electric Company 1999), and on monitoring conducted by the Licensee during 1999 and 2000.

### E2.5.3.1 Results from 1999-2000 Monitoring

This Section will discuss the results of monitoring conducted by the Licensee during 1999-2000. A discussion of methods and monitoring locations is presented in Section E2.5.1.1.

#### E2.5.3.1.1 General Chemistry

Table E2.5-10 summarizes the general water quality data from the NFFR and tributary streams for the 1999-2000 monitoring program. Water in the NFFR in the Poe Project area can be described as soft (35 – 59 mg/L as CaCO3) and of moderate to low alkalinity (40 – 122 mg/L as CaCO3). The water is generally low in dissolved minerals as measured by total dissolved solids (TDS) and specific conductance. TDS levels ranged from 45 to 110 mg/L with no pattern of concentration distribution apparent in the Project area.

The primary cation at all sampling stations in the NFFR was calcium, followed by magnesium and sodium. The levels of each of these three constituents were similar between stations. Calcium levels ranged from 7.1 to 12.0 mg/L; average magnesium values ranged from 3.4 to 5.9 mg/L; and average sodium levels ranged from 2.9 to 6.3 mg/L.

## Table E2.5-10

Iron MCL - 300ppb

Chemistry (Iron) Data

### Results of 1999-2000 general water quality monitoring in the Poe Project.

**Analytical Constituents**

| Constituent | Units | Reporting Limit | NFFR upstream of Poe Reservoir (Poe-1A) Sample Date 03/24/99 | 06/16/99 | 07/14/99 | 08/11/99 | 09/13/99 | 12/16/99 | 03/31/00 |
|---|---|---|---|---|---|---|---|---|---|
| ***General Chemistry*** | | | | | | | | | |
| Calcium | mg/L | 0.10 | 9.60 | 9.80 | 9.30 | 9.00 | 12.00 | 11.00 | 8.70 |
| Magnesium | mg/L | 0.10 | 3.70 | 3.90 | 4.10 | 4.00 | 5.40 | 4.90 | 3.60 |
| Sodium | mg/L | 0.005 | 3.30 | 3.60 | 3.80 | 3.70 | 6.30 | 4.60 | 5.20 |
| Potassium | mg/L | 1.00 | 0.77 | 0.89 | 1.40 | 0.98 | 1.10 | 1.10 | 0.89 |
| Sulfate | mg/L | 0.20 | 2.40 | 4.00 | 1.40 | 1.30 | 2.00 | 2.00 | 2.00 |
| Chloride | mg/L | 0.20 | 0.87 | 1.00 | 0.70 | 0.60 | 1.00 | 1.00 | ND[1] |
| Total Dissolved Solids | mg/L | 10 | 74 | 56 | 45 | 65 | 90 | 67 | 110 |
| Total Hardness | mg/L | 1.0 | 41 | 39 | 39 | 40 | 56 | 40 | 43 |
| Total Alkalinity | mg/L | 10 | 122 | 50 | 50 | 50 | 70 | 50 | 50 |
| Bicarbonate Alkalinity | mg/L | 10 | 122 | 50 | 50 | 50 | 70 | 50 | 50 |
| Silica | mg/L | 2.0 | 19.0 | 13.0 | 12.0 | 12.4 | 13.0 | 14.0 | 18.0 |
| MBAS | mg/L | 0.05 | ND | ND | ND | ND | ND | ND | ND |
| ***Trace Metals*** | | | | | | | | | |
| Arsenic | µg/L | 5.0[2] (3.2)[3] | ND | ND | ND | ND | ND | ND | ND |
| Barium | µg/L | 5.0 (0.4) | 17.0 | 14.0 | 12.0 | 11.0 | 19.0 | 13.0 | 17.0 |
| Boron | µg/L | 100 | ND | ND | ND | ND | ND | ND | ND |
| Cadmium | µg/L | 2.0 (0.4) | ND | ND | ND | ND | ND | ND | ND |
| Chromium | µg/L | 5.0 (0.5) | ND same | ND | ND | ND | ND | ND | ND |
| Copper | µg/L | 5.0 (0.4) | 3.5 | ND | ND | ND | ND | ND | ND |
| Iron | µg/L | 100 (2.8) | 340.0 | 210.0 | 140.0 | 100.0 | 540.0 | 95.0 | 280.0 |
| Lead | µg/L | 5.0 (1.3) | ND | ND | ND | ND | ND | ND | ND |
| Manganese | µg/L | 5.0 (0.5) | 17.0 | 26.0 | lab error | 32.0 | 41.0 | 15.0 | 25.0 |
| Mercury | µg/L | 0.2 (0.2) | ND | ND | ND | ND | ND | ND | ND |
| Selenium | µg/L | 5.0 (4.2) | ND | ND | ND | ND | ND | ND | ND |
| Silver | µg/L | 5.0 (0.4) | ND | 0.10 | ND | ND | 0.60 | ND | ND |
| Zinc | µg/L | 10.0 (1.3) | 3.4 | 7.8 | 1.6 | ND | 3.4 | 3.4 | ND |
| ***Nutrients*** | | | | | | | | | |
| Ammonia | mg/L | 0.10 | ND | ND | ND | ND | ND | ND | ND |
| Nitrate | mg/L | 0.10 | ND | ND | ND | ND | ND | ND | ND |
| Total Kjeldahl Nitrogen | mg/L | 0.20 | 0.22 | ND | ND | ND | ND | ND | ND |
| Total Organic Nitrogen | mg/L | 0.20 | 0.22 | ND | ND | ND | ND | ND | ND |
| Total Phosphorus | mg/L | 0.01 | ND | ND | 0.04 | ND | ND | ND | ND |
| Orthophosphate | mg/L | 0.01 | ND | ND | 0.03 | ND | ND | ND | ND |

1. ND = Non-detectable
2. Standard laboratory reporting limit
3. Method detection limit
4. *In situ* measurements of dissolved oxygen and turbidity are presented in other tables

## Table E2.5-10 (continued)

**Analytical Constituent**

| | | | NFFR at Pulga Bridge (Poe-2A) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Reporting | Sample Date | | | | | | |
| **Constituent** | **Units** | **Limit** | 03/24/99 | 06/16/99 | 07/14/99 | 08/11/99 | 09/13/99 | 12/16/99 | 03/31/00 |
| ***General Chemistry*** | | | | | | | | | |
| Calcium | mg/L | 0.1 | 8.10 | 9.20 | 9.30 | 9.00 | 11.0 | 11.0 | 7.10 |
| Magnesium | mg/L | 0.1 | 3.40 | 4.40 | 4.70 | 4.40 | 5.40 | 5.30 | 4.80 |
| Sodium | mg/L | 0.005 | 3.10 | 4.90 | 4.30 | 3.60 | 5.20 | 4.40 | 4.50 |
| Potassium | mg/L | 1.00 | 0.72 | 1.20 | 2.40 | 0.97 | 1.10 | 1.00 | 0.91 |
| Sulfate | mg/L | 0.20 | 2.20 | 4.00 | 1.60 | 1.60 | 2.10 | 2.00 | 2.00 |
| Chloride | mg/L | 0.20 | 0.80 | 1.00 | .90 | 1.30 | 1.10 | 1.00 | ND[1] |
| Total Dissolved Solids | mg/L | 10 | 76.0 | 74.0 | 55.0 | 74.00 | 53.0 | lab error | 84.0 |
| Total Hardness | mg/L | 1.0 | 35.0 | 39.0 | 43.0 | 40.0 | 59.0 | 41.0 | 36.0 |
| Total Alkalinity | mg/L | 10 | 70 | 50 | 50 | 50 | 60 | 60 | 40 |
| Bicarbonate Alkalinity | mg/L | 10 | 70 | 50 | 50 | 50 | 60 | 60 | 40 |
| Silica | mg/L | 2.0 | 18.0 | 13.0 | 13.0 | 12.4 | 13.0 | 14.0 | 16.0 |
| MBAS | mg/L | 0.05 | ND | ND | ND | ND | ND | ND | ND |
| ***Trace Metals*** | | | | | | | | | |
| Arsenic | µg/L | 5.0[2] (3.2)[3] | ND | ND | ND | ND | ND | ND | ND |
| Barium | µg/L | 5.0 (0.4) | 16.0 | 14.0 | 13.0 | 12.0 | 18.0 | 13.0 | 14.0 |
| Boron | µg/L | 100 | ND | ND | ND | ND | ND | ND | ND |
| Cadmium | µg/L | 2.0 (0.4) | ND | ND | ND | ND | ND | ND | ND |
| Chromium | µg/L | 5.0 (0.5) | ND | ND | ND | ND | ND | ND | ND |
| Copper | µg/L | 5.0 (0.4) | ND | ND | ND | ND | ND | ND | ND |
| Iron | µg/L | 100 (2.8) | 260.0 | 88.0 | 31.0 | 79.0 | 190.0 | 69.0 | 150.0 |
| Lead | µg/L | 5.0 (1.3) | ND | ND | ND | ND | ND | ND | ND |
| Manganese | µg/L | 5.0 (0.5) | 14.0 | 15.0 | 16.0 | 22.0 | 26.0 | 11.0 | 7.0 |
| Mercury | µg/L | 0.2 (0.2) | ND | ND | ND | ND | ND | ND | ND |
| Selenium | µg/L | 5.0 (4.2) | ND | ND | ND | ND | ND | ND | ND |
| Silver | µg/L | 5.0 (0.4) | ND | 0.10 | ND | ND | 0.74 | ND | ND |
| Zinc | µg/L | 10.0 (1.3) | 2.0 | 4.8 | ND | ND | 4.0 | ND | ND |
| ***Nutrients*** | | | | | | | | | |
| Ammonia | mg/L | 0.10 | ND | ND | ND | ND | ND | ND | ND |
| Nitrate | mg/L | 0.10 | ND | ND | ND | ND | ND | ND | ND |
| Total Kjeldahl Nitrogen | mg/L | 0.20 | ND | ND | ND | ND | ND | ND | ND |
| Total Organic Nitrogen | mg/L | 0.20 | ND | ND | ND | ND | ND | ND | ND |
| Total Phosphorus | mg/L | 0.01 | ND | ND | 0.03 | ND | ND | ND | 0.04 |
| Orthophosphate | mg/L | 0.01 | ND | ND | 0.02 | ND | ND | ND | ND |

1. ND = Non-detectable
2. Standard laboratory reporting limit
3. Method detection limit
4. *In situ* measurements of dissolved oxygen and turbidity are presented in other tables

## Table E2.5-10 (continued)

**Analytical Constituent**

| | | | NFFR upstream of Poe Powerhouse (Poe-3) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Reporting | Sample Date | | | | | | |
| **Constituent** | **Units** | **Limit** | 03/24/99 | 06/16/99 | 07/14/99 | 08/11/99 | 09/13/99 | 12/16/99 | 03/31/00 |
| ***General Chemistry*** | | | | | | | | | |
| Calcium | mg/L | 0.1 | 8.50 | 9.80 | 9.90 | 9.70 | 12.00 | 10.00 | 8.40 |
| Magnesium | mg/L | 0.1 | 3.40 | 5.00 | 5.20 | 5.00 | 5.70 | 5.90 | 5.80 |
| Sodium | mg/L | 0.005 | 2.90 | 4.40 | 3.90 | 3.60 | 5.00 | 3.80 | 4.30 |
| Potassium | mg/L | 1.00 | 0.64 | 1.20 | 1.90 | 1.10 | 1.10 | 1.00 | 1.00 |
| Sulfate | mg/L | 0.20 | 2.20 | 4.00 | 1.00 | 1.70 | 2.00 | 2.00 | 2.00 |
| Chloride | mg/L | 0.20 | 0.80 | 1.00 | 1.10 | 0.90 | 1.00 | 1.00 | ND[1] |
| Total Dissolved Solids | mg/L | 10 | 68.0 | 66.0 | 56.0 | 62.0 | 80.0 | 69.0 | 87.0 |
| Total Hardness | mg/L | 1.0 | 38.0 | 42.0 | 45.0 | 46.0 | 58.0 | 42.0 | 37.0 |
| Total Alkalinity | mg/L | 10 | 44 | 50 | 50 | 60 | 60 | 60 | 50 |
| Bicarbonate Alkalinity | mg/L | 10 | 44 | 50 | 50 | 60 | 60 | 60 | 50 |
| Silica | mg/L | 2.0 | 17.0 | 13.0 | 12.0 | 12.4 | 12.0 | 13.0 | 16.0 |
| MBAS | mg/L | 0.05 | ND | ND | ND | ND | ND | ND | ND |
| ***Trace Metals*** | | | | | | | | | |
| Arsenic | µg/L | 5.0[2] (3.2)[3] | ND | ND | ND | ND | ND | ND | ND |
| Barium | µg/L | 5.0 (0.4) | 15.0 | 16.0 | 16.0 | 14.0 | 21.0 | 13.0 | 15.0 |
| Boron | µg/L | 100 | ND | ND | ND | ND | ND | ND | ND |
| Cadmium | µg/L | 2.0 (0.4) | ND | ND | ND | ND | ND | ND | ND |
| Chromium | µg/L | 5.0 (0.5) | ND | ND | ND | ND | ND | ND | ND |
| Copper | µg/L | 5.0 (0.4) | 2.8 | ND | ND | ND | ND | ND | ND |
| Iron | µg/L | 100 (2.8) | 230.0 | 96.0 | 49.0 | 27.0 | 310.0 | 18.0 | 93.0 |
| Lead | µg/L | 5.0 (1.3) | ND | ND | ND | ND | ND | ND | ND |
| Manganese | µg/L | 5.0 (0.5) | 12.0 | 7.8 | 10.0 | 9.3 | 21.0 | 8.2 | ND |
| Mercury | µg/L | 0.2 (0.2) | ND | ND | ND | ND | ND | ND | ND |
| Selenium | µg/L | 5.0 (4.2) | ND | ND | ND | ND | ND | ND | ND |
| Silver | µg/L | 5.0 (0.4) | ND | 0.10 | ND | ND | 0.67 | ND | ND |
| Zinc | µg/L | 10.0 (1.3) | 4.6 | 2.0 | ND | ND | ND | ND | ND |
| ***Nutrients*** | | | | | | | | | |
| Ammonia | mg/L | 0.10 | ND | ND | ND | ND | ND | ND | ND |
| Nitrate | mg/L | 0.10 | ND | ND | ND | ND | ND | ND | ND |
| Total Kjeldahl Nitrogen | mg/L | 0.20 | ND | ND | ND | ND | ND | ND | ND |
| Total Organic Nitrogen | mg/L | 0.20 | ND | ND | ND | ND | ND | ND | ND |
| Total Phosphorus | mg/L | 0.01 | ND | ND | 0.05 | ND | ND | ND | ND |
| Orthophosphate | mg/L | 0.01 | ND | ND | 0.02 | ND | ND | ND | ND |
| ***PCB Aroclors*** | | | | | | | | | |
| *PCB1016* | µg/L | 0.50 | ND | ND | ND | ND | ND | ND | ND |
| *PCB1221* | µg/L | 2.0 | ND | ND | ND | ND | ND | ND | ND |
| PCB1232 | µg/L | 0.50 | ND | ND | ND | ND | ND | ND | ND |
| PCB1242 | µg/L | 0.50 | ND | ND | ND | ND | ND | ND | ND |
| PCB1228 | µg/L | 0.50 | ND | ND | ND | ND | ND | ND | ND |
| PCB1254 | µg/L | 0.50 | ND | ND | ND | ND | ND | ND | ND |
| PCB1260 | µg/L | 0.50 | ND | ND | ND | ND | ND | ND | ND |

1. ND = Non-detectable
2. Standard laboratory reporting limit
3. Method detection limit
4. *In situ* measurements of dissolved oxygen and turbidity are presented in other tables

## Table E2.5-10 (continued)

*In situ Parameters*[4]

| Station | Date | Time | Synoptic Temperature (°C) | pH (lab) | Conductivity (@ 25°C) (μmhos/cm) |
|---|---|---|---|---|---|
| Poe-1C | 06/16/99 | 1200 | 17.0 | 7.2 | 60 |
| | 09/15/99 | 945 | 17.0 | 7.7 | 121 |
| | 06/14/00 | 1100 | 17.5 | 7.9 | 94 |
| | 07/12/00 | 940 | 18.7 | 7.8 | 92 |
| | 08/10/00 | 1015 | 20.0 | 7.5 | 86 |
| | 09/14/00 | 1010 | 16.7 | 7.7 | 89 |
| Poe-1B | 06/16/99 | 1215 | 17.2 | 7.4 | 94 |
| | 07/15/99 | 1215 | 17.2 | 7.1 | 94 |
| | 09/15/99 | 907 | 18.0 | 7.7 | 128 |
| | 06/14/00 | 1030 | 17.4 | 7.9 | 99 |
| | 07/12/00 | 846 | 18.8 | 7.8 | 110 |
| | 08/09/00 | 900 | 20.7 | 7.8 | 104 |
| | 08/11/00 | 915 | 19.2 | 7.5 | 104 |
| | 09/13/00 | 933 | 17.0 | 8.0 | 99 |
| Poe-1A | 03/24/99 | 1100 | 7.2 | 8.0 | 101 |
| | 06/16/99 | 1245 | 17.3 | 7.2 | 92 |
| | 07/15/99 | 1715 | 20.2 | 7.5 | 97 |
| | 09/15/99 | 1020 | 18.0 | 7.6 | 123 |
| | 12/16/99 | 1015 | 4.1 | 7.7 | 110 |
| | 03/30/00 | 940 | 8.3 | 7.4 | 85 |
| | 06/14/00 | 955 | 17.5 | 8.0 | 101 |
| | 07/12/00 | 915 | 18.8 | 7.8 | 109 |
| | 08/09/00 | 937 | 20.6 | 7.7 | 103 |
| | 08/11/00 | 908 | 19.1 | 7.5 | 103 |
| | 09/13/00 | 1013 | 17.0 | 7.8 | 100 |
| Poe-4A | 06/16/99 | 1030 | 17.2 | --- | 84 |
| | 07/15/99 | 1545 | 21.0 | 7.7 | 100 |
| | 08/13/99 | 1415 | 19.5 | --- | 91 |
| | 09/15/99 | 1112 | 19.1 | 7.6 | 117 |
| Poe-5 | 06/16/99 | 1130 | 17.3 | 7.4 | 95 |
| | 07/15/99 | 1515 | 20.8 | 7.8 | 105 |
| | 08/13/99 | 1345 | 20.0 | 7.6 | 103 |
| | 09/15/99 | 1210 | 18.4 | 7.7 | 127 |
| | 06/15/00 | 1545 | 19.0 | 8.0 | 102 |
| | 07/12/00 | 1015 | 19.3 | 7.9 | 106 |
| | 08/09/00 | 1042 | 21.0 | 7.9 | 108 |
| | 09/13/00 | 1101 | 17.2 | 7.8 | 104 |

1. ND = Non-detectable
2. Standard laboratory reporting limit
3. Method detection limit
4. *In situ* measurements of dissolved oxygen and turbidity are presented in other tables

## Table E2.5-10 (continued)

*In situ Parameters*[4]

| Station | Date | Time | Synoptic Temperature (°C) | pH (lab) | Conductivity (@ 25°C) (µmhos/cm) |
|---|---|---|---|---|---|
| Mill Creek | 06/16/99 | 1000 | 12.4 | 7.2 | 68 |
| | 07/15/99 | 1430 | 17.2 | 7.9 | 78 |
| | 08/13/99 | 1500 | 15.6 | 7.7 | 81 |
| | 09/15/99 | 1245 | 14.5 | 7.7 | 86 |
| | 06/14/00 | 1130 | 15.0 | 7.9 | 68 |
| | 07/12/00 | 1040 | 14.6 | 8.0 | 73 |
| | 08/09/00 | 1108 | 16.2 | 7.9 | 78 |
| | 09/13/00 | 1132 | 14.3 | 8.0 | 80 |
| Flea Valley Creek | 06/16/99 | 930 | 12.8 | 7.5 | 140 |
| | 07/15/99 | 1400 | 17.0 | 7.8 | 150 |
| | 08/13/99 | 1530 | 16.4 | 7.8 | 170 |
| | 09/16/99 | 910 | 13.9 | 7.9 | 157 |
| | 06/14/00 | 1317 | 16.8 | 8.1 | 138 |
| | 07/12/00 | 1145 | 15.6 | 8.1 | 143 |
| | 08/09/00 | 1233 | 17.2 | 8.1 | 147 |
| | 09/13/00 | 1230 | 15.2 | 8.1 | 149 |
| Poe-2A | 03/24/99 | 1200 | 7.2 | 8.0 | 93 |
| | 06/16/99 | 1330 | 18.5 | 7.3 | 94 |
| | 07/15/99 | 1330 | 21.4 | 7.9 | 109 |
| | 08/11/99 | 1130 | 19.2 | 7.7 | 106 |
| | 09/14/99 | 1342 | 19.0 | 8.1 | 125 |
| | 12/16/99 | 1100 | 4.5 | 7.6 | 110 |
| | 03/30/00 | 1015 | 7.9 | 7.4 | 83 |
| | 06/14/00 | 1230 | 18.4 | 8.2 | 93 |
| | 07/12/00 | 1110 | 19.3 | 8.0 | 103 |
| | 08/09/00 | 1145 | 21.1 | 8.1 | 109 |
| | 09/13/00 | 1200 | 17.4 | 8.1 | 107 |
| Poe-6 | 07/15/99 | 1130 | 20.1 | 8.0 | 106 |
| | 06/16/99 | 830 | 17.1 | 7.4 | 94 |
| | 08/13/99 | 1232 | 19.7 | 7.9 | 110 |
| | 09/14/99 | 1230 | 17.9 | 8.0 | 126 |
| | 06/15/00 | 1642 | 21.2 | 8.6 | 68 |
| | 07/12/00 | 1235 | 19.7 | 8.4 | 105 |
| | 08/10/00 | 1145 | 20.0 | 8.0 | 105 |
| | 09/14/00 | 1300 | 18.0 | 8.2 | 107 |

1. ND = Non-detectable
2. Standard laboratory reporting limit
3. Method detection limit
4. *In situ* measurements of dissolved oxygen and turbidity are presented in other tables

## Table E2.5-10 (continued)

*In situ Parameters*[4]

| Station | Date | Time | Synoptic Temperature (°C) | pH (lab) | Conductivity (@ 25°C) (µmhos/cm) |
|---|---|---|---|---|---|
| Poe-3 | 03/24/99 | 1300 | 7.9 | 7.9 | 88 |
| | 06/16/99 | 1430 | 20.0 | 7.3 | 107 |
| | 07/15/99 | 940 | 21.5 | 7.8 | 114 |
| | 08/11/99 | 1230 | 20.5 | 7.7 | 113 |
| | 09/14/99 | 1030 | 18.0 | 7.7 | 130 |
| | 12/16/99 | 1200 | 5.1 | 7.6 | 113 |
| | 03/30/00 | 1130 | 10.8 | 7.6 | 94 |
| | 06/14/00 | 1430 | 21.4 | 8.2 | 102 |
| | 07/12/00 | 1426 | 22.0 | 8.3 | 108 |
| | 08/09/00 | 1345 | 22.6 | 8.2 | 109 |
| | 09/13/00 | 1330 | 18.1 | 8.1 | 109 |
| Poe-4B | 06/16/99 | 1500 | 17.2 | 7.2 | 96 |
| | 07/15/99 | 950 | 20.0 | 7.6 | 109 |
| | 08/13/99 | 1030 | 19.2 | 7.9 | 104 |
| | 09/14/99 | 1000 | 18.0 | 7.6 | 126 |
| | 12/16/99 | 1230 | 4.8 | 7.6 | 104 |
| | 03/30/00 | 1140 | 8.7 | 7.5 | 78 |
| | 06/15/00 | 1415 | 18.4 | 7.8 | 97 |
| | 07/12/00 | 1345 | 19.2 | 7.9 | 108 |
| | 08/09/00 | 1400 | 20.8 | 7.9 | 99 |
| | 09/13/00 | 1400 | 17.1 | 7.9 | 102 |

1. ND = Non-detectable
2. Standard laboratory reporting limit
3. Method detection limit
4. *In situ* measurements of dissolved oxygen and turbidity are presented in other tables

The primary anion at all sampling stations in the NFFR was bicarbonate, followed by sulfate and chloride. The levels of each of these constituents were similar between stations. Average bicarbonate levels ranged from 40 to 122 mg/L; average sulfate levels ranged from 1.0 to 4.0 mg/L; and chloride ranged from 0.6 to 1.3 mg/L.

Specific conductance in the river stations ranged from 60 to 130 µmhos/cm. There was no measurable difference in conductivity between stations above Poe Dam and those in the bypass reach. There was a slight tendency for conductivity to increase as water passed downstream through the bypass reach. Conductivity in Mill Creek was the lowest of all the stations sampled with levels ranging from 68 to 86 µmhos/cm. Flea Valley Creek had the highest conductivity levels of any of the stations, ranging from 138 to 170 µmhos/cm.

The pH of the NFFR in the Project area was consistent between stations, varying less than 0.5 units from one station to the next. NFFR pH values ranged from 7.1 to 8.6 units. There was no detectable pattern in concentration between upstream and downstream stations. The pH of the tributaries was similar to that found in the main NFFR, ranging from 7.2 to 8.1 units.

Monitoring for the presence of PCBs in Project waters was conducted in the NFFR above Poe Powerhouse (Poe-3). Seven PCB Aroclors were evaluated during each sampling period at this station. PCBs were not detected during any of the sampling periods.

The general water chemistry data collected during this study were similar to data in previous studies (Pacific Gas and Electric Company 1999). No spatial or temporal trends in the general chemistry data attributable to Project operations were noted.

#### E2.5.3.1.2 Results of Trace Metal Monitoring

Trace metal samples from the NFFR were analyzed for 13 metal species. These samples were collected from the three primary NFFR sampling stations during the 1999-2000 monitoring effort (Poe-1A, Poe-2A, and Poe-3). Of the 13 metals, seven were not detected during any sampling period at any station (arsenic, boron, cadmium, chromium, lead, mercury, and selenium).

Copper was detected only during March 1999, at concentrations slightly higher than the method detection limit at Poe-1A (3.5 µg/L), Poe-2 (3.1 µg/L), and Poe-3 (2.8 µg/L). These total copper levels were less than the reporting limit and represent 'J' flag values. None of these values exceeded the applicable regulatory criteria for total concentrations.

Barium, manganese, and iron were present during all periods at all stations. Barium concentrations remained consistent between periods and stations. Iron and manganese showed trends related to flow and turbidity. Zinc was at or near detection limits at all stations during most periods; concentrations did not show trends between periods, but did tend to be lowest at the downstream station. Silver concentrations were generally less than method reporting limits, but were measured at all stations during two periods (June and September 1999).

All detected trace metal levels during 1999-2000 were based on total unfiltered samples. With the exception of iron, none of the reported trace metal concentrations reported as *total* concentrations exceeded applicable regulatory criteria for *total* concentrations (based on updated criteria for total concentrations as of August 2003 [RWQCB 2003]). Total iron exceeded drinking water standards (DHS and USEPA, 300μg/L) at Poe-1A during March and September 1999, and at Poe-3 during September 1999. Total iron concentrations did not exceed any applicable criteria at station Poe-2 during 1999-2000.

All historical data (1999-2000) and comparisons to applicable updated regulatory criteria are included in Appendix E2-4. In 2003, both total and dissolved metal phases were evaluated and compared to the applicable regulatory criteria. A direct comparison of total with dissolved metal concentrations and further data measurements and analyses are presented in Section E2.5.3.2.2.

**E2.5.3.1.3 Spoil Pile Evaluations**

The Licensee conducted two distinct monitoring efforts associated with the Poe Project spoil piles. The first sampling effort was conducted in April 2000 and March 2001. Results of these sampling efforts are presented in total in the following section. The second effort was conducted in 2002 and is summarized in this section, with a complete presentation of results included in Appendix E2-1.

**Spoil Pile Runoff Sampling – (2000-2001)**

As discussed in Section E2.5.1.1.7, the Adit No. 2 drainage culvert and three stations in the NFFR (Figure E2.5-2) were sampled for various trace metals and selected *in situ* parameters on April 14, 2000 and again on March 5, 2001. This was done to determine the trace metals contribution to the NFFR associated with tunnel-spoil piles. The results of these sampling efforts are presented in Table E2.5-11. Results of the *in situ* sampling on April 14 indicated that all samples represented the same water source with little or no difference in conductivity and pH. Temperatures were also essentially the same. Flow through the culvert was visually estimated at approximately 1 to 2 cfs. Due to the configuration of the culvert discharge and the receiving channel, it was not possible to make a flow measurement using traditional methods. On the day of sampling, there was no significant flow of water from the catchment area of the spoil pile into the culvert drain. It is speculated that it would require a significant period of sustained rainfall to produce any measurable flow from the catchment area to the culvert. As a result of these conditions, the samples from the culvert discharge represent the water quality of the NFFR as it passes through the diversion tunnel to Poe Powerhouse.

**Table E2.5-11**
**Results of trace metal monitoring in spoil pile runoff**

**A: *In situ* parameters, April 2000**

| Parameter | Units | *Sampling Station*[1] *Poe S-1A* | *Poe S-2* | *Poe S-3* | *Poe S-4* |
|---|---|---|---|---|---|
| Date | --- | 04/14/2000 | 04/14/2000 | 04/14/2000 | 04/14/2000 |
| Time | --- | 11:30 | 10:30 | 10:20 | 10:00 |
| Temperature | °C | 9.8 | 10.2 | 10.2 | 10.2 |
| Specific Conductivity | µmhos/cm @ 25°C | 75.0 | 72.5 | 72.5 | 73.1 |
| pH | --- | 7.5 | 7.5 | 7.5 | 7.5 |

**B: Analytical Constituents, April 2000**

| Constituent | Reporting Limits: Standard[2] | | MDL[3] | | Sampling Station[1]: *Poe S-1A* | *Poe S-2* | *Poe S-3* | *Poe S-4* |
|---|---|---|---|---|---|---|---|---|
| Arsenic | 5.0 | µg/L | *3.2* | µg/L | ND[4] | ND | ND | ND |
| Barium | 5.0 | µg/L | *0.39* | µg/L | 20 | 20 | 10 | 20 |
| Cadmium | 2.0 | µg/L | *0.36* | µg/L | 1.0 | ND | ND | ND |
| Chromium | 5.0 | µg/L | *0.47* | µg/L | 0.8 | ND | ND | ND |
| Copper | 5.0 | µg/L | *0.4* | µg/L | 2.3 | 2.6 | 1.2 | 1.2 |
| Iron | 100 | µg/L | *2.8* | µg/L | 1200 | 350 | 320 | 350 |
| Lead | 5.0 | µg/L | *1.3* | µg/L | ND | ND | ND | ND |
| Manganese | 5.0 | µg/L | *0.46* | µg/L | 57 | 16 | 14 | 16 |
| Mercury | 0.2 | µg/L | *0.20* | µg/L | ND | ND | ND | ND |
| Nickel | 5.0 | µg/L | *0.46* | µg/L | 2.3 | 1.9 | 1.5 | 1.6 |
| Selenium | 5.0 | µg/L | *4.2* | µg/L | ND | ND | ND | ND |
| Silver | 5.0 | µg/L | *0.36* | µg/L | ND | 0.44 | ND | ND |
| Zinc | 10.0 | µg/L | *1.3* | µg/L | ND | ND | ND | ND |

1. Station Key: Poe S-1 = culvert flow from #2 Adit; Poe S-2 = NFFR upstream of culvert inflow; Poe S-3 = NFFR immediately downstream of culvert inflow; Poe S-4 = NFFR above Poe Powerhouse, approximately 0.5 miles downstream of culvert inflow.
2. Standard laboratory reporting limits.
3. MDL = Method detection limits, and are below the standard reporting limits.
4. ND = Not detectable

**Table E2.5-11 (Continued)**

**A: *In situ* parameters, March 2001**

| Parameter | Units | Sampling Station[1] | | | | | |
|---|---|---|---|---|---|---|---|
| | | *Poe S-1A* | *Poe S-1B* | *Poe S-2* | *Poe S-3* | *Poe S-4* | *Poe S-5* |
| Date | --- | *03/05/2001* | *03/05/2001* | *03/05/2001* | *03/05/2001* | *03/05/2001* | *03/05/2001* |
| Time | --- | 11:00 | 10:45 | 10:00 | 10:25 | 11:25 | 11:35 |
| Temperature | °C | 6.6 | 8.9 | 7.3 | 7.3 | 7.4 | 5.1 |
| Specific Conductivity | µmhos/cm @ 25°C | 131 | 129 | 111 | 112 | 111 | 114 |
| pH | --- | 8.0 | 8.3 | 8.5 | 8.4 | 8.1 | 8.0 |
| Turbidity | NTU | 4.7 | 9.1 | 7.7 | 6.3 | 6.0 | 2.6 |

**B: Analytical Constituents, March 2001**

| Constituent | Reporting Limits | | | | Sampling Station[1] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Standard[2] | | MDL[3] | | Poe S-1A | Poe S-1B | Poe S-2 | Poe S-3 | Poe S-4 | Poe S-5 |
| Arsenic | 5.0 | µg/L | *3.0* | µg/L | ND | ND | ND | ND | ND | ND |
| Barium | 5.0 | µg/L | *0.3* | µg/L | 15 | 17 | 12 | 12 | 12 | 14 |
| Cadmium | 2.0 | µg/L | *0.1* | µg/L | ND | ND | ND | ND | ND | ND |
| Chromium | 5.0 | µg/L | *0.2* | µg/L | ND | ND | ND | ND | ND | ND |
| Copper | 5.0 | µg/L | *0.3* | µg/L | 6.0 | 5.2 | ND | ND | ND | ND |
| Iron | 100 | µg/L | *15.1* | µg/L | 140 | 380 | 230 | 200 | 180 | 110 |
| Lead | 5.0 | µg/L | *1.6* | µg/L | ND | ND | ND | ND | ND | ND |
| Manganese | 5.0 | µg/L | *0.9* | µg/L | 20 | 5.4 | 24 | 25 | 22 | 22 |
| Mercury | 0.2 | µg/L | *0.04* | µg/L | ND | ND | ND | ND | ND | ND |
| Nickel | 5.0 | µg/L | *1.9* | µg/L | ND | ND | ND | ND | ND | ND |
| Selenium | 5.0 | µg/L | *4.2* | µg/L | ND | ND | ND | ND | ND | ND |
| Silver | 5.0 | µg/L | *0.3* | µg/L | ND | ND | ND | ND | ND | ND |
| Zinc | 10.0 | µg/L | *3.2* | µg/L | 4.7 | 6.3 | ND | ND | ND | ND |

1. Station Key: Poe S-1A = culvert flow from #2 Adit; Poe S-1B = surface flow into culvert; Poe S-2 = NFFR upstream of culvert inflow Poe S-3 = NFFR immediately downstream of culvert inflow; Poe S-4 = NFFR above Poe Powerhouse, approximately 0.5 miles downstream of culvert inflow, Poe S-5 = Poe Powerhouse tailrace outflow to NFFR.
2. Standard laboratory reporting limits.
3 MDL = Method detection limits, lower than the standard reporting limits.
4 ND = Not detectable

Trace metal results from April 2000 indicate that of the thirteen constituents measured five were reported below their respective reporting limits [arsenic, lead, mercury, selenium, zinc]. Barium, copper, iron, manganese, and nickel were reported at all sample locations. Barium occurred at relatively similar concentrations in the culvert and river stations. The highest concentrations of iron, manganese, and nickel were measured in the culvert flow (Poe S-1A) that passes under the spoil pile. The primary source of this water at the time of sampling was leakage from the Poe diversion tunnel. The highest concentration of copper was measured in the NFFR upstream of the culvert inflow (Poe S-2); silver was also detected in the river at this location only.

Iron exceeded the drinking water criteria (DHS, USEPA) at all stations during the April 2000 sampling effort (Appendix E2-4). Cadmium exceeded its respective recommended level for protection of freshwater aquatic life (USEPA National Ambient Water Quality Criteria, Freshwater Aquatic Life Protection Recommended Criteria.) at the culvert station (Poe S-1A) (Appendix E2-4). Manganese exceeded its respective drinking water criteria (DHS and USEPA) at the culvert station (Poe S-1A). These levels were not reflected in the river downstream of the culvert inflow.

All of these constituents were measured as total phase (unfiltered) during a period of elevated suspended sediment levels. Although suspended sediment levels (turbidity) were not measured on April 14, 2000, turbidity was measured in the NFFR as part of routine monitoring conducted on March 30. Turbidity levels on the sampling date were visually similar to those observed on March 30, with higher levels in the NFFR upstream of Poe Dam and in the Poe Powerhouse Tailrace as compared with the Poe Reach. Turbidity levels on March 30 ranged from 2.8 to 12.6 NTU.

Some differences between trace metal concentrations in the culvert sample and the NFFR samples were observed. This is largely explained by the difference in water quality that occurs above Poe Dam (the primary source of the culvert water) compared with the NFFR in the Poe Reach. Past sampling has indicated that the NFFR above Poe Dam has higher suspended sediment levels than the bypass reach. The typically lower levels in the bypass reach are a result of the dilution effect from the two tributaries (Mill and Flea Valley creeks) and the comparatively long travel time between the dam and the sampling location.

A second sampling of runoff from the spoil pile was conducted on March 5, 2001. This effort was conducted after several days of significant rainfall. As a result, sheet runoff was present in the catchment area and was flowing into the main culvert. Results of this sampling effort are included in Table E2.5-11. Results of the *in situ* sampling on March 5, 2001, indicated that the culvert samples (Poe S-1A and Poe S-1B) represented a water source that was different from the NFFR (both the bypass reach and the penstock flow). This distinction was manifested primarily as a difference in conductivity between the culvert and river samples. The temperature, turbidity, and pH parameters were similar in all samples. Due to the configuration of the culvert discharge and the receiving channel, it was not possible to make a flow measurement using traditional methods. Flow through the culvert was visually estimated at approximately 2 to 3 cfs. On the day of sampling, sheet runoff through the catchment area at the toe of the spoil pile into the culvert drain was present. The majority of this flow originated from the drainage system that runs parallel with the railroad tracks.

Trace metal results from March 2001 indicate that of the thirteen constituents eight were reported below their respective reporting limits [arsenic, cadmium, chromium, lead, mercury, nickel, selenium, and silver]. Barium, iron, and manganese, were reported at all sample locations. Barium occurred at relatively similar concentrations in the culvert flow and river stations. Iron was measured in the highest concentrations in the surface flow (Poe S-1B). Copper was measured in the both the culvert flow (Poe S-1A), and the surface runoff sample (PoeS-1B). The culvert and runoff samples were also the only stations with detected levels of zinc.

Iron exceeded the drinking water criteria (DHS and USEPA) only at station Poe S-1B (surface runoff) during the March 2001 sampling effort (Appendix E2-4). Copper exceeded the recommended levels for protection of freshwater aquatic life (USEPA National Ambient Water Quality Criteria, Freshwater Aquatic Life Protection Recommended Criteria) at the culvert station (Poe S-1A) and in the surface runoff sample (Poe S-1B) (Appendix E2-4). In addition, copper exceeded the criteria for freshwater aquatic life protection [California Toxics Rule] (USEPA 40 CFR Part 131, Water Quality Standards; Establishment on Numeric Criteria for Priority Toxic Pollutants for the State of California) at these same two stations (Appendix E2-4). These levels were not reflected in the river downstream of the culvert inflow.

The condition of the spoil pile was visually evaluated on the day of sampling. In general, the pile appeared to be stable with few erosion gullies, little accumulation of material at the toe, and most of the surfaces having some degree of vegetative cover.

**Spoil Pile Evaluation – (2002)**

This section will present a summary of the 2002 spoil pile sampling. A compete presentation of the monitoring effort with results is included in Appendix E2-1.

***Phase I – Soil Sampling***

Results of the TTLC analysis indicated that none of the discrete samples from either spoil pile exceeded the total threshold criteria. Levels of the CAM-17 metals from the spoil pile samples using the TTLC method were typically similar to levels found in background samples. Geologic data indicated that both tunnel sections were composed of similar geologic materials. Data from both piles indicated that chromium, cobalt, and nickel were significantly higher in the background samples than the spoil pile samples. Barium and copper were found in slightly higher concentrations in the spoil pile samples. However, all levels were well below the threshold concentrations used to define hazardous waste.

Results of the STLC-WET analysis indicated that none of the discrete samples exceeded the soluble threshold criteria. Levels of the CAM-17 metals from the spoil pile samples using the STLC-WET method were typically similar to levels found in background samples. Only barium, copper, and nickel were found in detectable concentrations in the spoil pile samples. All levels were well below the threshold concentrations used to define hazardous waste.

Results of the STLC-DI analysis were collected as an indicator of possible leachate concentrations; there are no applicable threshold criteria established for the deionized extraction method. Levels of the CAM-17 metals from the spoil pile samples using the STLC-DI method were typically similar to levels found in background samples. Only barium was found in detectable concentrations in the spoil pile samples using the DI extraction method.

***Phase II-Water Quality Sampling***

Results of the dry (base flow) period sampling indicated that *in situ* conditions (water temperature, conductivity, pH, and turbidity) were similar at all six monitoring stations. Of the thirteen trace metal constituents only barium, chromium, copper, iron, manganese, nickel, and zinc were measured in detectable concentrations. Due to the low suspended sediment concentration, filtration had little effect on the concentration of the detected constituents, with the exception of copper, manganese and iron. These constituents exhibited significant reductions in concentration after filtration. This indicates that these constituents existed in the water column primarily as suspended matter and not as a dissolved species. In general, there was little or no difference in water quality between the control and test stations. This was especially evident when comparing dissolved concentrations.

A comparison of sampling results from the dry period sampling with the applicable regulatory criteria indicates that none of the dissolved metal concentrations exceeds any of the listed criteria. Where applicable, hardness based criteria were calculated based on measured hardness.

Results of the wet period sampling indicated that *in situ* data (water temperature, conductivity, pH, and turbidity) was similar at all three river stations and the powerhouse tailrace. The three stations associated with the leakage from Adit No. 2 exhibited the influence from surface and ephemeral tributary/spring flow contributions. However, as was observed during the dry period sampling, of the thirteen trace metal constituents only barium, copper, iron, manganese, nickel, and zinc were measured in detectable concentrations. In addition, silver was also measured in detectable concentrations. The suspended sediment concentrations in the river were 2.0 to 8.5 times the levels measured during the dry period. As a result, filtration significantly reduced the concentration of copper, iron, manganese, and nickel. In general, there was little or no difference in trace metal concentrations between the control and test stations. This was especially evident when comparing dissolved concentrations.

A comparison of sampling results from the wet period sampling with the applicable regulatory criteria indicates that none of the dissolved metal concentrations exceeds any of the listed criteria. Where applicable, hardness based criteria were calculated based on measured hardness.

Based on the data collected as part of the Poe Relicensing effort, the spoil piles associated with the Poe Diversion Tunnel do not appear to contribute elevated levels of trace metals to the NFFR. TTLC and STLC analysis indicates that concentrations of the CAM-17 metals are well below the associated threshold criteria. Water sampling indicated that there was no difference in trace metals concentrations in the NFFR downstream of either the Adit No. 1 or Adit No. 2 piles.

**E2.5.3.2 Results from 2003 Monitoring**

This Section will discuss the results of monitoring conducted by the Licensee in 2003. A discussion of methods and monitoring locations is presented in Section E2.5.1.2.

**E2.5.3.2.1 General Chemistry**

Table E2.5-12 summarizes the general water quality data from the NFFR and tributary streams for the 2003 monitoring program. Water in the NFFR in the Poe Project area can be described as soft (31–56 mg/L as CaCO3) and of moderate to low alkalinity (24–61 mg/L as CaCO3). The water of the NFFR is generally low in dissolved minerals as measured by total dissolved solids (TDS) and specific conductance.

TDS levels ranged from 50 to 77 mg/L with no pattern of concentration distribution apparent in the Project area. Mill Creek exhibited slightly softer conditions than the NFFR, and Flea Valley Creek had slightly harder conditions.

# Table E2.5-12
# Results of 2003 general water quality monitoring in the Poe Project.

**Analytical Constituents**

| | | | NFFR upstream of Poe Reservoir (Poe-1A) | | | | |
|---|---|---|---|---|---|---|---|
| | | | Reporting | Sample Date | | | |
| Constituent | | Units | Limit | 03/27/03 | 05/13/03 | 08/13/03 | 10/15/03 |
| | | | *General Chemistry* | | | | |
| Calcium | Total fraction | mg/L | 0.07 | 8.11 | 8.89 | 10.00 | 10.10 |
| Magnesium | Total fraction | mg/L | 0.001 | 3.17 | 3.45 | 3.73 | 4.96 |
| Sodium | Total fraction | mg/L | 0.02 | 2.50 | 2.76 | 4.35 | 4.77 |
| Potassium | Total fraction | mg/L | 0.03 | 0.58 | 0.64 | 0.81 | 1.37 |
| Sulfate | Total fraction | mg/L | 0.4 | 1.96 | 2.04 | 1.62 | 1.57 |
| Chloride | Total fraction | mg/L | 0.2 | 0.70 | 0.76 | 1.02 | 1.17 |
| Total Dissolved Solids | Total fraction | mg/L | 10 | 60 | 56 | 77 | 66 |
| Total Hardness | Total fraction | mg/L | 1.0 | 33.7 | 38.2 | 52.5 | 47.6 |
| Total Alkalinity | Total fraction | mg/L | 1.6 | 34.6 | 42.2 | 55.3 | 58.2 |
| | | | *Trace Metals* | | | | |
| Aluminum | Total fraction | mg/L | 0.01 | 0.06 | 0.188 | 0.0433 | 0.018 |
| Arsenic | Total fraction | mg/L | 0.0001 | 0.00069 | 0.00044 | 0.00116 | 0.00121 |
| Barium | Total fraction | mg/L | 0.0002 | 0.014 | 0.015 | 0.011 | 0.013 |
| Cadmium | Total fraction | mg/L | 0.00002 | <0.00001 | <0.000002 | 0.000005 | <0.000002 |
| Chromium | Total fraction | mg/L | 0.0002 | 0.00057 | 0.00108 | 0.00061 | 0.00008 |
| Copper | Total fraction | mg/L | 0.000003 | 0.00114 | 0.00108 | 0.00051 | 0.00029 |
| Iron | Total fraction | mg/L | 0.0012 | NS | NS | 0.0723 | 0.0799 |
| Lead | Total fraction | mg/L | 0.000002 | 0.000073 | 0.000037 | 0.000036 | <0.000002 |
| Manganese | Total fraction | mg/L | 0.00001 | 0.02040 | 0.01780 | 0.03940 | 0.035 |
| Mercury | Total fraction | mg/L | 2.00E-07 | 2.83E-06 | 2.66E-06 | 3.80E-07 | 4.34E-07 |
| Nickel | Total fraction | mg/L | 0.000006 | 0.00199 | 0.00127 | 0.00041 | 0.00017 |
| Selenium | Total fraction | mg/L | 0.0001 | <0.0003 | <0.0001 | 0.0002 | 0.00025 |
| Silver | Total fraction | mg/L | 0.000008 | <0.000008 | <0.000008 | <0.000008 | <0.000008 |
| Zinc | Total fraction | mg/L | 0.00002 | 0.00064 | <0.00002 | 0.00034 | 0.0001 |
| Arsenic | Dissolved fraction | mg/L | 0.00010 | 0.00066 | 0.00047 | 0.00109 | 0.00112 |
| Cadmium | Dissolved fraction | mg/L | 0.00002 | <0.00001 | <0.000002 | <0.000002 | 0.000003 |
| Copper | Dissolved fraction | mg/L | 0.000003 | 0.00071 | 0.00072 | 0.00043 | 0.00018 |
| Iron | Dissolved fraction | mg/L | 0.0012 | 0.0250 | 0.0410 | 0.0021 | 0.0046 |
| Lead | Dissolved fraction | mg/L | 0.000002 | 0.000014 | <0.000002 | 0.000002 | <0.000002 |
| Mercury | Dissolved fraction | mg/L | 2.00E-07 | 2.09E-06 | 1.55E-06 | <0.20E-06 | 3.04E-07 |
| Nickel | Dissolved fraction | mg/L | 0.000006 | 0.00144 | 0.00102 | 0.00021 | 0.00008 |
| Silver | Dissolved fraction | mg/L | 0.000008 | <0.000008 | <0.000008 | <0.000008 | <0.000008 |
| Zinc | Dissolved fraction | mg/L | 0.00002 | 0.00127 | <0.00002 | 0.00046 | <0.00002 |
| | | | *Nutrients* | | | | |
| Ammonia | Total fraction | mg/L | 0.05 | 0.07 | <0.05 | <0.05 | <0.05 |
| Nitrate | Total fraction | mg/L | 0.005 | 0.0656 | 0.0522 | 0.0741 | 0.0603 |
| Orthophosphate | Total fraction | mg/L | 0.005 | 0.0114 | 0.0118 | 0.0117 | 0.0145 |
| Total Phosphorus | Total fraction | mg/L | 0.03 | <0.03 | <0.03 | <0.03 | 0.02 |
| Chlorophyll a | Total fraction | µg/L | 0.000045 | 0.78 | 3.94 | 1.48 | 0.22 |

## Table E2.5-12 (continued)

**Analytical Constituent**

| NFFR at Pulga Gage Station (Poe-2A) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Reporting | Sample Date | | | |
| Constituent | | Units | Limit | 03/27/03 | 05/13/03 | 08/13/03 | 10/15/03 |
| | | | *General Chemistry* | | | | |
| Calcium | Total fraction | mg/L | 0.07 | 7.27 | 8.40 | 9.83 | 9.68 |
| Magnesium | Total fraction | mg/L | 0.001 | 3.67 | 3.61 | 5.43 | 5.06 |
| Sodium | Total fraction | mg/L | 0.02 | 2.25 | 2.60 | 4.53 | 4.58 |
| Potassium | Total fraction | mg/L | 0.03 | 0.57 | 0.65 | 1.74 | 1.34 |
| Sulfate | Total fraction | mg/L | 0.4 | 1.94 | 1.93 | 1.65 | 1.56 |
| Chloride | Total fraction | mg/L | 0.2 | 0.65 | 0.72 | 0.97 | 1.01 |
| Total Dissolved Solids | Total fraction | mg/L | 10 | 57 | 57 | 72 | 67 |
| Total Hardness | Total fraction | mg/L | 1.0 | 33.7 | 36.3 | 52.0 | 46.6 |
| Total Alkalinity | Total fraction | mg/L | 1.6 | 23.6 | 41.6 | 55.8 | 49.9 |
| | | | *Trace Metals* | | | | |
| Aluminum | Total fraction | mg/L | 0.01 | 0.033 | 0.111 | 0.0294 | <0.010 |
| Arsenic | Total fraction | mg/L | 0.0001 | 0.00057 | 0.00045 | 0.00107 | 0.0011 |
| Barium | Total fraction | mg/L | 0.0002 | 0.012 | 0.014 | 0.012 | 0.011 |
| Cadmium | Total fraction | mg/L | 0.00002 | <0.00001 | <0.000002 | <0.000002 | <0.000002 |
| Chromium | Total fraction | mg/L | 0.0002 | 0.00050 | 0.00106 | 0.00058 | 0.00009 |
| Copper | Total fraction | mg/L | 0.000003 | 0.00079 | 0.00087 | 0.00050 | 0.00033 |
| Iron | Total fraction | mg/L | 0.0012 | NS | NS | 0.0476 | 0.0478 |
| Lead | Total fraction | mg/L | 0.000002 | 0.000043 | 0.000020 | 0.000020 | 0.000007 |
| Manganese | Total fraction | mg/L | 0.00001 | 0.00984 | 0.01300 | 0.02240 | 0.0233 |
| Mercury | Total fraction | mg/L | 2.00E-07 | 2.01E-06 | 2.56E-06 | 4.80E-07 | 4.09E-07 |
| Nickel | Total fraction | mg/L | 0.000006 | 0.00181 | 0.00143 | 0.00071 | 0.00039 |
| Selenium | Total fraction | mg/L | 0.0001 | <0.0003 | <0.0001 | 0.00019 | 0.00034 |
| Silver | Total fraction | mg/L | 0.000008 | <0.000008 | <0.000008 | <0.000008 | <0.000008 |
| Zinc | Total fraction | mg/L | 0.00002 | 0.00040 | <0.00002 | 0.00019 | <0.00002 |
| Arsenic | Dissolved fraction | mg/L | 0.00010 | 0.00050 | 0.00034 | 0.00106 | 0.00096 |
| Cadmium | Dissolved fraction | mg/L | 0.00002 | <0.000002 | <0.000002 | <0.000002 | <0.000002 |
| Copper | Dissolved fraction | mg/L | 0.000003 | 0.00058 | 0.00062 | 0.00038 | 0.00022 |
| Iron | Dissolved fraction | mg/L | 0.0012 | 0.0200 | 0.0310 | <0.002 | 0.0033 |
| Lead | Dissolved fraction | mg/L | 0.000002 | 0.000010 | <0.00001 | <0.000002 | <0.000002 |
| Mercury | Dissolved fraction | mg/L | 2.00E-07 | 1.90E-06 | 1.85E-06 | <2.0E-07 | 2.68E-07 |
| Nickel | Dissolved fraction | mg/L | 0.000006 | 0.00156 | 0.00118 | 0.00046 | 0.00021 |
| Silver | Dissolved fraction | mg/L | 0.000008 | <0.000008 | <0.000008 | <0.000008 | <0.000008 |
| Zinc | Dissolved fraction | mg/L | 0.00002 | 0.00019 | <0.00002 | 0.00004 | <0.00002 |
| | | | *Nutrients* | | | | |
| Ammonia | Total fraction | mg/L | 0.05 | 0.06 | <0.05 | <0.05 | <0.05 |
| Nitrate | Total fraction | mg/L | 0.005 | 0.0562 | 0.06 | 0.0731 | 0.0737 |
| Orthophosphate | Total fraction | mg/L | 0.005 | 0.0116 | 0.0112 | 0.0126 | 0.0159 |
| Total Phosphorus | Total fraction | mg/L | 0.03 | <0.03 | <0.03 | <0.03 | 0.02 |
| Chlorophyll a | Total fraction | µg/L | 0.000045 | 0.22 | 8.72 | 0.95 | 0.19 |

# Table E2.5-12 (continued)

## Analytical Constituent

| NFFR downstream of Poe Dam (Poe-5) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Reporting | Sample Date | | | |
| Constituent | | Units | Limit | 03/27/03 | 05/13/03 | 08/13/03 | 10/15/03 |
| *General Chemistry* | | | | | | | |
| Calcium | Total fraction | mg/L | 0.07 | 7.76 | 8.60 | 10.20 | 9.83 |
| Magnesium | Total fraction | mg/L | 0.001 | 3.16 | 3.27 | 3.65 | 4.87 |
| Sodium | Total fraction | mg/L | 0.02 | 2.50 | 2.67 | 4.38 | 4.71 |
| Potassium | Total fraction | mg/L | 0.03 | 0.69 | 0.66 | 1.40 | 1.41 |
| Sulfate | Total fraction | mg/L | 0.4 | 2.01 | 1.95 | 1.64 | 1.57 |
| Chloride | Total fraction | mg/L | 0.2 | 0.67 | 0.75 | 0.98 | 1.03 |
| Total Dissolved Solids | Total fraction | mg/L | 10 | 53 | 59 | 72 | 62 |
| Total Hardness | Total fraction | mg/L | 1.0 | 31.7 | 36.3 | 51.4 | 45.2 |
| Total Alkalinity | Total fraction | mg/L | 1.6 | 36.5 | 40.1 | 54.5 | 50.2 |
| *Trace Metals* | | | | | | | |
| Aluminum | Total fraction | mg/L | 0.01 | 0.101 | 0.108 | 0.0214 | 0.0109 |
| Arsenic | Total fraction | mg/L | 0.0001 | 0.00059 | 0.00046 | 0.00102 | 0.00108 |
| Barium | Total fraction | mg/L | 0.0002 | 0.013 | 0.014 | 0.015 | 0.014 |
| Cadmium | Total fraction | mg/L | 0.00002 | 0.000009 | <0.000002 | <0.000002 | <0.000002 |
| Chromium | Total fraction | mg/L | 0.0002 | 0.00045 | 0.00097 | 0.00056 | 0.00026 |
| Copper | Total fraction | mg/L | 0.000003 | 0.00093 | 0.00101 | 0.00064 | 0.00034 |
| Iron | Total fraction | mg/L | 0.0012 | NS | NS | 0.0337 | 0.0389 |
| Lead | Total fraction | mg/L | 0.000002 | 0.000048 | 0.000040 | 0.000012 | <0.000002 |
| Manganese | Total fraction | mg/L | 0.00001 | 0.00990 | 0.01550 | 0.01660 | 0.0188 |
| Mercury | Total fraction | mg/L | 2.00E-07 | 2.48E-06 | 2.44E-06 | 4.80E-07 | 5.38E-07 |
| Nickel | Total fraction | mg/L | 0.000006 | 0.00149 | 0.00129 | 0.00074 | 0.00038 |
| Selenium | Total fraction | mg/L | 0.0001 | <0.0001 | <0.00001 | 0.00023 | 0.00027 |
| Silver | Total fraction | mg/L | 0.000008 | 0.000021 | <0.000008 | <0.000008 | <0.000008 |
| Zinc | Total fraction | mg/L | 0.00002 | 0.00039 | 0.00018 | 0.00016 | <0.00002 |
| Arsenic | Dissolved fraction | mg/L | 0.00010 | 0.00060 | 0.00037 | 0.00098 | 0.00101 |
| Cadmium | Dissolved fraction | mg/L | 0.00002 | <0.00001 | <0.000002 | <0.000002 | <0.000002 |
| Copper | Dissolved fraction | mg/L | 0.000003 | 0.00075 | 0.00070 | 0.00056 | 0.00033 |
| Iron | Dissolved fraction | mg/L | 0.0012 | 0.0190 | 0.0370 | <0.002 | 0.0032 |
| Lead | Dissolved fraction | mg/L | 0.000002 | 0.000011 | <0.000002 | <0.000002 | <0.000002 |
| Mercury | Dissolved fraction | mg/L | 2.00E-07 | 1.74E-06 | 1.81E-06 | 3.10E-07 | 5.40E-07 |
| Nickel | Dissolved fraction | mg/L | 0.000006 | 0.00122 | 0.00093 | 0.00065 | 0.00027 |
| Silver | Dissolved fraction | mg/L | 0.000008 | <0.000008 | <0.000008 | <0.000008 | <0.000008 |
| Zinc | Dissolved fraction | mg/L | 0.00002 | 0.00020 | <0.00002 | 0.00003 | <0.00002 |
| *Nutrients* | | | | | | | |
| Ammonia | Total fraction | mg/L | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Nitrate | Total fraction | mg/L | 0.005 | 0.079 | 0.0644 | 0.11 | 0.075 |
| Orthophosphate | Total fraction | mg/L | 0.005 | 0.0125 | 0.0106 | 0.0153 | 0.0174 |
| Total Phosphorus | Total fraction | mg/L | 0.03 | <0.03 | <0.03 | <0.03 | 0.02 |
| Chlorophyll a | Total fraction | µg/L | 0.000045 | 0.21 | 4.86 | 0.81 | 0.12 |

same

## Table E2.5-12 (continued)

### Analytical Constituent

| NFFR upstream of Poe Powerhouse (Poe-3) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Reporting | Sample Date | | | |
| Constituent | | Units | Limit | 03/27/03 | 05/13/03 | 08/13/03 | 10/15/03 |
| | | | *General Chemistry* | | | | |
| Calcium | Total fraction | mg/L | 0.07 | 7.51 | 8.59 | 10.20 | 9.53 |
| Magnesium | Total fraction | mg/L | 0.001 | 3.45 | 4.02 | 5.59 | 5.31 |
| Sodium | Total fraction | mg/L | 0.02 | 2.22 | 2.62 | 4.38 | 4.56 |
| Potassium | Total fraction | mg/L | 0.03 | 0.58 | 0.67 | 1.41 | 1.41 |
| Sulfate | Total fraction | mg/L | 0.4 | 1.98 | 1.99 | 1.75 | 1.70 |
| Chloride | Total fraction | mg/L | 0.2 | 0.64 | 0.77 | 0.96 | 1.06 |
| Total Dissolved Solids | Total fraction | mg/L | 10 | 50 | 59 | 74 | 60 |
| Total Hardness | Total fraction | mg/L | 1.0 | 32.7 | 38.2 | 56.2 | 46.6 |
| Total Alkalinity | Total fraction | mg/L | 1.6 | 29.9 | 40.9 | 60.7 | 52.6 |
| | | | *Trace Metals* | | | | |
| Aluminum | Total fraction | mg/L | 0.01 | 0.021 | 0.116 | 0.026 | <0.010 |
| Arsenic | Total fraction | mg/L | 0.0001 | 0.00055 | 0.00046 | 0.00098 | 0.00101 |
| Barium | Total fraction | mg/L | 0.0002 | 0.012 | 0.014 | 0.013 | 0.012 |
| Cadmium | Total fraction | mg/L | 0.00002 | <0.00001 | <0.000002 | <0.000002 | <0.000002 |
| Chromium | Total fraction | mg/L | 0.0002 | 0.00064 | 0.00111 | 0.00103 | 0.00011 |
| Copper | Total fraction | mg/L | 0.000003 | 0.00077 | 0.00080 | 0.00052 | 0.00032 |
| Iron | Total fraction | mg/L | 0.0012 | NS | NS | 0.0352 | 0.0213 |
| Lead | Total fraction | mg/L | 0.000002 | 0.000047 | 0.000021 | 0.000011 | <0.000002 |
| Manganese | Total fraction | mg/L | 0.00001 | 0.00726 | 0.00857 | 0.00987 | 0.00552 |
| Mercury | Total fraction | mg/L | 2.00E-07 | 2.61E-06 | 2.37E-06 | 4.70E-07 | 3.86E-07 |
| Nickel | Total fraction | mg/L | 0.000006 | 0.00161 | 0.00139 | 0.00076 | 0.00047 |
| Selenium | Total fraction | mg/L | 0.0001 | <0.0003 | <0.0001 | <0.0001 | 0.00015 |
| Silver | Total fraction | mg/L | 0.000008 | <0.000008 | <0.000008 | <0.000008 | <0.000008 |
| Zinc | Total fraction | mg/L | 0.00002 | 0.00038 | 0.00016 | 0.00011 | <0.00002 |
| Arsenic | Dissolved fraction | mg/L | 0.00010 | 0.00049 | 0.00028 | 0.00102 | 0.00101 |
| Cadmium | Dissolved fraction | mg/L | 0.00002 | <0.00001 | <0.000002 | <0.000002 | <0.000002 |
| Copper | Dissolved fraction | mg/L | 0.000003 | 0.00060 | 0.00059 | 0.00050 | 0.00029 |
| Iron | Dissolved fraction | mg/L | 0.0012 | 0.0220 | 0.0140 | 0.0020 | 0.0035 |
| Lead | Dissolved fraction | mg/L | 0.000002 | 0.000014 | <0.000002 | <0.000002 | <0.000002 |
| Mercury | Dissolved fraction | mg/L | 2.00E-07 | 1.79E-06 | 1.56E-06 | <2.0E-7 | 3.87E-07 |
| Nickel | Dissolved fraction | mg/L | 0.000006 | 0.00132 | 0.00120 | 0.00066 | 0.00042 |
| Silver | Dissolved fraction | mg/L | 0.000008 | 0.000012 | <0.000008 | <0.000008 | <0.000008 |
| Zinc | Dissolved fraction | mg/L | 0.00002 | 0.00022 | <0.00002 | 0.00111 | <0.00002 |
| | | | *Nutrients* | | | | |
| Ammonia | Total fraction | mg/L | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Nitrate | Total fraction | mg/L | 0.005 | 0.0622 | 0.0695 | 0.0757 | 0.069 |
| Orthophosphate | Total fraction | mg/L | 0.005 | 0.0104 | 0.0097 | 0.0118 | 0.0155 |
| Total Phosphorus | Total fraction | mg/L | 0.03 | <0.03 | <0.03 | <0.03 | 0.03 |
| Chlorophyll a | Total fraction | µg/L | 0.000045 | 0.38 | 2.19 | 0.30 | 0.09 |

Same

## Table E2.5-12 (continued)

### Analytical Constituent

| NFFR at Big Bend Dam (Poe-7) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Reporting | Sample Date | | | |
| Constituent | | Units | Limit | 03/27/03 | 05/13/03 | 08/13/03 | 10/15/03 |
| ***General Chemistry*** | | | | | | | |
| Calcium | Total fraction | mg/L | 0.07 | 7.72 | 8.57 | 10.20 | 9.95 |
| Magnesium | Total fraction | mg/L | 0.001 | 3.00 | 3.41 | 3.74 | 4.86 |
| Sodium | Total fraction | mg/L | 0.02 | 2.36 | 2.67 | 4.37 | 4.68 |
| Potassium | Total fraction | mg/L | 0.03 | 0.57 | 0.64 | 0.82 | 1.33 |
| Sulfate | Total fraction | mg/L | 0.4 | 1.93 | 1.96 | 1.66 | 1.60 |
| Chloride | Total fraction | mg/L | 0.2 | 0.67 | 0.77 | 1.05 | 1.05 |
| Total Dissolved Solids | Total fraction | mg/L | 10 | 55 | 62 | 72 | 63 |
| Total Hardness | Total fraction | mg/L | 1.0 | 30.7 | 37.2 | 53 | 46.6 |
| Total Alkalinity | Total fraction | mg/L | 1.6 | 31.2 | 40.7 | 55 | 52.1 |
| ***Trace Metals*** | | | | | | | |
| 0.2 Aluminum | Total fraction | mg/L | 0.01 | 0.32 | 0.143 | 0.0282 | <0.010 |
| Arsenic | Total fraction | mg/L | 0.0001 | 0.00068 | 0.00042 | 0.00125 | 0.00115 |
| Barium | Total fraction | mg/L | 0.0002 | 0.013 | 0.014 | 0.012 | 0.011 |
| Cadmium | Total fraction | mg/L | 0.00002 | <0.00001 | <0.000002 | 0.00001 | <0.000002 |
| Chromium | Total fraction | mg/L | 0.0002 | 0.00058 | 0.00107 | 0.00054 | 0.0001 |
| Copper | Total fraction | mg/L | 0.000003 | 0.00118 | 0.00096 | 0.00052 | 0.0003 |
| Iron | Total fraction | mg/L | 0.0012 | NS | NS | 0.0511 | 0.135 |
| Lead | Total fraction | mg/L | 0.000002 | 0.000103 | 0.000029 | 0.000043 | <0.000002 |
| Manganese | Total fraction | mg/L | 0.00001 | 0.02300 | 0.01520 | 0.02220 | 0.0276 |
| Mercury | Total fraction | mg/L | 2.00E-07 | 2.51E-06 | 2.46E-06 | 2.10E-07 | 3.90E-07 |
| Nickel | Total fraction | mg/L | 0.000006 | 0.00201 | 0.00130 | 0.00040 | 0.00019 |
| Selenium | Total fraction | mg/L | 0.0001 | <0.0001 | <0.00001 | 0.0002 | 0.00016 |
| Silver | Total fraction | mg/L | 0.000008 | <0.000008 | <0.000008 | <0.000008 | <0.000008 |
| Zinc | Total fraction | mg/L | 0.00002 | 0.00076 | <0.00002 | 0.00038 | 0.0003 |
| Arsenic | Dissolved fraction | mg/L | 0.00010 | 0.00059 | 0.00038 | 0.00112 | 0.00105 |
| Cadmium | Dissolved fraction | mg/L | 0.00002 | <0.00001 | <0.000002 | <0.000002 | <0.000002 |
| Copper | Dissolved fraction | mg/L | 0.000003 | 0.00065 | 0.00065 | 0.00042 | 0.00026 same |
| Iron | Dissolved fraction | mg/L | 0.0012 | 0.0180 | 0.0210 | <0.002 | 0.0041 |
| Lead | Dissolved fraction | mg/L | 0.000002 | 0.000010 | 0.000009 | <0.000002 | <0.000002 |
| Mercury | Dissolved fraction | mg/L | 2.00E-07 | 1.81E-06 | 1.91E-06 | <2.0E-07 | 2.17E-07 |
| Nickel | Dissolved fraction | mg/L | 0.000006 | 0.00131 | 0.00100 | 0.00027 | 0.00013 |
| Silver | Dissolved fraction | mg/L | 0.000008 | <0.000008 | <0.000008 | <0.000008 | <0.000008 |
| Zinc | Dissolved fraction | mg/L | 0.00002 | 0.00025 | <0.00002 | 0.00011 | <0.00002 |
| ***Nutrients*** | | | | | | | |
| Ammonia | Total fraction | mg/L | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Nitrate | Total fraction | mg/L | 0.005 | 0.0593 | 0.0767 | 0.0782 | 0.0633 |
| Orthophosphate | Total fraction | mg/L | 0.005 | 0.0113 | 0.0106 | 0.0124 | 0.0166 |
| Total Phosphorus | Total fraction | mg/L | 0.03 | <0.03 | <0.03 | <0.03 | 0.03 |
| Chlorophyll a | Total fraction | µg/L | 0.000045 | 0.32 | 4.58 | 0.69 | 0.10 |

## Table E2.5-12 (continued)

### Analytical Constituent

| Constituent | | Units | Reporting Limit | 03/27/03 | 05/13/03 | 08/13/03 | 10/15/03 |
|---|---|---|---|---|---|---|---|
| Mill Creek upstream of Hwy 70 (MC) | | | | Sample Date | | | |
| *General Chemistry* | | | | | | | |
| Calcium | Total fraction | mg/L | 0.07 | 3.10 | 2.79 | 3.90 | 3.90 |
| Magnesium | Total fraction | mg/L | 0.001 | 5.52 | 5.20 | 6.39 | 7.08 |
| Sodium | Total fraction | mg/L | 0.02 | 1.15 | 1.11 | 1.28 | 1.65 |
| Potassium | Total fraction | mg/L | 0.03 | 0.41 | 0.40 | 0.38 | 0.01 |
| Sulfate | Total fraction | mg/L | 0.4 | 1.26 | 1.16 | 1.79 | 2.04 |
| Chloride | Total fraction | mg/L | 0.2 | 0.41 | 0.51 | 0.57 | 0.56 |
| Total Dissolved Solids | Total fraction | mg/L | 10 | 51 | 51 | 61 | 50 |
| Total Hardness | Total fraction | mg/L | 1.0 | 30.7 | 29.4 | 41.5 | 40 |
| Total Alkalinity | Total fraction | mg/L | 1.6 | 31.4 | 32.1 | 39.6 | 39.1 |
| *Trace Metals* | | | | | | | |
| Aluminum | Total fraction | mg/L | 0.010 | 0.022 | 0.240 | 0.016 | <0.010 |
| Arsenic | Total fraction | mg/L | 0.0001 | <0.00010 | <0.00010 | <0.00010 | 0.00017 |
| Barium | Total fraction | mg/L | 0.0002 | 0.008 | 0.008 | 0.011 | 0.012 |
| Cadmium | Total fraction | mg/L | 0.000002 | <0.000002 | <0.000002 | <0.000002 | <0.000002 |
| Chromium | Total fraction | mg/L | 0.0002 | 0.0008 | 0.0013 | 0.0011 | 0.00046 |
| Copper | Total fraction | mg/L | 0.000003 | 0.0002 | 0.0002 | 0.0002 | 0.00004 |
| Iron | Total fraction | mg/L | 0.005 | NS | NS | 0.0124 | 0.006 |
| Lead | Total fraction | mg/L | 0.000002 | <0.00001 | 0.000011 | <0.000002 | <0.000002 |
| Manganese | Total fraction | mg/L | 0.00001 | 0.00056 | 0.00061 | 0.00060 | 0.00026 |
| Mercury | Total fraction | mg/L | 2.00E-07 | 1.54E-06 | 1.79E-06 | <2.0E-7 | 3.19E-07 |
| Nickel | Total fraction | mg/L | 0.000006 | 0.0052 | 0.0059 | 0.0043 | 0.00391 |
| Selenium | Total fraction | mg/L | 0.0001 | <0.0001 | 0.0001 | 0.00013 | 0.00038 |
| Silver | Total fraction | mg/L | 0.000008 | <0.000008 | <0.000008 | <0.000008 | <0.000008 |
| Zinc | Total fraction | mg/L | 0.00006 | 0.00031 | <0.00006 | 0.00004 | <0.00002 |
| Arsenic | Dissolved fraction | mg/L | 0.00010 | <0.00010 | <0.00010 | 0.00012 | 0.00014 |
| Cadmium | Dissolved fraction | mg/L | 0.00002 | <0.000002 | <0.000002 | <0.000002 | 0.000006 |
| Copper | Dissolved fraction | mg/L | 0.000003 | 0.00013 | 0.00006 | 0.00017 | 0.00005 |
| Iron | Dissolved fraction | mg/L | 0.005 | <0.0050 | <0.0050 | <0.002 | <0.0020 |
| Lead | Dissolved fraction | mg/L | 0.000002 | <0.00002 | <0.000002 | <0.000002 | <0.000002 |
| Mercury | Dissolved fraction | mg/L | 2.00E-07 | 1.31E-06 | 1.41E-06 | <2.0E-7 | 2.60E-07 |
| Nickel | Dissolved fraction | mg/L | 0.000006 | 0.00472 | 0.00526 | 0.00429 | 0.00362 |
| Silver | Dissolved fraction | mg/L | 0.000008 | <0.000008 | <0.000008 | <0.000008 | <0.000008 |
| Zinc | Dissolved fraction | mg/L | 0.00002 | 0.00013 | <0.00002 | 0.00007 | <0.00002 |
| *Nutrients* | | | | | | | |
| Ammonia | Total fraction | mg/L | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Nitrate | Total fraction | mg/L | 0.005 | 0.03 | 0.06 | 0.10 | 0.09 |
| Orthophosphate | Total fraction | mg/L | 0.005 | 0.01 | 0.01 | 0.02 | 0.03 |
| Total Phosphorus | Total fraction | mg/L | 0.03 | <0.03 | <0.03 | <0.03 | 0.02 |
| Chlorophyll a | Total fraction | µg/L | 0.000045 | 0.06 | 1.27 | 0.08 | 0.08 |

same

## Table E2.5-12 (continued)

### Analytical Constituent

| Flea Valley Creek (FVC) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Reporting | Sample Date | | | |
| Constituent | | Units | Limit | 03/27/03 | 05/13/03 | 08/13/03 | 10/15/03 |
| | | | *General Chemistry* | | | | |
| Calcium | Total fraction | mg/L | 0.07 | 11.61 | 10.40 | 13.00 | 13.20 |
| Magnesium | Total fraction | mg/L | 0.001 | 8.65 | 8.72 | 8.58 | 9.07 |
| Sodium | Total fraction | mg/L | 0.02 | 3.54 | 3.35 | 4.60 | 4.83 |
| Potassium | Total fraction | mg/L | 0.03 | 1.51 | 1.34 | 2.31 | 2.21 |
| Sulfate | Total fraction | mg/L | 0.4 | 3.74 | 3.27 | 4.92 | 5.43 |
| Chloride | Total fraction | mg/L | 0.2 | 1.12 | 1.18 | 1.16 | 1.18 |
| Total Dissolved Solids | Total fraction | mg/L | 10 | 101 | 95 | 107 | 101 |
| Total Hardness | Total fraction | mg/L | 1.0 | 61.9 | 61.7 | 78.5 | 72.4 |
| Total Alkalinity | Total fraction | mg/L | 1.6 | 66.6 | 69.1 | 76.5 | 74.9 |
| | | | *Trace Metals* | | | | |
| Aluminum | Total fraction | mg/L | 0.01 | 0.064 | 0.129 | 0.121 | 0.0122 |
| Arsenic | Total fraction | mg/L | 0.0001 | 0.00036 | 0.00012 | 0.00048 | 0.00041 |
| Barium | Total fraction | mg/L | 0.0002 | 0.019 | 0.017 | 0.026 | 0.025 |
| Cadmium | Total fraction | mg/L | 0.00002 | <0.00001 | <0.000002 | 0.000002 | <0.000002 |
| Chromium | Total fraction | mg/L | 0.0002 | 0.00093 | 0.00168 | 0.00160 | 0.00033 |
| Copper | Total fraction | mg/L | 0.000003 | 0.00040 | 0.00036 | 0.00068 | 0.00032 |
| Iron | Total fraction | mg/L | 0.0012 | NS | NS | 0.074 | 0.011 |
| Lead | Total fraction | mg/L | 0.000002 | 0.000015 | <0.000002 | 0.000047 | 0.000025 |
| Manganese | Total fraction | mg/L | 0.00001 | 0.00085 | 0.00097 | 0.00246 | 0.00156 |
| Mercury | Total fraction | mg/L | 2.00E-07 | 1.62E-06 | 1.59E-06 | 7.20E-07 | 2.35E-07 |
| Nickel | Total fraction | mg/L | 0.000006 | 0.00151 | 0.00172 | 0.00213 | 0.00148 |
| Selenium | Total fraction | mg/L | 0.0001 | <0.0003 | <0.00001 | 0.00031 | 0.00023 |
| Silver | Total fraction | mg/L | 0.000008 | <0.000008 | <0.000008 | <0.000008 | <0.000008 |
| Zinc | Total fraction | mg/L | 0.00002 | 0.00024 | <0.00002 | 0.00043 | 0.00003 |
| Arsenic | Dissolved fraction | mg/L | 0.00010 | 0.00035 | <0.00010 | 0.00049 | 0.00043 |
| Cadmium | Dissolved fraction | mg/L | 0.00002 | <0.00001 | <0.000002 | <0.000002 | 0.000003 |
| Copper | Dissolved fraction | mg/L | 0.000003 | 0.00029 | 0.00021 | 0.00030 | 0.00016 |
| Iron | Dissolved fraction | mg/L | 0.0012 | 0.0190 | <0.0050 | <0.002 | <0.0020 |
| Lead | Dissolved fraction | mg/L | 0.000002 | <0.00001 | <0.000002 | <0.000002 | <0.000002 |
| Mercury | Dissolved fraction | mg/L | 2.00E-07 | 1.29E-06 | 1.70E-06 | <2.0E-7 | 2.95E-07 |
| Nickel | Dissolved fraction | mg/L | 0.000006 | 0.00128 | 0.00145 | 0.00105 | 0.0008 |
| Silver | Dissolved fraction | mg/L | 0.000008 | <0.000008 | <0.000008 | <0.000008 | <0.000008 |
| Zinc | Dissolved fraction | mg/L | 0.00002 | 0.00016 | <0.00002 | 0.00011 | <0.00002 |
| | | | *Nutrients* | | | | |
| Ammonia | Total fraction | mg/L | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Nitrate | Total fraction | mg/L | 0.005 | 0.036 | 0.062 | 0.079 | 0.084 |
| Orthophosphate | Total fraction | mg/L | 0.005 | 0.033 | 0.030 | 0.041 | 0.049 |
| Total Phosphorus | Total fraction | mg/L | 0.03 | 0.03 | <0.03 | 0.04 | 0.05 |
| Chlorophyll a | Total fraction | µg/L | 0.000045 | 0.09 | 1.92 | 1.08 | 0.03 |

same

**Table E2.5-12 (continued)**

*In situ Parameters*[4]

| Station | Date | Time | Synoptic Temperature (°C) | pH (lab) (units) | Conductivity (@ 25°C) (µmhos/cm) |
|---|---|---|---|---|---|
| Poe-1C | 03/27/03 | 1508 | 9.4 | 8.0 | 57 |
| | 05/13/03 | 1430 | 12.1 | 8.5 | 64 |
| | 08/13/03 | 1510 | 20.1 | 7.9 | 104 |
| | 10/15/03 | NS | --- | --- | --- |
| Poe-1B | 03/27/03 | 1448 | 7.9 | 7.8 | 79 |
| | 05/13/03 | 1400 | 10.5 | 8.5 | 84 |
| | 08/13/03 | 1500 | 19.2 | 7.8 | 100 |
| | 10/15/03 | NS | --- | --- | --- |
| Poe-1A | 03/27/03 | 1413 | 7.9 | 7.8 | 73 |
| | 05/13/03 | 800 | 11.0 | 8.5 | 83 |
| | 08/13/03 | 805 | 19.2 | 7.8 | 114 |
| | 10/15/03 | 830 | 14.3 | 8.7 | 106 |
| Poe-5 | 03/27/03 | 1337 | 9.5 | 7.8 | 75 |
| | 05/13/03 | 830 | 11.1 | 8.5 | 80 |
| | 08/13/03 | 845 | 19.3 | 8.1 | 113 |
| | 10/15/03 | 900 | 14.4 | 8.1 | 107 |
| Mill Creek | 03/27/03 | 1317 | 7.9 | 8.0 | 62 |
| | 05/13/03 | 900 | 8.5 | 8.4 | 60 |
| | 08/13/03 | 910 | 13.4 | 8.0 | 78 |
| | 10/15/03 | 915 | 9.9 | 8.3 | 82 |
| Flea Valley Creek | 03/27/03 | 1200 | 10.3 | 8.3 | 134 |
| | 05/13/03 | 1010 | 10.7 | 8.2 | 132 |
| | 08/13/03 | 1020 | 13.8 | 8.3 | 157 |
| | 10/15/03 | 945 | 11.8 | 7.9 | 156 |
| Poe-2A | 03/27/03 | 1236 | 9.5 | 8.3 | 74 |
| | 05/13/03 | 930 | 11.1 | 8.3 | 80 |
| | 08/13/03 | 942 | 18.4 | 8.0 | 112 |
| | 10/15/03 | 930 | 14.0 | 8.2 | 106 |
| Poe-6 | 03/27/03 | NS | --- | --- | --- |
| | 05/13/03 | NS | --- | --- | --- |
| | 08/13/03 | 1412 | 20.4 | 8.3 | 112 |
| | 10/15/03 | NS | --- | --- | --- |

NS = Not sampled

## Table E2.5-12 (continued)

*In situ Parameters*[4]

| Station | Date | Time | Synoptic Temperature (°C) | pH (lab) (units) | Conductivity (@ 25°C) (μmhos/cm) |
|---|---|---|---|---|---|
| Poe-3 | 03/27/03 | 915 | 8.9 | 7.8 | 73 |
| | 05/13/03 | 1215 | 12.5 | 8.7 | 85 |
| | 08/13/03 | 1230 | 21.1 | 8.3 | 118 |
| | 10/15/03 | 1330 | 14.8 | 8.2 | 106 |
| Poe-4B | 03/27/03 | 946 | 8.5 | 7.9 | 71 |
| | 05/13/03 | 1236 | 11.0 | 8.2 | 79 |
| | 08/13/03 | 1256 | 19.4 | 8.4 | 111 |
| | 10/15/03 | 1340 | 14.5 | 7.7 | 106 |
| Poe-7 | 03/27/03 | 1030 | 8.7 | 7.8 | 71 |
| | 05/13/03 | 1130 | 11.4 | 8.3 | 81 |
| | 08/13/03 | 1145 | 19.4 | 8.4 | 113 |
| | 10/15/03 | 1230 | 14.5 | 7.7 | 106 |

The primary cation at all sampling stations in the NFFR was calcium, followed by magnesium and sodium. The levels of each of these three constituents were similar between stations. Calcium levels ranged from 7.3 to 10.2 mg/L; magnesium values ranged from 3.0to 5.6 mg/L; and average sodium levels ranged from 2.2 to 4.5 mg/L. Magnesium was the primary cation in Mill Creek, with Flea Valley Creek having calcium as the predominate cation.

The primary anion at all sampling stations in the NFFR was bicarbonate, followed by sulfate and chloride. The levels of each of these constituents were similar between stations. Average sulfate levels in the NFFR ranged from 1.6 to 2.0 mg/L; and chloride ranged from 0.6 to 1.1 mg/L. Flea Valley Creek exhibited slightly higher sulfate concentrations that either the NFFR or Mill Creek.

Specific conductance in the river stations ranged from 57 to 118 μmhos/cm. There was no measurable difference in conductivity between stations above Poe Dam and those in the bypass reach. There was a slight tendency for conductivity to increase as water passed downstream through the bypass reach. Conductivity in Mill Creek was the lowest of all the stations sampled with levels ranging from 60 to 82 μmhos/cm. Flea Valley Creek had the highest conductivity levels of any of the stations, ranging from 132 to 156 μmhos/cm.

The pH of the NFFR in the Project area was consistent between stations, varying less than

0.5 units from one station to the next. NFFR pH values ranged from 7.7 to 8.7 units. There was no detectable pattern in concentration between upstream and downstream stations. The pH of the tributaries was similar to that found in the main NFFR, ranging from 7.9 to 8.4 units.

The general water chemistry data collected during this study were similar to data in previous monitoring years (1999-2000). No spatial or temporal trends in the general chemistry data attributable to Project operations were noted.

**E2.5.3.2.2 Results of Trace Metal Monitoring**

Trace metal samples were collected from the seven sampling stations during the 2003 monitoring effort. Trace metal samples were collected in order to test for total and dissolved phases. Fourteen metal species were analyzed as total; of these same species nine were evaluated for dissolved concentrations. For the 2003 monitoring effort, the Licensee used Ultra Clean collection techniques and analytical methods that resulted in much lower detection limits than the 1999-2000 monitoring effort. As a result of these lower reporting limits most of the metal species evaluated were detected at each station at some point during the monitoring effort. On average, metal concentrations in samples from the two tributary streams were slightly lower than those measured in the five river stations. Concentrations at all stations tended to be higher in samples collected during the early spring (March 2003) and late runoff (May 2003) sampling efforts. This was related to elevated levels of suspended sediments, and increased non-point source runoff from the watershed.

During the four sampling efforts only aluminum (total) was measured at levels exceeding any applicable regulatory criteria. Concentrations of total aluminum in May 2003 exceeded the recommended criteria for the protection of freshwater aquatic life (USEPA National Ambient Water Quality Criteria) at all seven stations. Total aluminum exceeded the same criteria at Poe-5 and Poe-7 in the March 2003 samples and at Flea Valley in the August 2003 sample. Total aluminum exceeded the California Department of Health Services Drinking water standard at Poe-7 and Flea Valley Creek in March 2003 and Mill Creek in May 2003. A complete comparison of the 2003 analytical results with the various applicable regulatory criteria is presented in Appendix E2.4.

**E2.5.4 Results of Dissolved Oxygen Monitoring**

The DO concentration of a water body is largely a function of water temperature and atmospheric pressure (i.e., elevation). Oxygen levels decrease with increasing water temperature. Because of the stable temperature regime, high aeration caused by turbulence in channel flows, and relatively low levels of aquatic vegetation, DO levels are maintained at a saturation condition throughout the Project area.

### E2.5.4.1 Results from 1999-2000 Monitoring

#### E2.5.4.1.1 General Conditions

Table E2.5-13 summarizes the DO monitoring results for the Project area. Figure E2.5-27 compares DO saturation at all NFFR stations for the period June-September 1999 and 2000.

*In situ* monitoring of DO indicates that levels follow seasonally defined patterns. In general, DO concentrations were highest in March, coinciding with the coldest water temperatures. In contrast, the highest percentage saturation occurred during the summer and was associated with the powerhouse tailrace. These high saturation values were present only in the tailrace itself and quickly returned to values less than super-saturation (115%) at downstream locations. There was no typical pattern of concentration changes within the bypass reach. DO levels were generally similar throughout the reach during any given sampling period. Levels did tend to be higher in the upstream stations compared with those in the bypass reach. DO levels in the stations upstream of Poe Dam ranged from 7.6 to 13.6 mg/L (88 to 125% saturation); DO levels in the Poe Reach ranged from 8.0 to 12.2 mg/L (83 to 119% saturation); and DO levels in the two tributary streams were similar, ranging from 8.3 to 10.0 mg/L (86 to 108% saturation).

## Table E2.5-13

## Results of 1999, 2000, and 2003 dissolved oxygen monitoring in the Poe Project

| Station | Location | Date | Time | Temp. (°C) | Dissolved Oxygen Level (mg/L) | Dissolved Oxygen Saturation (%) |
|---|---|---|---|---|---|---|
| Poe-1A | NFFR above Poe Reservoir | 03/24/99 | 1100 | 7.2 | 12.5 | 109 |
| | | 06/16/99 | 1245 | 17.3 | 9.1 | 99 |
| | | 07/15/99 | 1715 | 20.2 | 10.8 | 125 |
| | | 08/11/99 | 908 | 19.1 | 9.8 | 111 |
| | | 09/15/99 | 1020 | 18.0 | 9.3 | 103 |
| | | 12/16/99 | 1015 | 4.1 | 13.6 | 110 |
| | | 03/30/00 | 940 | 8.3 | 10.7 | 96 |
| | | 06/14/00 | 955 | 17.5 | 9.2 | 101 |
| | | 07/12/00 | 915 | 18.8 | 9.6 | 108 |
| | | 08/09/00 | 937 | 20.6 | 9.2 | 107 |
| | | 09/13/00 | 1013 | 17.0 | 11.0 | 119 |
| | | 03/27/03 | 1413 | 7.9 | 11.0 | 97 |
| | | 05/13/03 | 800 | 11.0 | 11.3 | 107 |
| | | 08/13/03 | 805 | 19.2 | 10.5 | 119 |
| | | 10/15/03 | 830 | 14.3 | 10.5 | 108 |
| Poe-1B | Cresta Powerhouse tailrace | 06/16/99 | 1215 | 17.2 | 9.4 | 102 |
| | | 07/15/99 | 1215 | 17.2 | 9.4 | 102 |
| | | 08/11/99 | 915 | 19.2 | 9.8 | 111 |
| | | 09/15/99 | 907 | 18.0 | 9.5 | 105 |
| | | 06/14/00 | 1030 | 17.4 | 9.2 | 101 |
| | | 07/12/00 | 846 | 18.8 | 9.3 | 105 |
| | | 08/09/00 | 900 | 20.7 | 9.2 | 108 |
| | | 09/13/00 | 933 | 17.0 | 11.0 | 119 |
| | | 03/27/03 | 1448 | 7.9 | 11.1 | 99 |
| | | 05/13/03 | 1400 | 10.5 | 12.3 | 116 |
| | | 08/13/03 | 1500 | 19.2 | 10.5 | 119 |
| | | 10/15/03 | NS | NS | NS | NS |
| Poe-1C | NFFR above Cresta Powerhouse | 06/16/99 | 1200 | 17.0 | 8.2 | 89 |
| | | 07/15/99 | --- | --- | --- | --- |
| | | 08/11/99 | --- | --- | --- | --- |
| | | 09/15/99 | 945 | 17.0 | 8.2 | 89 |
| | | 06/14/00 | 1100 | 17.5 | 8.6 | 94 |
| | | 07/12/00 | 940 | 18.7 | 8.4 | 94 |
| | | 08/10/00 | 1015 | 20.0 | 7.6 | 88 |
| | | 09/14/00 | 1010 | 16.7 | 9.0 | 97 |
| | | 03/27/03 | 1508 | 9.4 | 10.2 | 94 |
| | | 05/13/03 | 1430 | 12.1 | 11.0 | 108 |
| | | 08/13/03 | 1510 | 20.1 | 9.9 | 114 |
| | | 10/15/03 | NS | NS | NS | NS |

## Table E2.5-13 (continued)

| Station | Location | Date | Time | Temp. (C) | Dissolved Oxygen Level (mg/L) | Dissolved Oxygen Saturation (%) |
|---|---|---|---|---|---|---|
| Poe-2A | NFFR at Pulga Bridge (NF-23) | 03/24/99 | 1200 | 7.2 | 12.2 | 106 |
| | | 06/16/99 | 1330 | 18.5 | 8.3 | 92 |
| | | 07/15/99 | 1330 | 21.4 | 10.1 | 119 |
| | | 08/11/99 | 1130 | 19.2 | 8.2 | 93 |
| | | 09/14/99 | 1342 | 19.0 | 9.1 | 102 |
| | | 12/16/99 | 1100 | 4.5 | 10.2 | 83 |
| | | 03/30/00 | 1015 | 7.9 | 11.2 | 99 |
| | | 06/14/00 | 1230 | 18.4 | 9.1 | 101 |
| | | 07/12/00 | 1110 | 19.3 | 8.6 | 97 |
| | | 08/09/00 | 1145 | 21.1 | 8.4 | 98 |
| | | 09/13/00 | 1200 | 17.4 | 9.4 | 102 |
| | | 03/27/03 | 1236 | 9.5 | 10.5 | 97 |
| | | 05/13/03 | 930 | 11.1 | 11.3 | 108 |
| | | 08/13/03 | 942 | 18.4 | 9.1 | 101 |
| | | 10/15/03 | 930 | 14.0 | 11.2 | 114 |
| Poe-3 | NFFR above Poe Powerhouse | 03/24/99 | 1300 | 7.9 | 11.8 | 102 |
| | | 06/16/99 | 1430 | 20.0 | 8.4 | 94 |
| | | 07/15/99 | 940 | 21.5 | 9.5 | 110 |
| | | 08/11/99 | 1230 | 20.5 | 8.4 | 96 |
| | | 09/14/99 | 1030 | 18.0 | 8.5 | 92 |
| | | 12/16/99 | 1200 | 5.1 | 12.0 | 97 |
| | | 03/30/00 | 1130 | 10.8 | 10.7 | 99 |
| | | 06/14/00 | 1430 | 21.4 | 8.2 | 95 |
| | | 07/12/00 | 1426 | 22.0 | 8.0 | 94 |
| | | 08/09/00 | 1345 | 22.6 | 9.0 | 107 |
| | | 09/13/00 | 1330 | 18.1 | 9.9 | 108 |
| | | 03/27/03 | 915 | 8.9 | 9.9 | 88 |
| | | 05/13/03 | 1215 | 12.5 | 10.9 | 105 |
| | | 08/13/03 | 1230 | 21.1 | 9.7 | 113 |
| | | 10/15/03 | 1330 | 14.8 | 11.6 | 118 |
| Poe-4A | Poe Reservoir at Dam, near intake | 06/16/99 | 1030 | 17.2 | 9.2 | 100 |
| | | 07/15/99 | 1545 | 21.0 | 10.0 | 117 |
| | | 08/13/99 | 1415 | 19.5 | 9.5 | 108 |
| | | 09/15/99 | 1112 | 19.1 | 8.5 | 96 |

## Table E2.5-13 (continued)

| Station | Location | Date | Time | Temp. (C) | Dissolved Oxygen Level (mg/L) | Dissolved Oxygen Saturation (%) |
|---|---|---|---|---|---|---|
| Poe-4B | Poe Powerhouse tailrace | 06/16/99 | 1500 | 17.2 | 9.6 | 102 |
| | | 07/15/99 | 950 | 20.0 | 11.1 | 125 |
| | | 08/13/99 | 1030 | 19.2 | 10.0 | 111 |
| | | 09/14/99 | 1000 | 18.0 | 9.8 | 106 |
| | | 12/16/99 | 1230 | 4.8 | 12.4 | 100 |
| | | 03/30/00 | 1140 | 8.7 | 13.3 | 118 |
| | | 06/15/00 | 1415 | 18.4 | 10.0 | 109 |
| | | 07/12/00 | 1345 | 19.2 | 9.8 | 109 |
| | | 08/09/00 | 1400 | 20.8 | 9.7 | 111 |
| | | 09/13/00 | 1400 | 17.1 | 10.0 | 106 |
| | | 03/27/03 | 946 | 8.5 | 11.4 | 101 |
| | | 05/13/03 | 1236 | 11.0 | 12.4 | 116 |
| | | 08/13/03 | 1256 | 19.4 | 10.2 | 114 |
| | | 10/15/03 | 1340 | 14.5 | 11.3 | 115 |
| Poe-5 | NFFR below Poe Dam | 06/16/99 | 1130 | 17.3 | 9.0 | 98 |
| | | 07/15/99 | 1515 | 20.8 | 9.9 | 115 |
| | | 08/13/99 | 1345 | 20.0 | 9.0 | 104 |
| | | 09/15/99 | 1210 | 18.4 | 8.8 | 98 |
| | | 06/15/00 | 1545 | 19.0 | 9.1 | 103 |
| | | 07/12/00 | 1015 | 19.3 | 8.8 | 100 |
| | | 08/09/00 | 1042 | 21.0 | 8.4 | 99 |
| | | 09/13/00 | 1101 | 17.2 | 9.9 | 108 |
| | | 03/27/03 | 1337 | 9.5 | 10.3 | 95 |
| | | 05/13/03 | 830 | 11.1 | 12.1 | 115 |
| | | 08/13/03 | 845 | 19.3 | 8.6 | 98 |
| | | 10/15/03 | 900 | 14.4 | 8.3 | 85 |
| Poe-6 | NFFR at Bardee's Bar | 06/16/99 | 830 | 17.1 | 8.6 | 92 |
| | | 07/15/99 | 1130 | 20.1 | 10.2 | 116 |
| | | 08/13/99 | 1232 | 19.7 | 9.3 | 105 |
| | | 09/14/99 | 1230 | 17.9 | 9.1 | 99 |
| | | 06/15/00 | 1642 | 21.2 | 8.6 | 100 |
| | | 07/12/00 | 1235 | 19.7 | 8.4 | 95 |
| | | 08/10/00 | 1145 | 20.0 | 8.0 | 91 |
| | | 09/14/00 | 1300 | 18.0 | 9.0 | 98 |
| | | 03/27/03 | NS | NS | NS | NS |
| | | 05/13/03 | NS | NS | NS | NS |
| | | 08/13/03 | 1412 | 20.4 | 10.9 | 125 |
| | | 10/15/03 | NS | NS | NS | NS |

## Table E2.5-13 (continued)

| Station | Location | Date | Time | Temp. ( C) | Dissolved Oxygen Level (mg/L) | Dissolved Oxygen Saturation (%) |
|---|---|---|---|---|---|---|
| FVC | Flea Valley Creek | 06/16/99 | 930 | 12.8 | 9.4 | 93 |
| | | 07/15/99 | 1400 | 17.0 | 10.0 | 108 |
| | | 08/13/99 | 1530 | 16.4 | 8.8 | 94 |
| | | 09/16/99 | 910 | 13.9 | 9.6 | 97 |
| | | 06/14/00 | 1317 | 16.8 | 8.3 | 90 |
| | | 07/12/00 | 1145 | 15.6 | 8.6 | 91 |
| | | 08/09/00 | 1233 | 17.2 | 8.4 | 91 |
| | | 09/13/00 | 1230 | 15.2 | 9.5 | 99 |
| | | 03/27/03 | 1200 | 10.3 | 9.7 | 90 |
| | | 05/13/03 | 1010 | 10.7 | 12.3 | 116 |
| | | 08/13/03 | 1020 | 13.8 | 9.9 | 101 |
| | | 10/15/03 | 945 | 11.8 | 11.8 | 115 |
| MC | Mill Creek | 06/16/99 | 1000 | 12.4 | 8.9 | 88 |
| | | 07/15/99 | 1430 | 17.2 | 10.0 | 108 |
| | | 08/13/99 | 1500 | 15.6 | 8.8 | 93 |
| | | 09/15/99 | 1245 | 14.5 | 9.0 | 93 |
| | | 06/14/00 | 1130 | 15.0 | 8.9 | 93 |
| | | 07/12/00 | 1040 | 14.6 | 8.8 | 91 |
| | | 08/09/00 | 1108 | 16.2 | 8.4 | 90 |
| | | 09/13/00 | 1132 | 14.3 | 8.4 | 86 |
| | | 03/27/03 | 1317 | 7.9 | 11.2 | 99 |
| | | 05/13/03 | 900 | 8.5 | 12.0 | 108 |
| | | 08/13/03 | 910 | 13.4 | 10.6 | 106 |
| | | 10/15/03 | 915 | 9.9 | 11.8 | 110 |
| Poe-7 | NFFR at Big Bend Dam | 03/27/03 | 1030 | 8.7 | 11.1 | 98 |
| | | 05/13/03 | 1130 | 11.4 | 12.6 | 119 |
| | | 08/13/03 | 1145 | 20.0 | 9.3 | 105 |
| | | 10/15/03 | 1230 | 15.0 | 11.7 | 120 |

### E2.5.4.1.2 Diel Oxygen Cycle

To evaluate the magnitude of diel DO cycling, the Licensee conducted a monitoring program in the lower portion of the Poe Reach. The monitoring was conducted on August 17 and 18, 1999 in a large pool upstream of Poe Powerhouse. The results of this test are presented in Figure E2.5-28. Flow in the NFFR during this period was about 92 cfs, and water temperatures ranged from 19.0 to 21.9°C and averaged 20.3°C for the test period. DO values during the test ranged from 8.5 to 9.5 mg/L (96 to 109% saturation). The diel fluctuation was 1.0 mg/L, which is relatively small. The data indicated that there were no impacts related to water temperature or extreme changes in DO values indicative of excessive aquatic plant growth.

### E2.5.4.2 Results from 2003 Monitoring

As was seen during the 1999-2000 monitoring, there was no typical pattern of concentration changes within the bypass reach. DO levels were generally similar throughout the reach during any given sampling period. Levels did tend to be higher in the upstream stations compared with those in the bypass reach. Table E2.5-13 presents the results of the 2003 monitoring effort. During the 2003 monitoring effort, DO levels in the stations upstream of Poe Dam ranged from 10.5 to 12.3 mg/L (97 to 119% saturation); DO levels in the Poe Reach ranged from 8.3 to 12.1 mg/L (85 to 126% saturation); and DO levels in the two tributary streams were similar, ranging from 9.7 to 12.3 mg/L (91 to 116% saturation). Levels measured during the 2003 monitoring effort were similar to those observed in 1999-2000.

### E2.5.5 Results of Nutrient Monitoring

#### E2.5.5.1 Results from 1999-2000 Monitoring

Results of nutrient analysis are included in Table E2.5-10. Nitrogen species (nitrate, ammonia, Kjeldahl nitrogen, and organic nitrogen) were not detected at any station during any of the monitoring periods. Phosphorus species (orthophosphate and total phosphorus) were detected only during the July 1999 period and were present at all stations at similar concentrations. These concentrations were only slightly above the detection limit. The results of the nutrient monitoring indicate that biostimulatory compounds are not present in concentrations that could contribute to degraded water quality in the Project area, and that there are no sustained organic discharges (agricultural runoff, feed lot, and industrial) to the NFFR in the vicinity of the Poe Project.

#### E2.5.5.2 Results from 2003 Monitoring

Results of the 2003 nutrient analysis are included in Table E2.5-12. Ammonia species was detected only at stations Poe-1A and Poe-2A in March 2003. Nitrogen species (nitrate + nitrite) were detected at similar concentrations at all stations during all four monitoring periods. Total phosphorus was detected above the reporting limit at all stations in October 2003, in general total phosphorus levels were highest in Flea Valley Creek. Orthophosphate was detected at similar concentrations at all stations during all four monitoring periods. Orthophosphate concentrations tended to be highest in Flea Valley Creek. Nutrient concentrations did not exceed any regulatory criteria during the 2003 monitoring effort. The results of the nutrient monitoring indicate that biostimulatory compounds are present in low concentrations that do not contribute to degraded water quality in the Project area, and that there are no sustained organic discharges (agricultural runoff, feed lot, and industrial) to the NFFR in the vicinity of the Poe Project.

### E2.5.6 Results of Coliform Bacteria Monitoring

Two measurement methods were used to detect coliform bacteria. Total coliform is a measure of all coliform bacteria regardless of origin. Fecal coliform is measure of coliform bacteria originating from the waste products of warm-blooded animal species. The concentration of coliform bacteria is generally reported as the most probable number per 100 mL (MPN/100 mL). The typical sampling method involves collecting multiple samples over the span of several weeks to establish a statistically accurate estimate of the bacterial population. Routine coliform sampling conducted during this monitoring program consisted of collecting a single sample during each effort. It is assumed that this method gives an acceptable estimate of the concentration of bacteria present at that time.

#### E2.5.6.1 Results from 1999-2000 Monitoring

In 1999, coliform bacteria were measured at the three primary sampling stations in the NFFR. During the 2000 monitoring program, the number of sampling stations was increased to further define the concentration distribution within the bypass reach. Table E2.5-14 summarizes the results of coliform bacteria sampling. Figure E2.5-29 compares total coliform results at all stations for the period June-September 1999 and 2000.

Total coliform was present in the NFFR above Poe Reservoir throughout the program at relatively low concentrations 8 to 50 MPN/100-mL. Total coliform was also present in the NFFR above Poe Powerhouse throughout the program at concentrations similar to the upstream station, except for July 1999 when an elevated concentration of 500 MPN/100-mL was measured. Fecal coliform was present at both of these stations at low concentrations. Concentrations ranged from less than 2 to 8 MPN/100-mL at the upstream station (Poe-1A) and from less than 2 to 13 MPN/100-mL at the downstream station (Poe-3).

To evaluate possible sources of coliform bacteria, samples were collected from additional stations in the bypass reach. These samples were collected on two occasions in 1999 (September and December), in March 2000, and monthly for the period June-September 2000. Results indicated that levels of both species of coliform immediately below Poe Dam (Poe-5) were similar to or slightly higher than those measured at the upstream station (Poe-1A).

## Table E2.5-14

**Results of 1999-2000 Coliform bacteria monitoring in the Poe Project**

| Station | Location | Date | Total (MPN/100mL) | Fecal (MPN/100mL) |
|---|---|---|---|---|
| Poe-1A | NFFR above Poe Reservoir | 03/24/99 | 23 | 8 |
| | | 06/16/99 | lab error [1] | lab error [1] |
| | | 07/15/99 | 23 | <2 |
| | | 08/11/99 | 50 | <2 |
| | | 09/15/99 | 30 | <2 |
| | | 12/16/99 | 8 | 4 |
| | | 03/30/00 | 8 | 8 |
| | | 06/14/00 | 17 | 4 |
| | | 07/12/00 | 50 | 2 |
| | | 08/09/00 | 220 | <2 |
| | | 09/13/00 | 30 | <2 |
| Poe-2A | NFFR at Pulga Bridge (NF-23) | 03/24/99 | NS[2] | NS |
| | | 06/16/99 | NS | NS |
| | | 07/15/99 | NS | NS |
| | | 08/11/99 | NS | NS |
| | | 09/15/99 | 110 | 4 |
| | | 12/16/99 | 17 | 2 |
| | | 03/30/00 | 4 | 2 |
| | | 06/14/00 | 130 | 4 |
| | | 07/12/00 | 50 | 2 |
| | | 08/09/00 | 70 | <2 |
| | | 09/13/00 | 90 | 4 |
| Poe-3 | NFFR above Poe Powerhouse | 03/24/99 | 23 | 4 |
| | | 06/16/99 | lab error* | lab error* |
| | | 07/15/99 | 500 | 13 |
| | | 08/11/99 | 22 | 4 |
| | | 09/15/99 | 30 | 4 |
| | | 12/16/99 | 8 | <2 |
| | | 03/30/00 | 2 | <2 |
| | | 06/14/00 | 70 | <2 |
| | | 07/12/00 | 50 | 4 |
| | | 08/09/00 | 220 | <2 |
| | | 09/13/00 | 170 | <2 |
| Poe-5 | NFFR below Poe Dam | 06/14/00 | NS | NS |
| | | 07/12/00 | 50 | 4 |
| | | 08/09/00 | 130 | 7 |
| | | 09/13/00 | 80 | <2 |
| FVC | Flea Valley Creek | 06/14/00 | 300 | 17 |
| | | 07/12/00 | 130 | 2 |
| | | 08/09/00 | 130 | 4 |
| | | 09/13/00 | 300 | 4 |
| MC | Mill Creek | 06/14/00 | 170 | 4 |
| | | 07/12/00 | 50 | 9 |
| | | 08/09/00 | 90 | <2 |
| | | 09/13/00 | 22 | 2 |

1. Laboratory method error, reported as present without a qualitative density value.

2. NS = Not sampled.

Total coliform levels in Mill Creek were typically similar to or slightly lower than the NFFR during the summer 2000 sampling period, while fecal coliform levels in Mill Creek tended to be slightly higher than the NFFR receiving waters during the same period. Coliform levels in Flea Valley Creek were measured at concentrations that were typically elevated over any of the other monitoring stations. Total coliform was measured at levels 2.5 to 7.5 times the levels measured in the NFFR. Fecal coliform levels were typically less elevated when compared with the NFFR.

The elevated coliform concentrations present in the tributary streams were not always observed in the NFFR downstream of these tributaries. This is attributed to the small flow volume present in both streams during the summer. Coliform concentrations in the NFFR near Pulga (Poe-2A) were typically similar to those measured below Poe Dam (Poe-5).

All detected coliform concentrations were less than the Basin Plan criteria for contact recreation.

### E2.5.6.2 Recreation Impacts on Coliform Density

#### E2.5.6.2.1 Poe Powerhouse Beach

Following discussions with the SWRCB in early 2001, the Licensee conducted a second supplemental investigation of bacteriological density in the lower Project area. This investigation involved the collection of 5 samples within a 30-day period. This sampling was conducted between May 21 and June 15, 2001. Samples were collected prior to and following the 2001 Memorial Day holiday in an attempt to capture a worst-case event. Samples were collected from the lower most location in the Poe Reach (Poe-3). Two different sampling points were selected at this location where the main NFFR bifurcates into two channels. The first sampling point was in the main NFFR channel and corresponded with the location of the routine water quality sampling site (Poe-3A). The second sampling point was in a small side channel off the main NFFR (Poe-3B). Both of these stations sampled water that split off the same main channel upstream. These channels also converged into one channel downstream of the sampling locations. The data from the 30-day sampling is presented in Table E2.5-15. This sampling effort indicated that Poe -3A had a 30-day mean density of 6 MPN/100 mL for fecal coliform. Poe-3B had a 30-day mean density of 5 MPN/100 mL. As indicated by this data, both stations had 30-day mean fecal coliform densities that were well below the 200 MPN/100 mL cited for contact recreation.

## Table E2.5-15

**Summary of 30-day coliform sampling in lower portion of Poe Project.**

| Station[1] | Date | Time | Cumulative Days | Coliform Bacteria Total | Coliform Bacteria Fecal | Units | Remarks |
|---|---|---|---|---|---|---|---|
| Poe-3A | 05/21/01 | 1130 | 0 | 220 | 2 | MPN/100mL | Pre-holiday sampling |
| Poe-3B | 05/21/01 | 1130 | 0 | ---- | ---- | MPN/100mL | |
| Poe-3A | 05/29/01 | 1130 | 8 | 280 | 13 | MPN/100mL | Post-Memorial day |
| Poe-3B | 05/29/01 | 1130 | 8 | 500 | 2 | MPN/100mL | sampling |
| Poe-3A | 06/04/01 | 950 | 14 | 900 | 2 | MPN/100mL | |
| Poe-3B | 06/04/01 | 1000 | 14 | 300 | 4 | MPN/100mL | |
| Poe-3A | 06/11/01 | 840 | 21 | 300 | 4 | MPN/100mL | |
| Poe-3B | 06/11/01 | 850 | 21 | 300 | 13 | MPN/100mL | |
| Poe-3A | 06/15/01 | 835 | 25 | 300 | 7 | MPN/100mL | |
| Poe-3B | 06/15/01 | 845 | 25 | 500 | 2 | MPN/100mL | |
| Poe-3A | | | 30-day average | 346 | 4 | MPN/100mL | |
| Poe-3B | | | 30-day average | 387 | 4 | MPN/100mL | |

1 = Station location:

Poe-3A is in the main channel of the NFFR above Poe Powerhouse.

Poe-3B is in a side channel off the NFFR above Poe Powerhouse.

Both channels received the same source water upstream and converged to one channel downstream of the sampling location

## Table E2.5-15

## (Continued)

| Station[1] | Date | Time | Cumulative Days | Coliform Bacteria Total | Coliform Bacteria Fecal | Units | Remarks |
|---|---|---|---|---|---|---|---|
| Bardees | 06/26/03 | 1130 | 0 | 23 | <2 | MPN/100ml | Pre-holiday sampling<br>Campers on site |
| Bardees | 07/07/03 | 1240 | 11 | 140 | 4 | MPN/100ml | Post-July 4 holiday<br>Heavy use 6/30 to 7/6 |
| Bardees | 07/11/03 | 945 | 15 | 500 | 27 | MPN/100ml | |
| Bardees | 07/25/03 | 900 | 25 | 280 | 8 | MPN/100ml | |
| Bardees | 08/06/03 | 930 | 41 | 900 | 4 | MPN/100ml | Replacement sampling |
| Bardees | Geometric | 30-day average | | 210 | 5 | MPN/100ml | |

#### E2.5.6.2.2 Bardees Bar Beach

In early 2003, the SWRCB requested that the Licensee conducted a third supplemental investigation of bacteriological density in the lower Project area. This investigation involved the collection of 5 samples within a 30-day period at the Bardees Bar area. This area is undeveloped (no installed facilities) but does receive relatively high recreational use. The sampling was conducted between June 26 and August 6, 2003. Samples were collected prior to and following the 2003 July Fourth holiday in an attempt to capture a worst-case event. Samples were collected from the largest pool downstream of the informal camping areas. The data from the 30-day sampling is presented in Table E2.5-15. This sampling effort indicated that the Bardees Bar area had a 30-day mean density of 10 MPN/100 ml for fecal coliform. As indicated by this data, both stations had 30-day mean fecal coliform densities that were well below the 200 MPN/100 ml cited for contact recreation.

### E2.5.7 Results of Suspended Sediment Monitoring

Two methods of measuring suspended sediment concentrations were used during the monitoring program. Turbidity is a measure of suspended material using optical methods; this method is best at measuring particle sizes ranging from clay to silt. The total suspended solids (TSS) method measures all (mineral and organic) material suspended in the water column.

### E2.5.7.1 Results from 1999-2000 Monitoring

Table E2.5-16 summarizes the results of suspended sediment sampling. Figure E2.5-30 compares the results of turbidity at all NFFR stations for the period June-September 1999 and 2000.

Turbidity levels at the upstream stations tended to be higher, reflecting higher velocities, than at stations in the bypass section. Turbidity levels at stations upstream of Poe Dam ranged from 0.8 to 12.6 NTU. Levels in the bypass reach ranged from 0.6 to 6.7 NTU. Turbidity in the tributaries was low, ranging from 0.2 to 0.9 NTU. For each station, the highest turbidities were measured during the March sampling effort. These levels coincided with the periods of high runoff.

TSS levels were measured at the three primary NFFR stations during the period March 1999 through March 2000. The pattern of TSS concentration tended to be similar to turbidity with higher concentrations present at stations upstream of Poe Dam, and decreasing concentrations from upstream to downstream in the bypass reach. TSS levels at all stations were low, ranging from less than 1.0 to 7.0 mg/L.

## Table E2.5-16

**Results of 1999, 2000, and 2003 suspended sediment monitoring in the Poe Project area**

| Station | Location | Date | Time | Turbidity. (NTU) | TSS (mg/L) |
|---|---|---|---|---|---|
| Poe-1A | NFFR above Poe Reservoir | 03/24/99 | 1100 | 7.0 | 5.0 |
| | | 06/16/99 | 1245 | 2.3 | < 1.0 |
| | | 07/15/99 | 1715 | 2.6 | < 1.0 |
| | | 08/11/99 | 908 | 1.8 | 1.7 |
| | | 09/15/99 | 1020 | 5.6 | 2.6 |
| | | 12/16/99 | 1015 | 1.5 | < 1.0 |
| | | 03/30/00 | 940 | 7.2 | 5.9 |
| | | 06/14/00 | 955 | 2.6 | ---- |
| | | 07/12/00 | 915 | 3.5 | ---- |
| | | 08/09/00 | 937 | 3.0 | ---- |
| | | 09/13/00 | 1013 | 2.3 | ---- |
| | | 03/27/03 | 1413 | 5.0 | 4.2 |
| | | 05/13/03 | 800 | 1.7 | 1.9 |
| | | 08/13/03 | 805 | <2.0 | 2.2 |
| | | 10/15/03 | 830 | 1.1 | 1.4 |
| Poe-1B | Cresta Powerhouse Tailrace | 06/16/99 | 1215 | 2.6 | ---- |
| | | 07/15/99 | 1215 | 2.6 | ---- |
| | | 08/11/99 | 915 | 2.4 | ---- |
| | | 09/15/99 | 907 | 7.5 | ---- |
| | | 06/14/00 | 1030 | 2.5 | ---- |
| | | 07/12/00 | 846 | 2.9 | ---- |
| | | 08/09/00 | 900 | 2.4 | ---- |
| | | 09/13/00 | 933 | 2.3 | ---- |
| | | 03/27/03 | 1448 | 4.6 | ---- |
| | | 05/13/03 | 1400 | 1.2 | ---- |
| | | 08/13/03 | 1500 | <2.0 | ---- |
| | | 10/15/03 | NS | NS | ---- |
| Poe-1C | NFFR above Cresta Powerhouse | 06/16/99 | 1200 | 0.5 | ---- |
| | | 07/15/99 | --- | --- | ---- |
| | | 08/13/99 | --- | --- | ---- |
| | | 09/15/99 | 945 | 4.0 | ---- |
| | | 06/14/00 | 1100 | 2.5 | ---- |
| | | 07/12/00 | 940 | 1.0 | ---- |
| | | 08/10/00 | 1015 | 2.1 | ---- |
| | | 09/14/00 | 1010 | 0.8 | ---- |
| | | 03/27/03 | 1508 | 3.8 | ---- |
| | | 05/13/03 | 1430 | 1.2 | ---- |
| | | 08/13/03 | 1510 | <2.0 | ---- |
| | | 10/15/03 | NS | NS | ---- |

**Table E2.5-16 (continued)**

| Station | Location | Date | Time | Turbidity. (NTU) | TSS (mg/L) |
|---|---|---|---|---|---|
| Poe-7 | NFFR at Big Bend Dam | 03/27/03 | 1030 | 3.6 | 12.3[1] |
| | | 05/13/03 | 1130 | 1.8 | <1.0 |
| | | 08/13/03 | 1145 | <2.0 | 1.3 |
| | | 10/15/03 | 1230 | 2.1 | 1.1 |

1. Value is suspected as non-representative of river condition due to localized disturbance that occurred during sampling.

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### E2.5.7.2 Results from 2003 Monitoring

Turbidity levels at the upstream stations tended to be higher, reflecting higher velocities, than at stations in the bypass section. Turbidity levels at stations upstream of Poe Dam ranged from 0.5 to 5.0 NTU. Levels in the bypass reach ranged from 0.8 to 2.7 NTU (Table E2.5-16). For each of the river stations, the highest turbidities were measured during the March sampling effort. These levels coincided with the periods of high runoff. Turbidity in the tributaries was low, ranging from less than 0.5 to 1.6 NTU.

TSS levels were measured at the seven WQ stations during the period March through October 2003 monitoring efforts. The pattern of TSS concentration tended to be similar to turbidity with higher concentrations present at stations upstream of Poe Dam, and decreasing concentrations from upstream to downstream in the bypass reach. TSS levels at stations upstream of Poe Dam ranged from less than 1.0 to 4.2 mg/L. Turbidity levels in the bypass reach ranged from less than 1.0 to 2.0 NTU (Table E2.5-16). For of the river stations, the highest turbidities were measured during the March sampling effort. These levels coincided with the periods of high runoff. TSS in the tributaries was low, with Mill Creek levels always below the 1.0 mg/L detection limit. Turbidity levels in Flea Valley Creek ranged from less than 1.0 to 3.1 NTU.

### E2.5.7.3 Sediment Incipient Motion Study

The incipient motion analysis determines the flow threshold of sediment motion, which is the minimum flow needed to mobilize a specific size of sediment. The predominant factors in the calculation of sediment incipient motion are: channel velocity, energy slope at the cross section, and characteristic roughness height of the bed. The median ($D_{50}$) size of the bed material is typically used to evaluate incipient motion conditions because, in cobble and gravel bed streams, the full range of particle sizes in the bed are mobilized over a very narrow range of shear stresses. At discharges less than the critical discharge for the median size, the bed is essentially immobile. At higher discharges, virtually the entire bed material matrix is in motion.

Analysis of the variation in dimensionless grain shear stress ($\tau^*$) with discharge at key locations provides a good representation of the dynamics of the study reach. Five grain sizes, ranging from very fine to very coarse gravels, were included for incipient motion analysis. At each transect and a given sediment size, a shear stress and flow relationship was developed. The threshold flow at which the sediment incipient motion is expected for the given size is determined. Five threshold flows were used to construct the curve showing required minimum flow to mobilize the given sediment size. Each river section typically contained five to six riverine categories, varying from low gradient riffles to runs. No pools were included in the analysis. These threshold flows versus grain-size curves are then plotted together to determine an optimal range of discharges to mobilize various gravel sizes for each specific river section. The three sections of the Poe Reach, therefore, yielded three "optimal discharge versus grain-size" relationships (see Figure E2.5-31). From these three relationships, a composite, best-fit relationship is then inferred to typify the entire Poe Reach. Based on the composite curve for the Poe Reach, the current instream flow release of 100 cfs at Poe Dam will mobilize sediments less than 6 mm (fine gravel) in size.

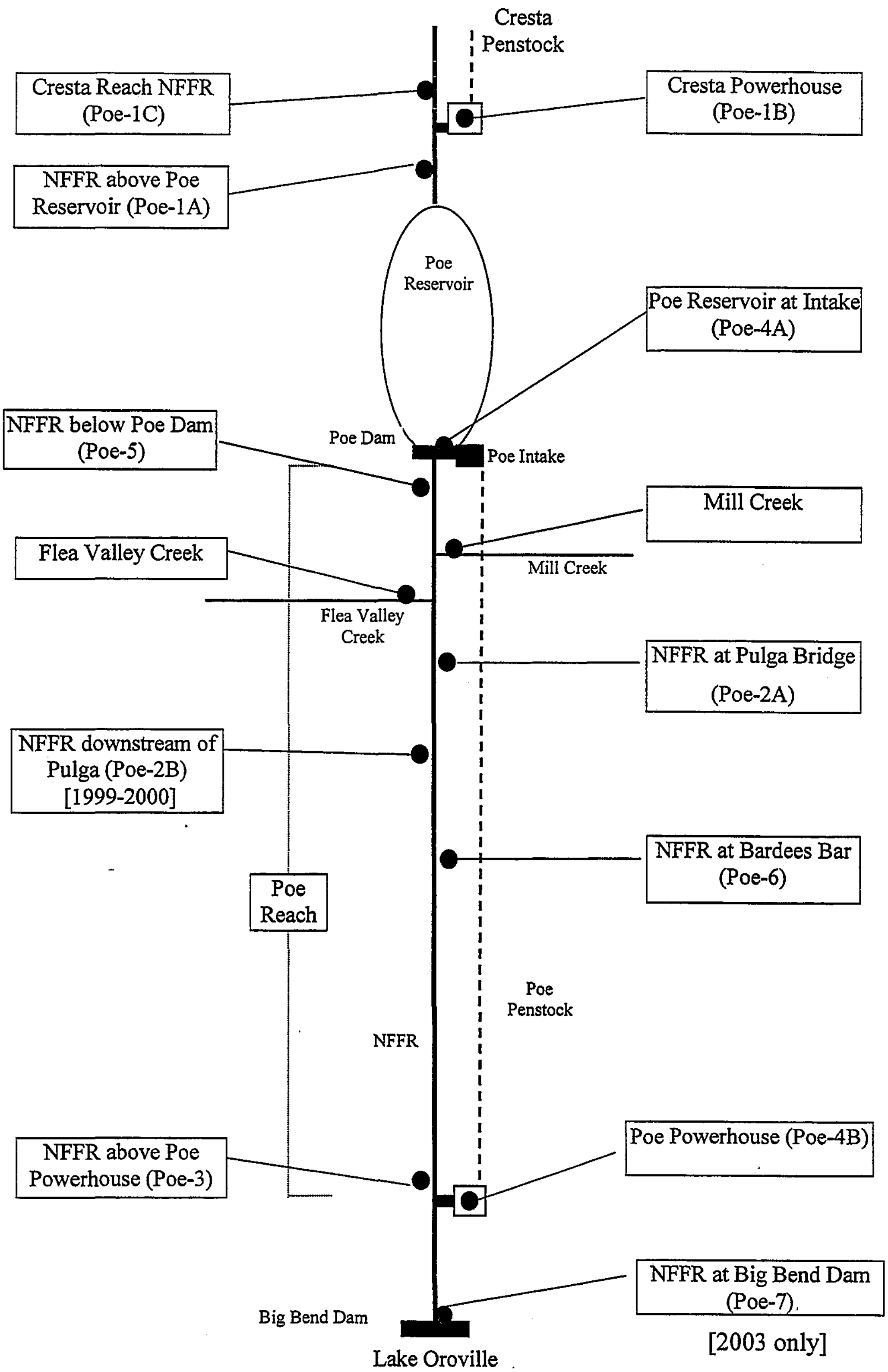



Figure E2.5-1 Schematic diagram of the Poe Project water quality monitoring stations.

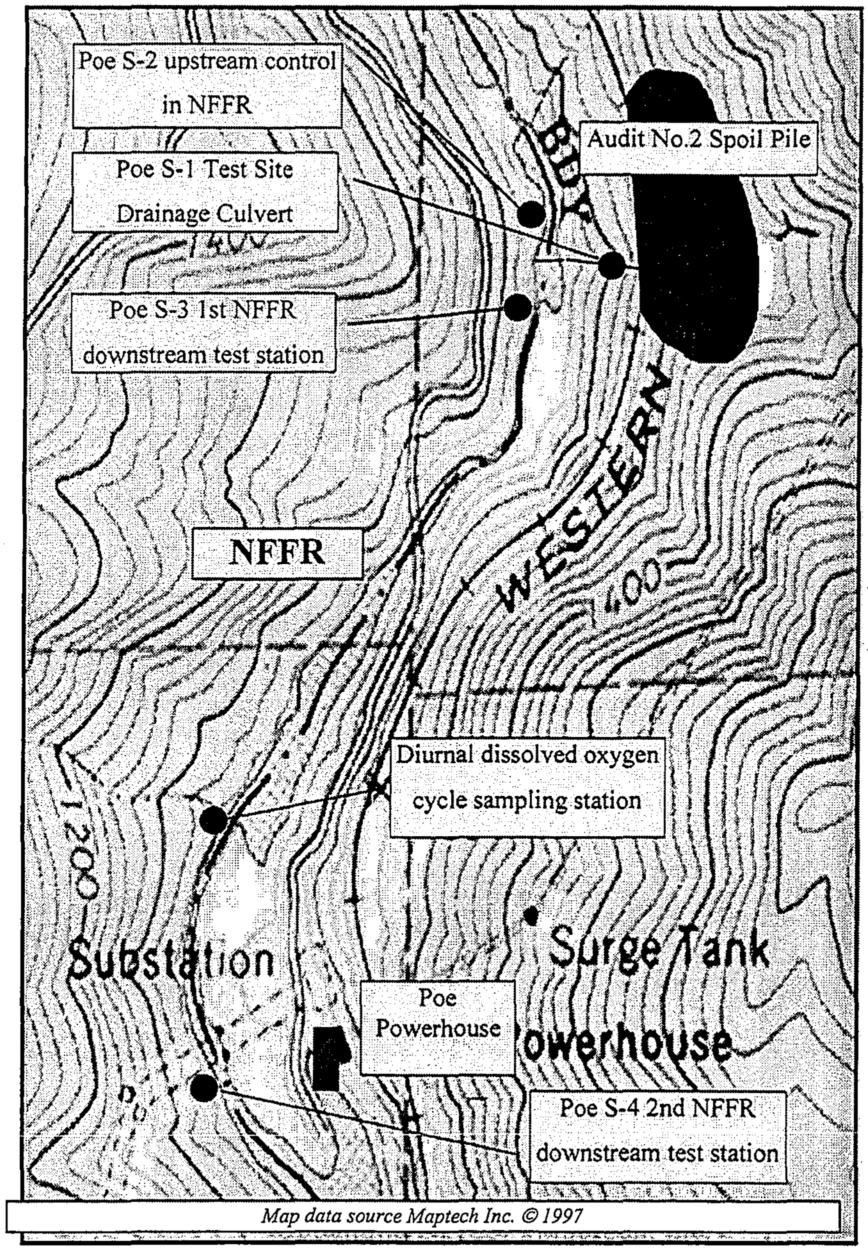
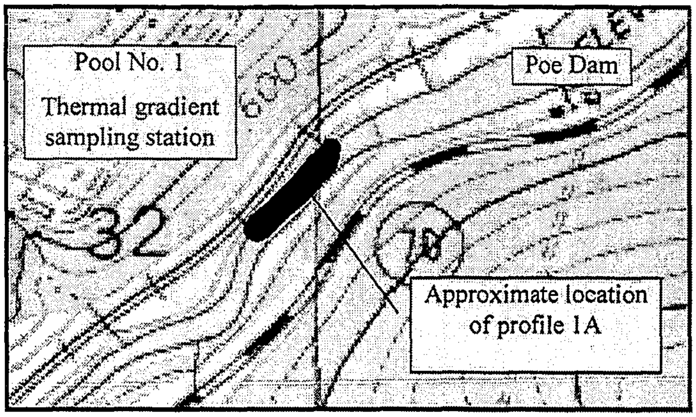
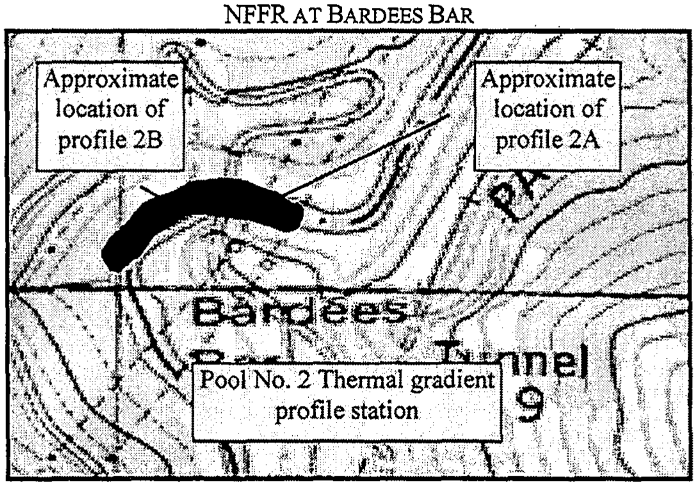



Figure E2.5-2 Location of DO cycle and spoil pile stations used during special investigations

NFFR DOWNSTREAM OF POE DAM




NFFR AT BARDEES BAR




NFFR UPSTREAM OF POE POWERHOUSE

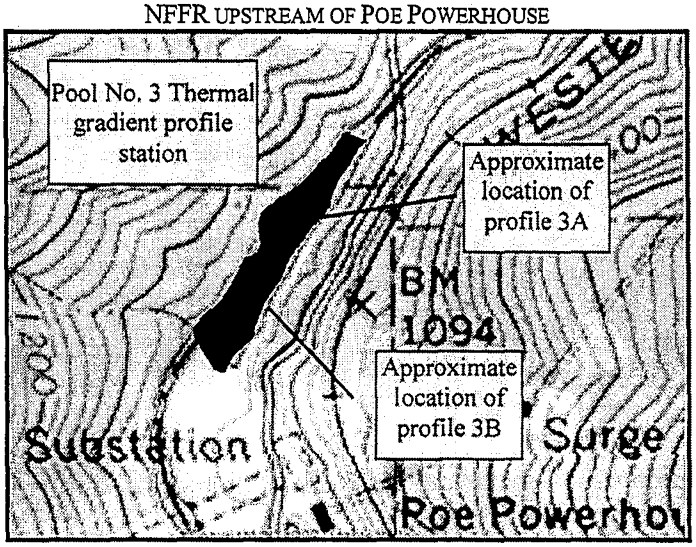



Figure E2.5-3 Location of pools used during thermal gradient investigation.

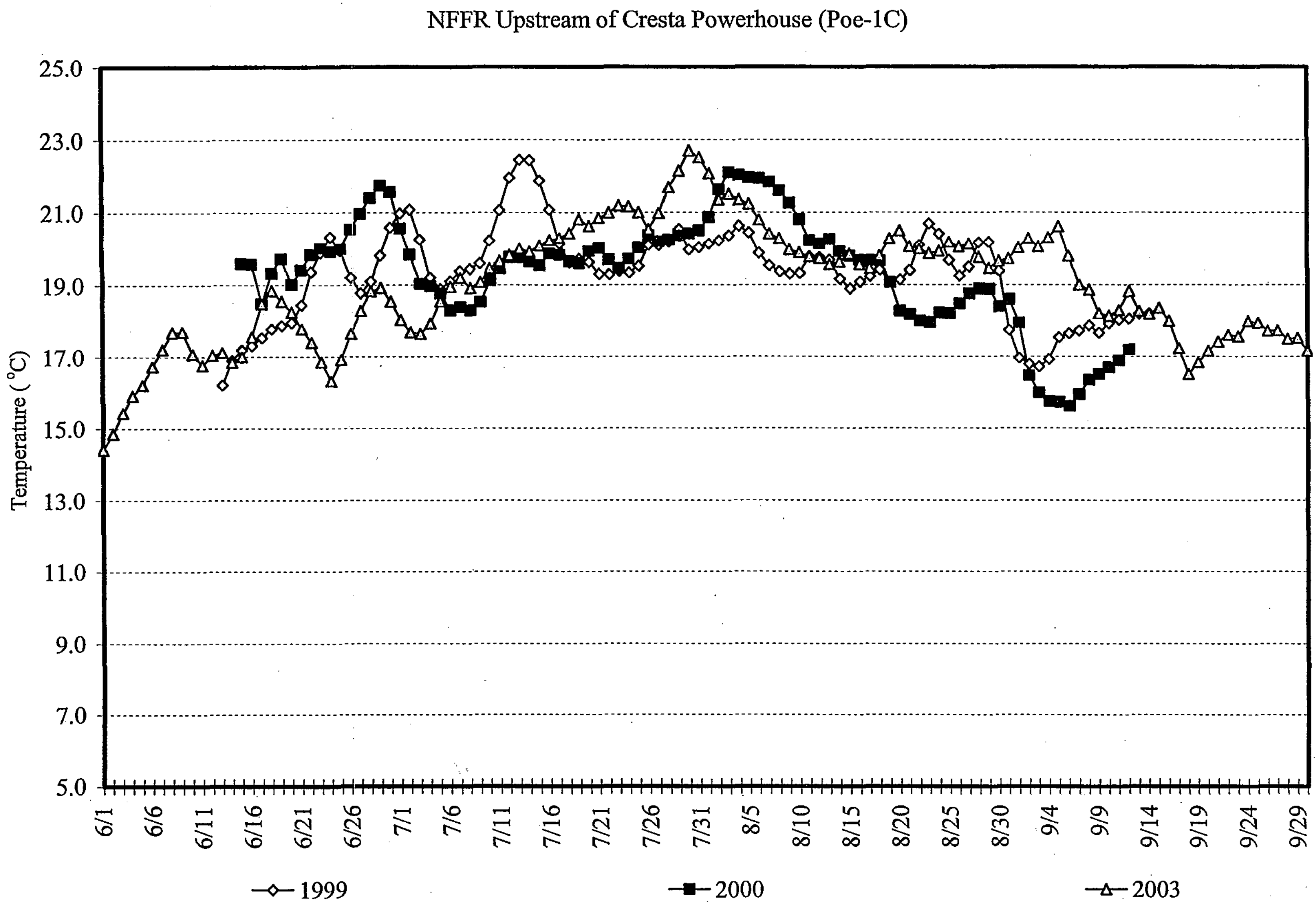



Figure E2.5-4 Comparison of 1999, 2000, and 2003 daily average water temperature in the NFFR upstream of Cresta Powerhouse.

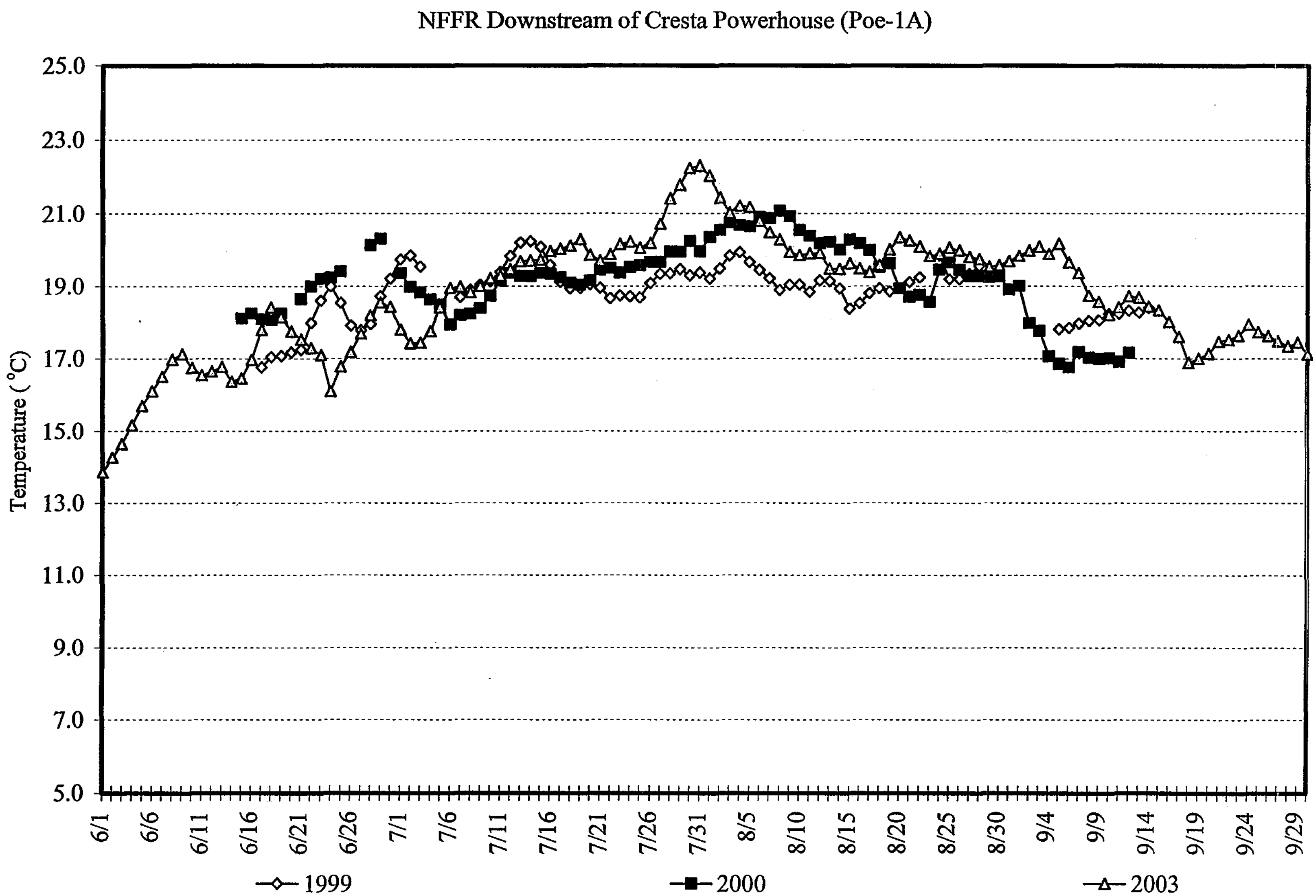



Figure E2.5-5 Comparison of 1999, 2000, and 2003 daily average water temperature in the NFFR downstream of Cresta Powerhouse.

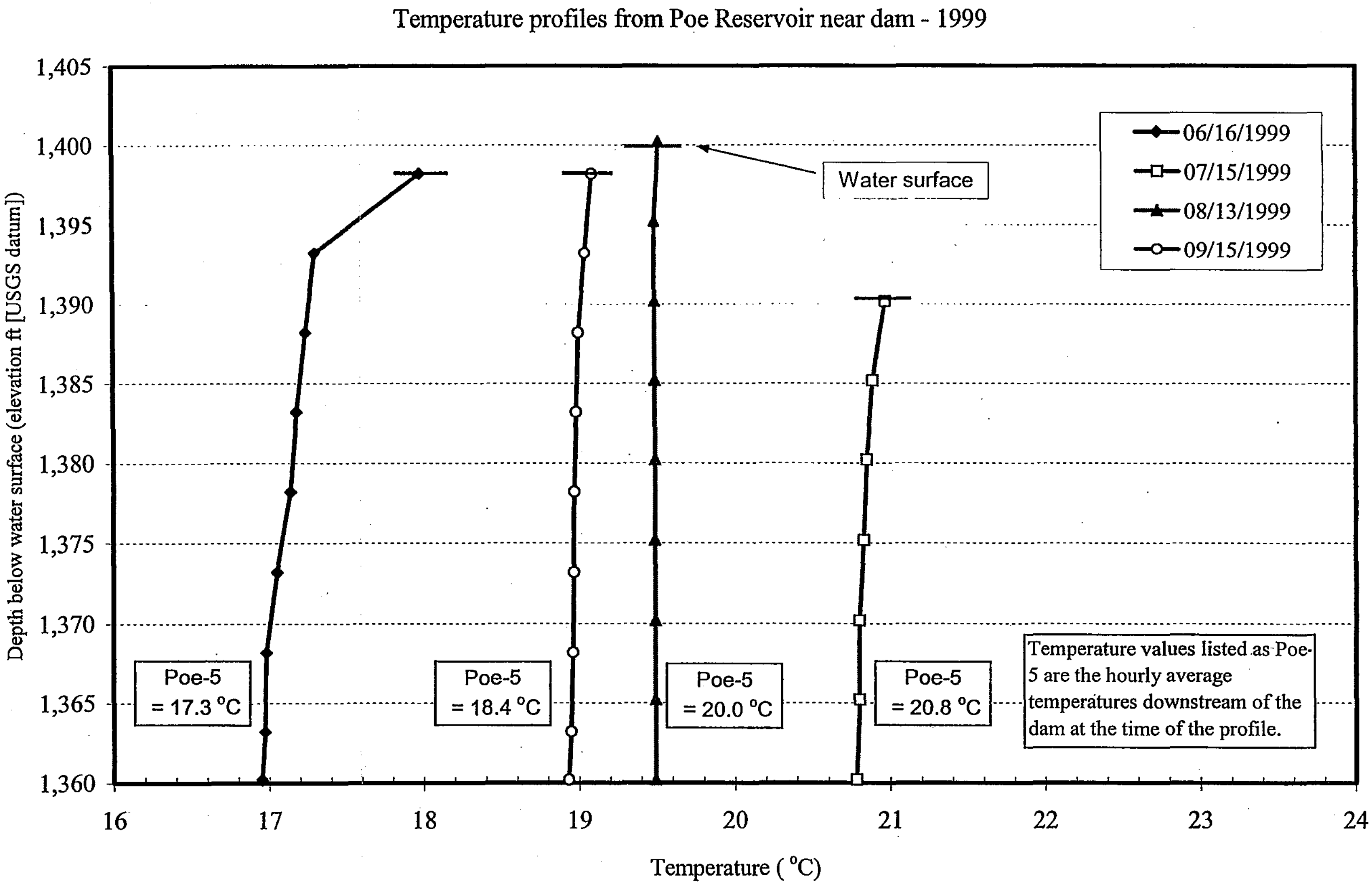



Figure E2.5-6 Water temperature profiles in Poe Reservoir near Poe Dam in 1999.

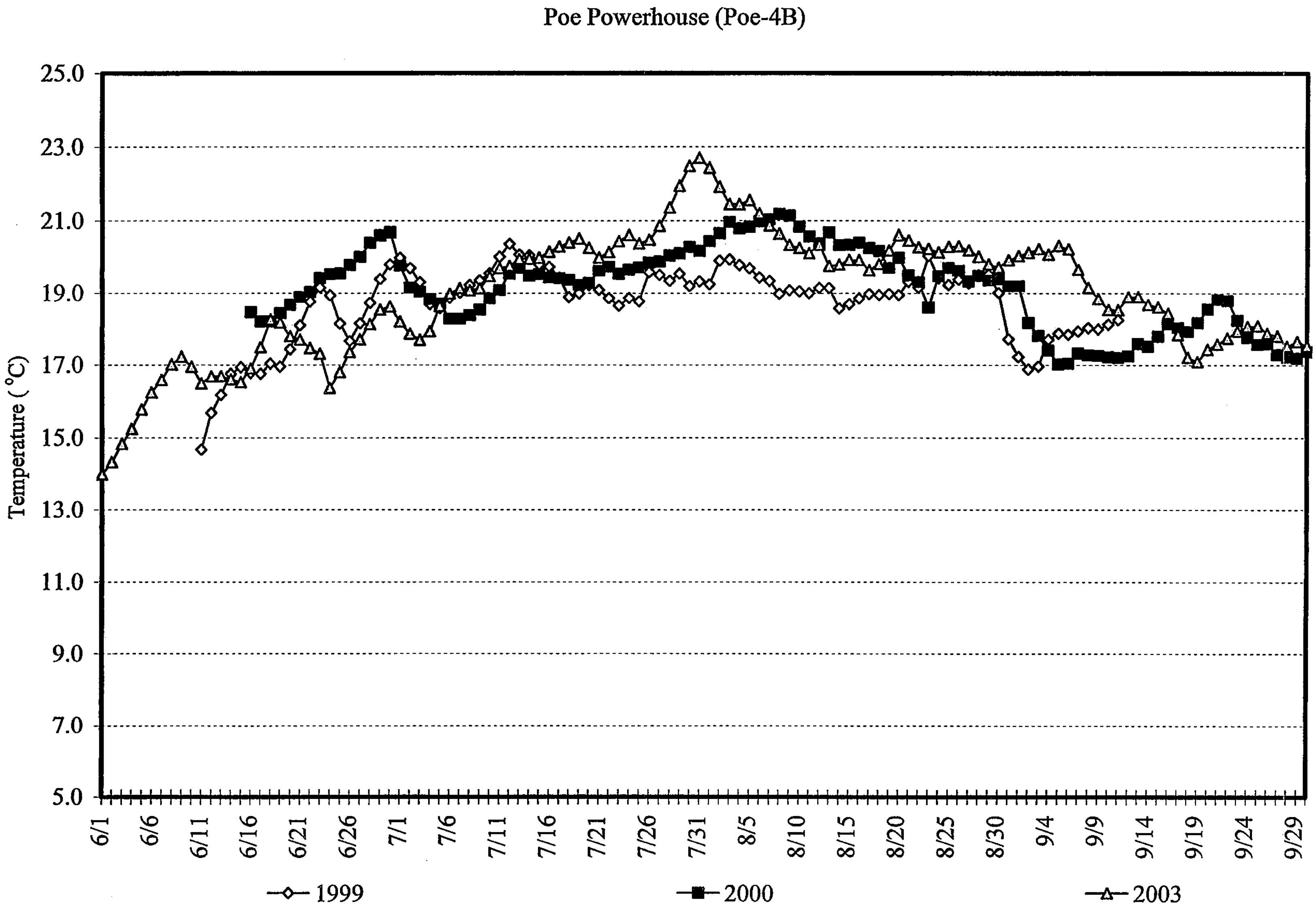



Figure E2.5-7 Comparison of 1999, 2000, and 2003 daily average water temperature in the Poe Powerhouse Tailrace.

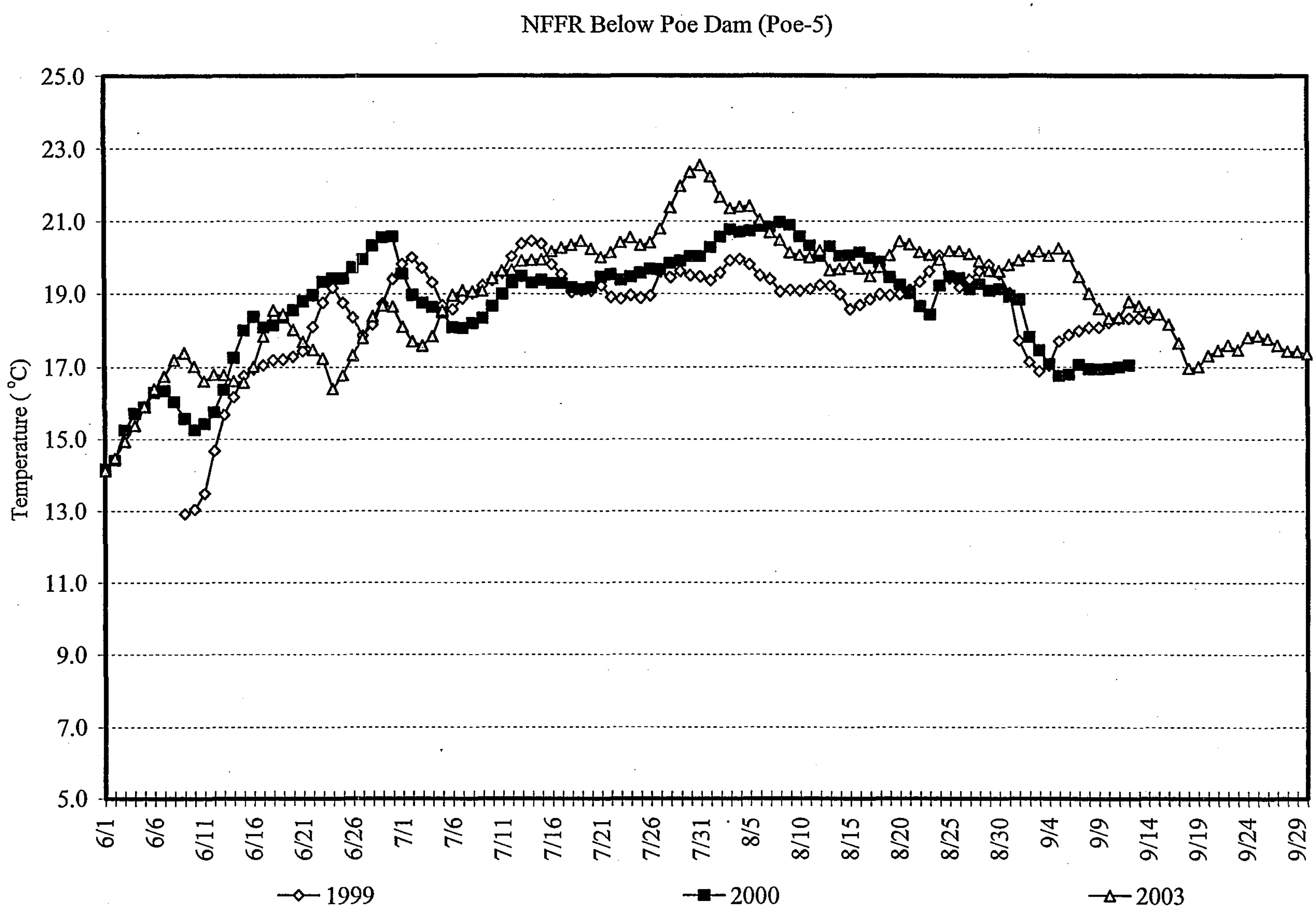



Figure E2.5-8 Comparison of 1999, 2000, and 2003 daily average water temperature in the NFFR downstream of Poe Dam.

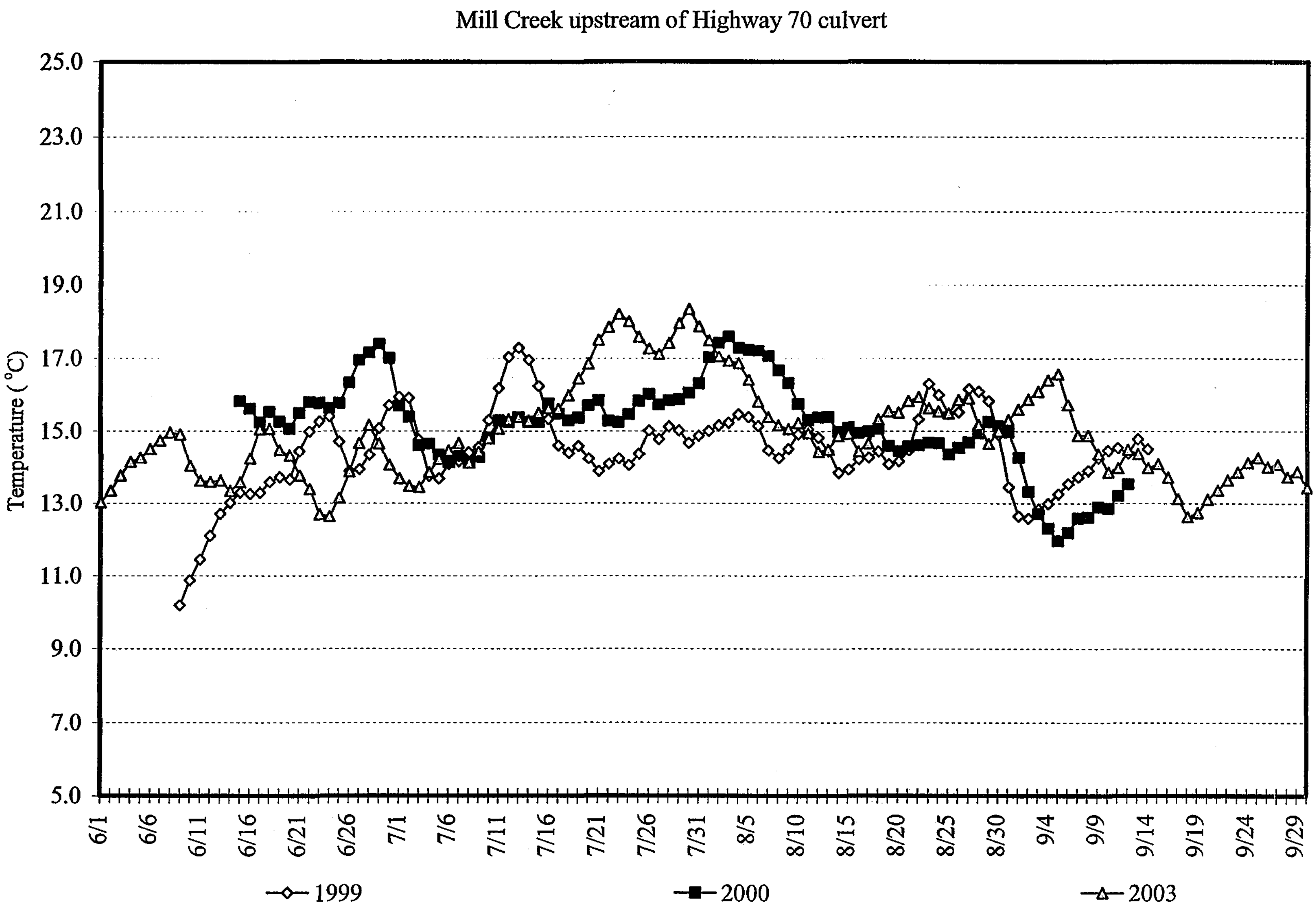



Figure E2.5-9 Comparison of 1999, 2000, and 2003 daily average water temperature in Mill Creek.

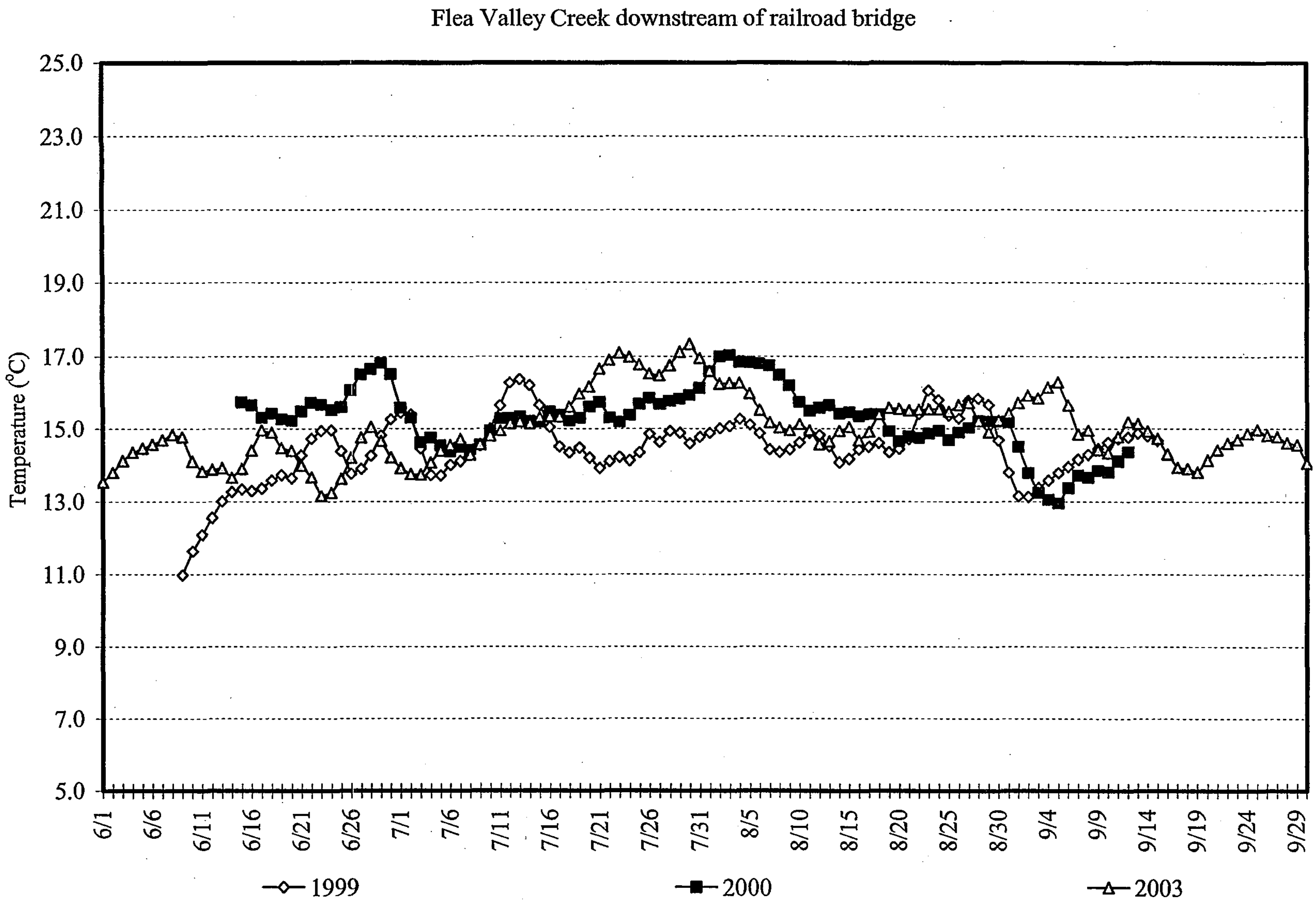



Figure E2.5-10 Comparison of 1999, 2000, and 2003 daily average water temperature in Flea Valley Creek.

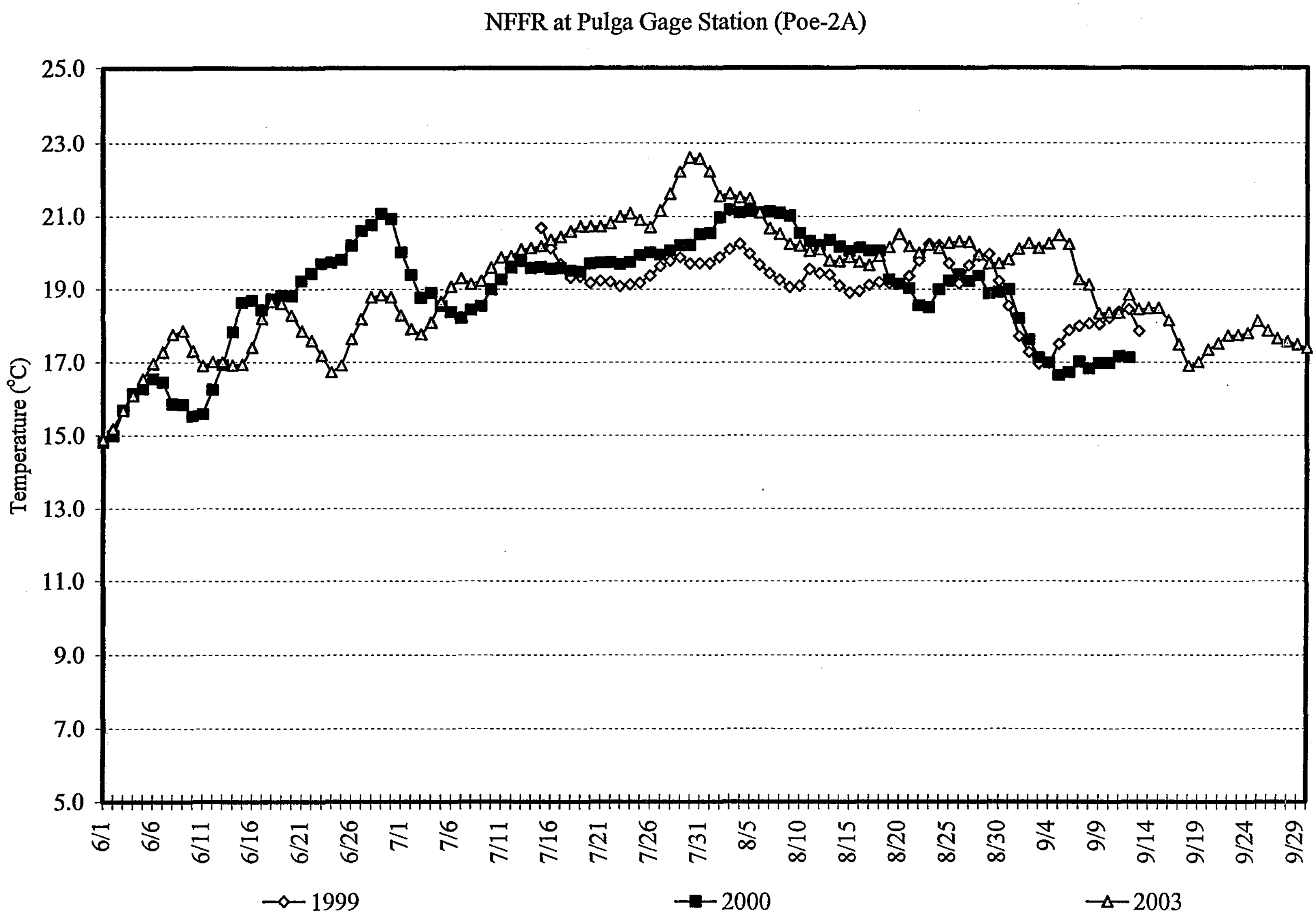



Figure E2.5-11 Comparison of 1999, 2000, and 2003 daily average water temperature in the NFFR at Pulga gaging station.

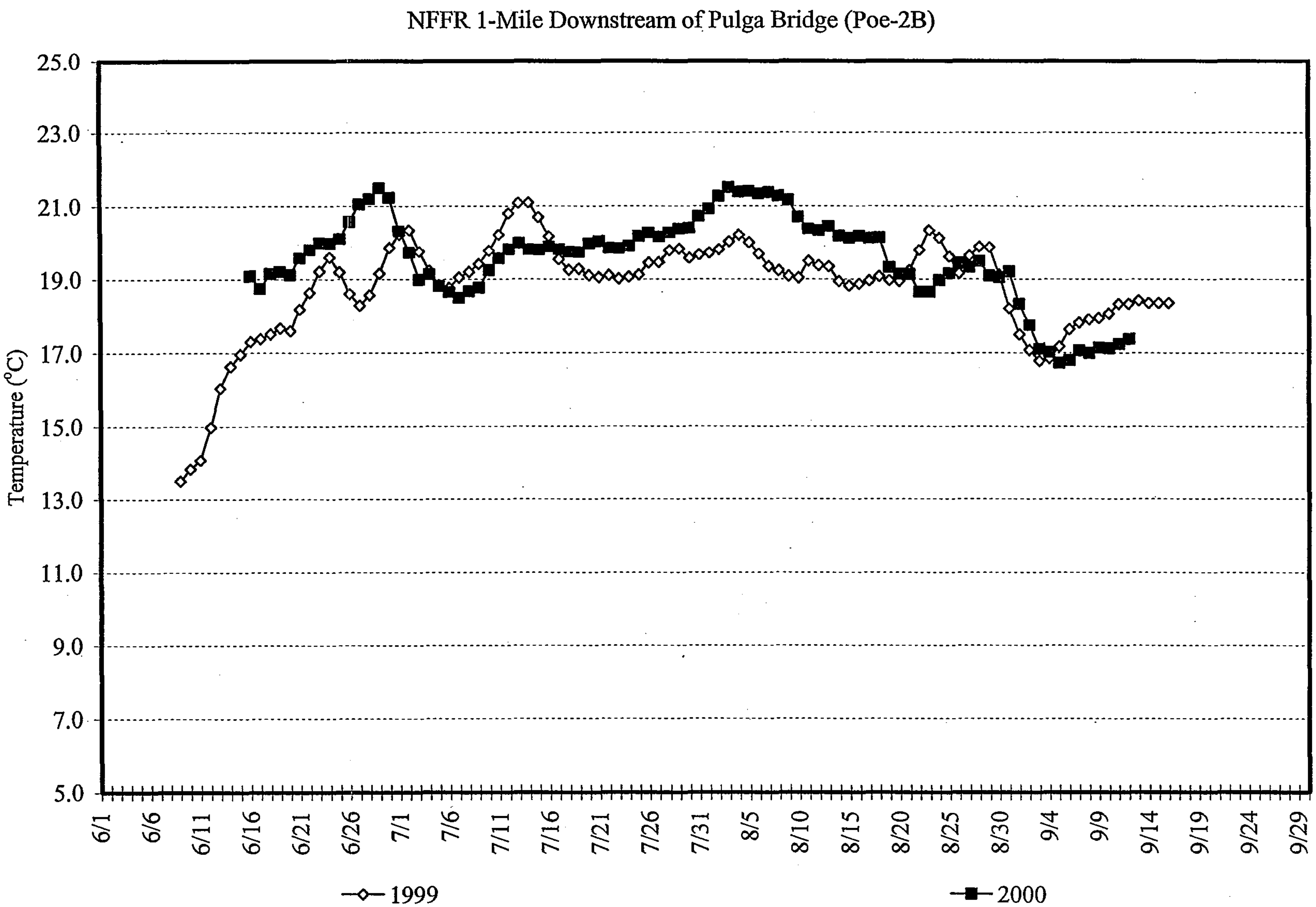



Figure E2.5-12 Comparison of 1999 and 2000 daily average water temperature in the NFFR 1-mile downstream of Pulga Bridge.

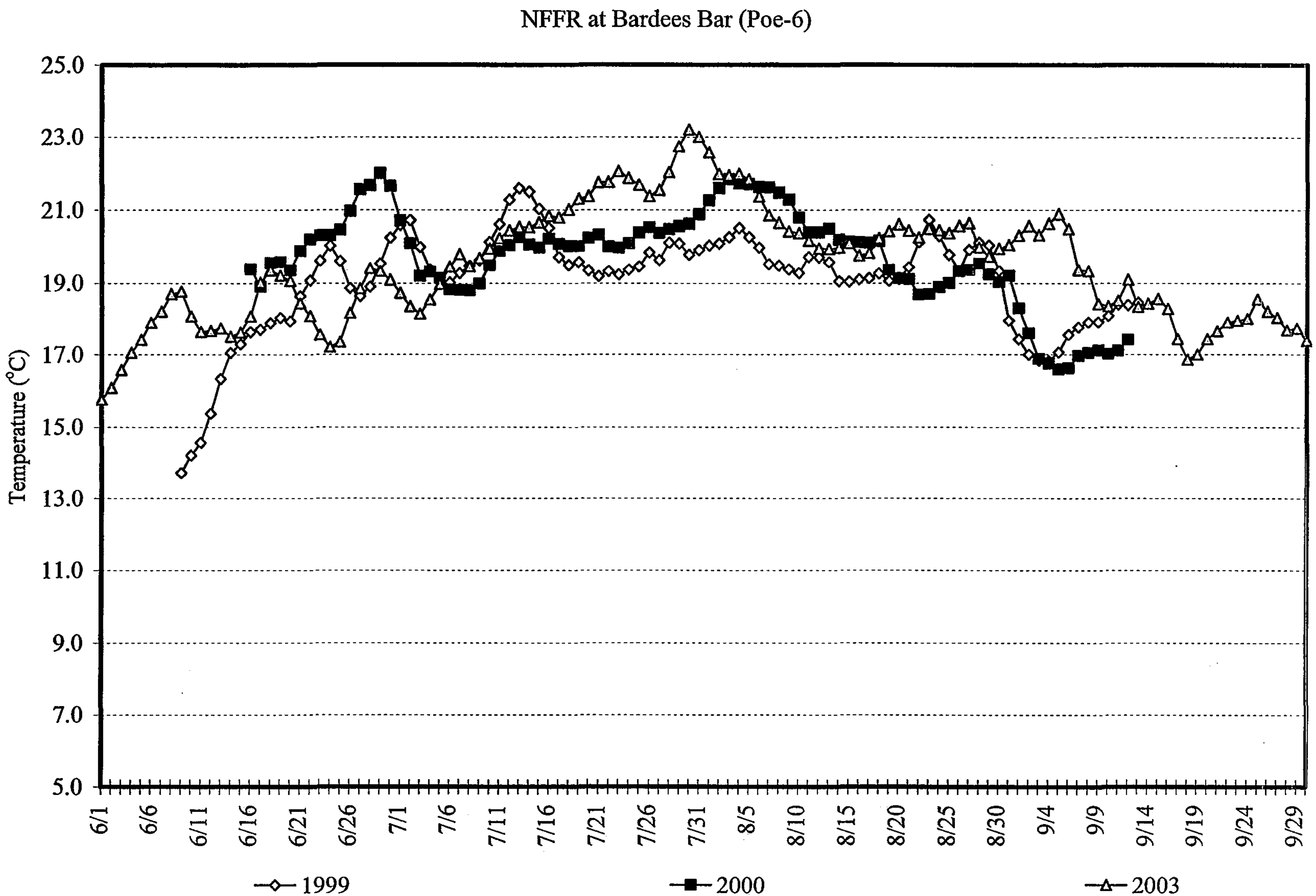



Figure E2.5-13 Comparison of 1999, 2000, and 2003 daily average water temperature in the NFFR at Bardees Bar.

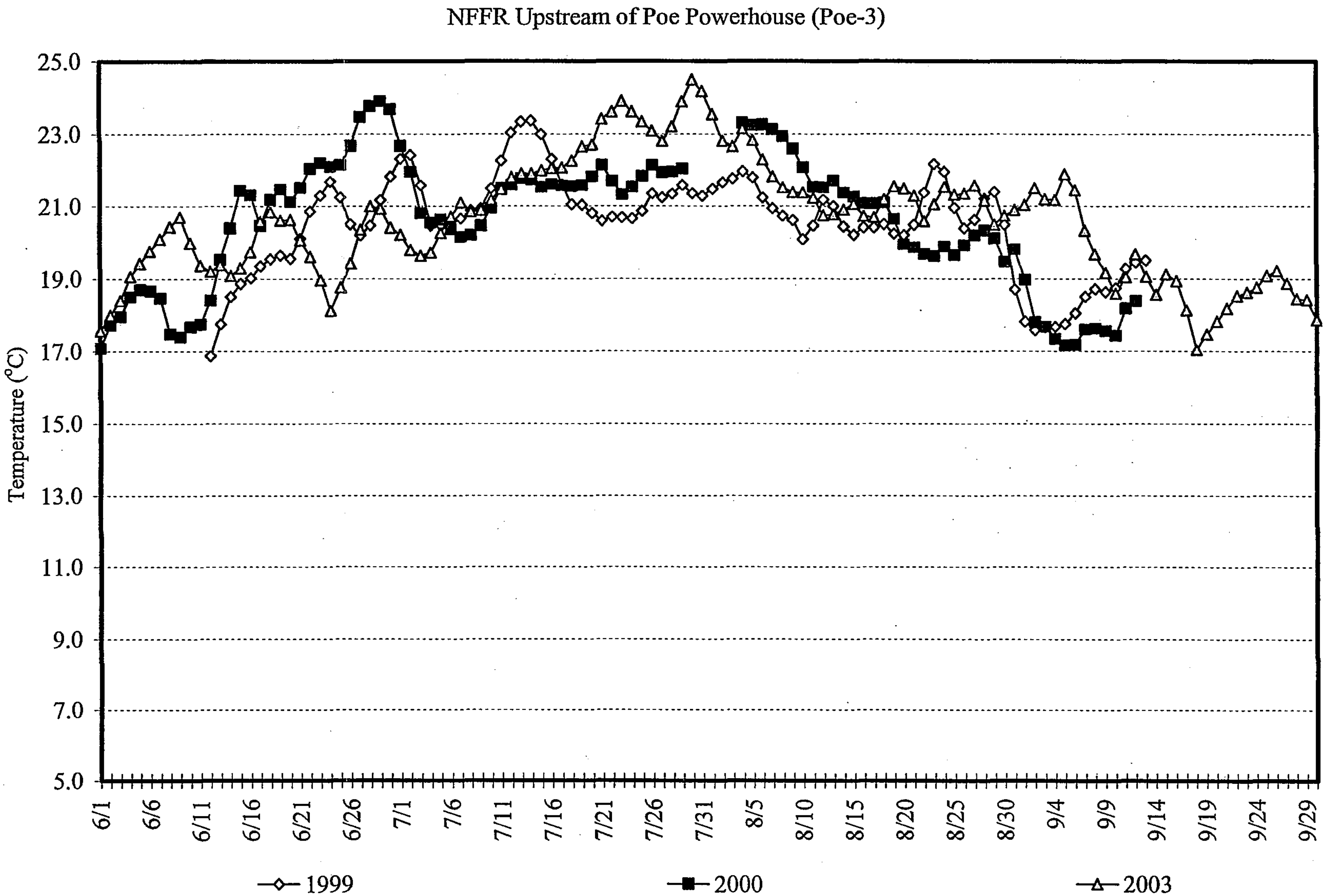



Figure E2.5-14 Comparison of 1999, 2000, and 2003 daily average water temperature in the NFFR upstream of Poe Powerhouse.

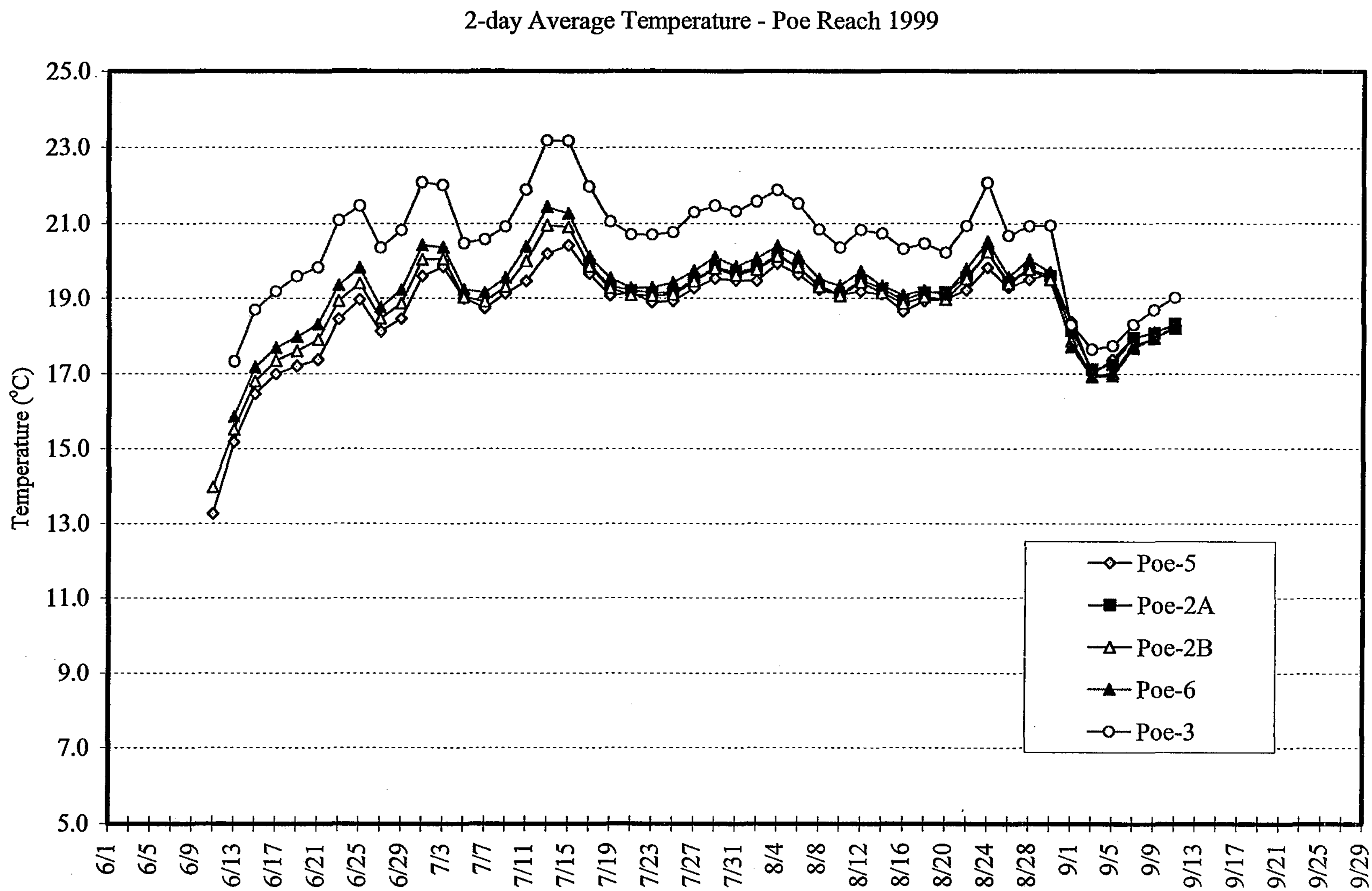



Figure E2.5-15 Comparison of 2-day average water temperature in Poe Reach of the NFFR in 1999.

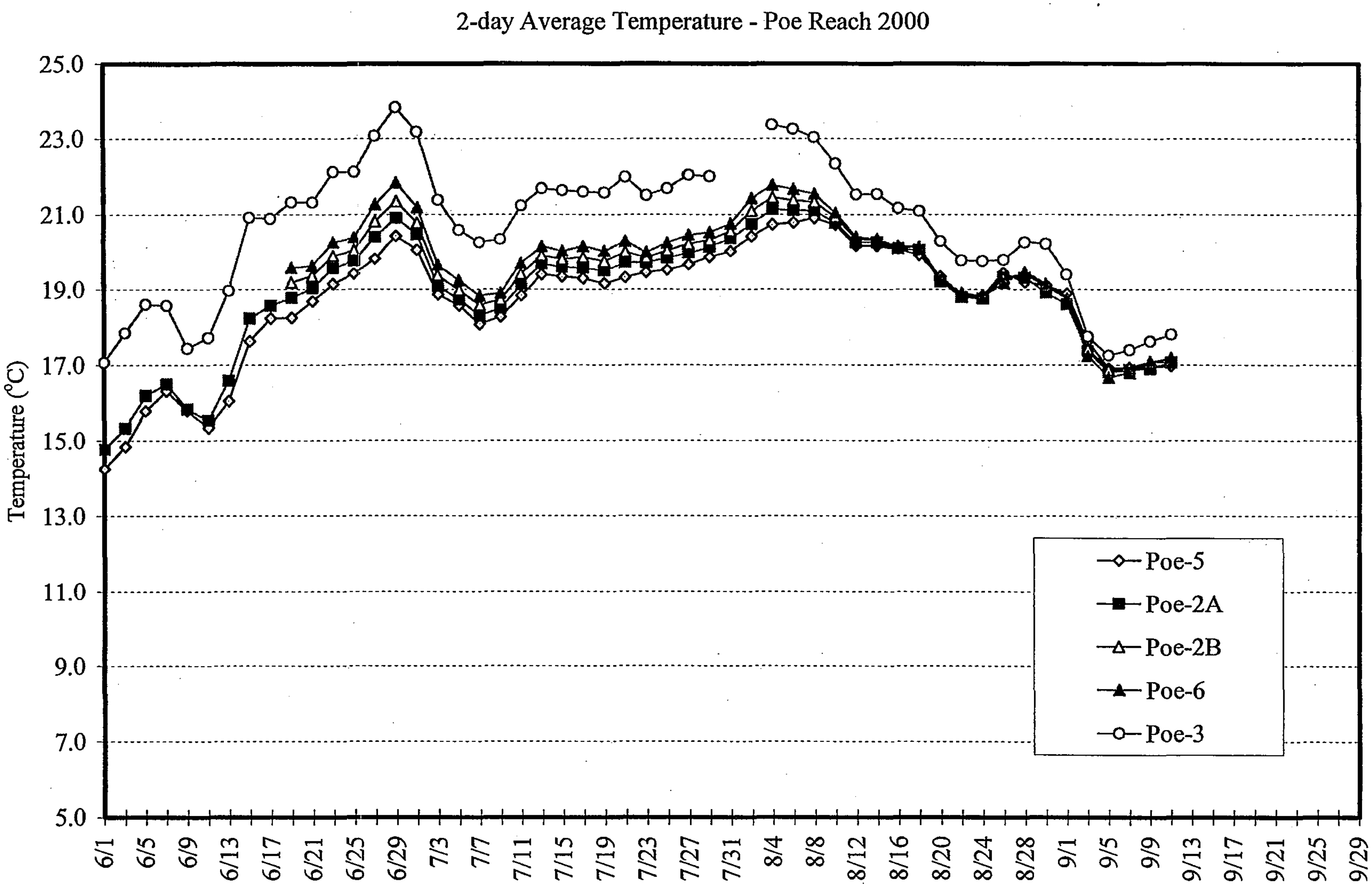



Figure E2.5-16 Comparison of 2-day average water temperature in Poe Reach of the NFFR in 2000.

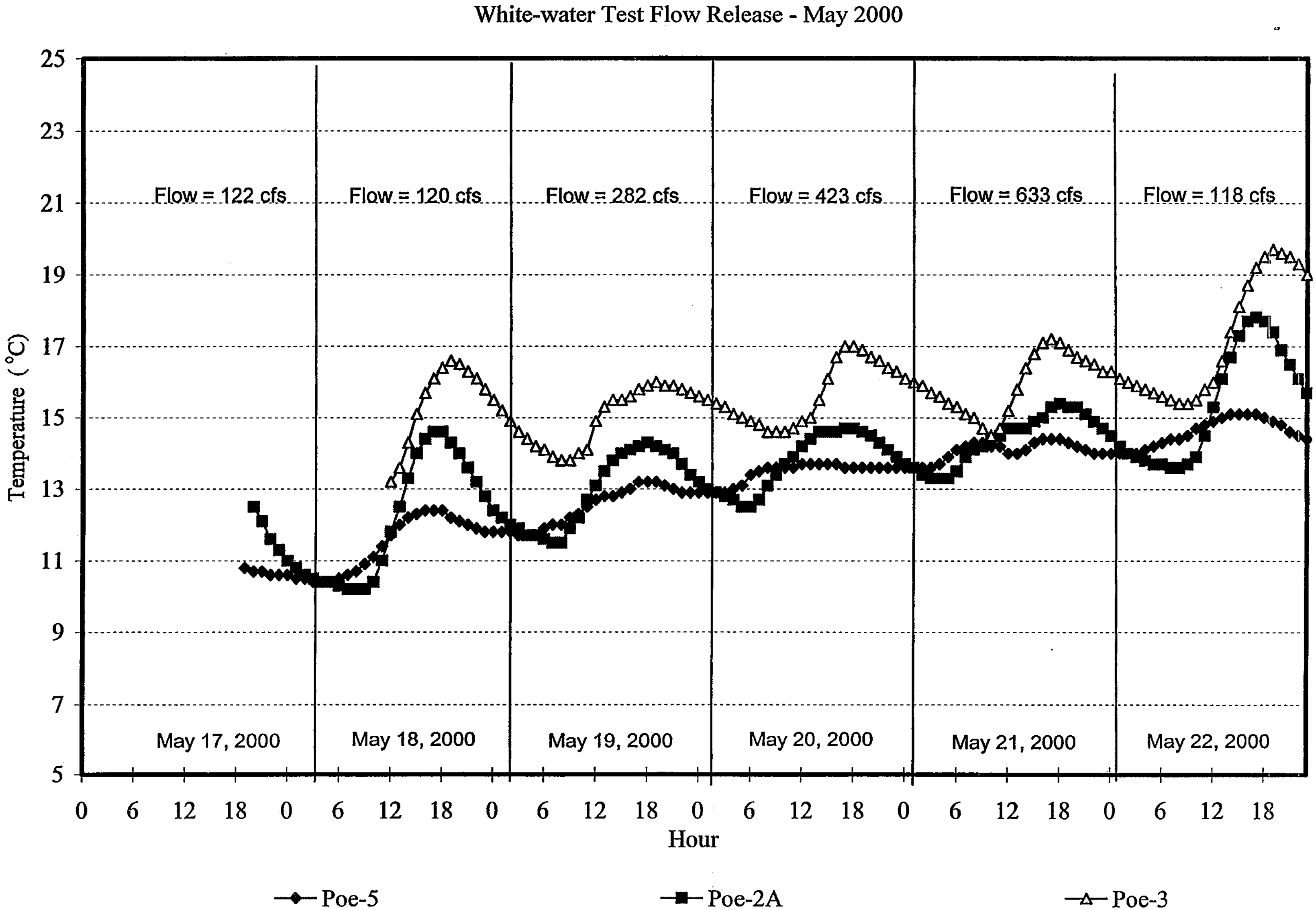



Figure E2.5-17 Comparison of diel temperature cycle at three stations in the Poe Reach during May 2000 test flow releases.

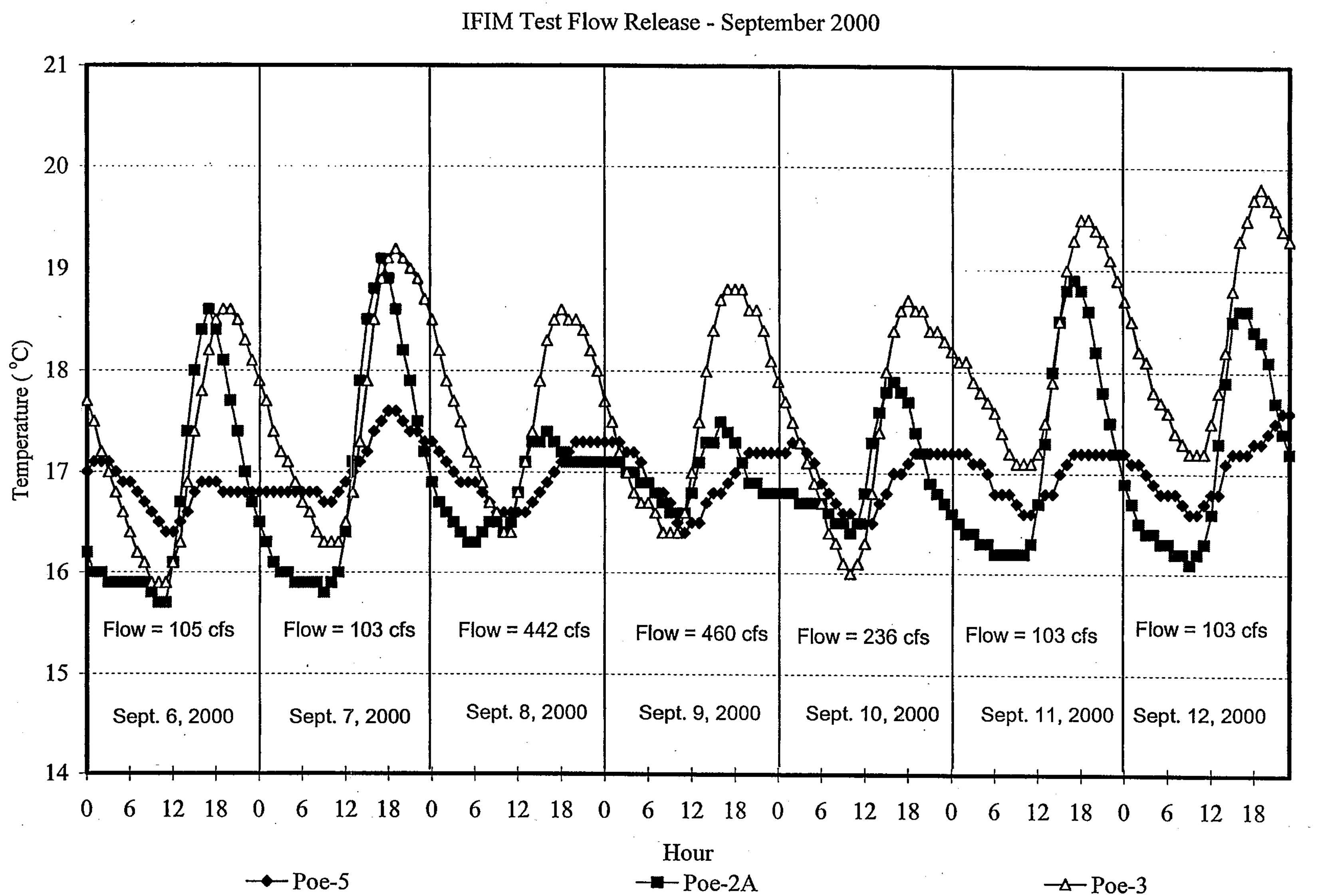



Figure E2.5-18 Comparison of diel temperature cycle at three stations in the Poe Reach during September 2000 test flow releases.

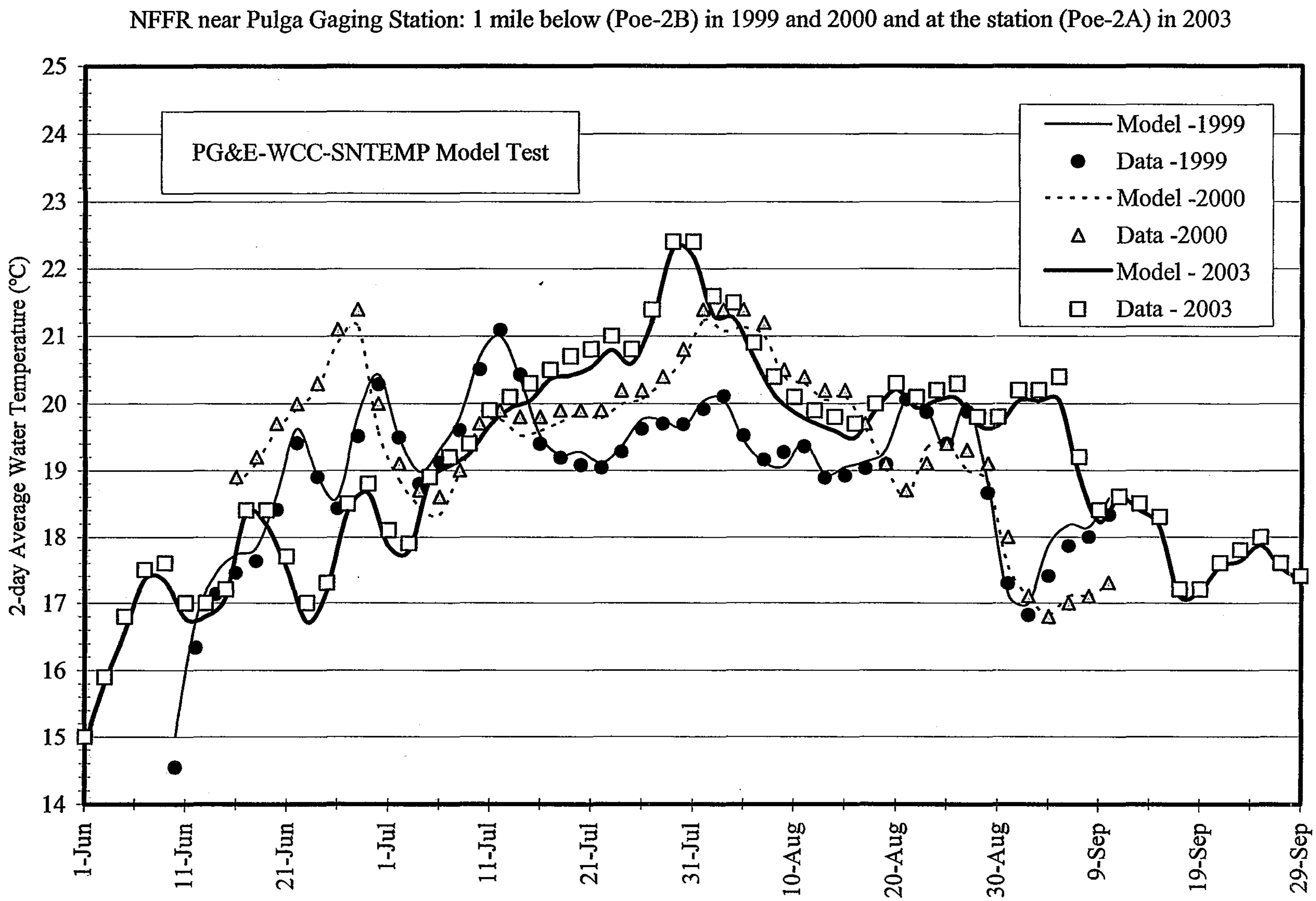



Figure E2.5-19 Predicted and observed water temperature in the NFFR 1-mile downstream of Pulga Gaging Station (Poe-2B).

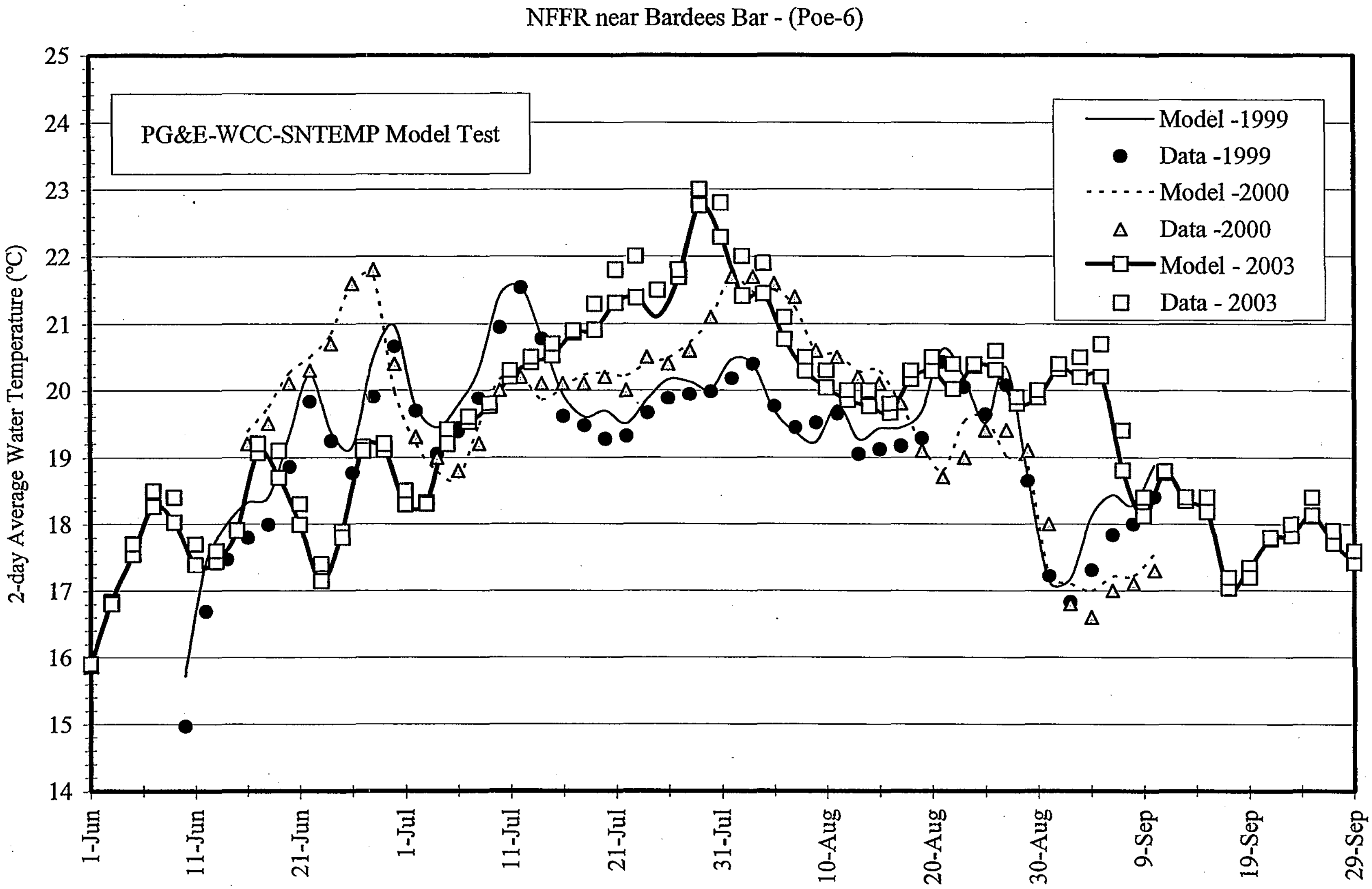



Figure E2.5-20 Predicted and observed water temperature in the NFFR at Bardees Bar (Poe-6).

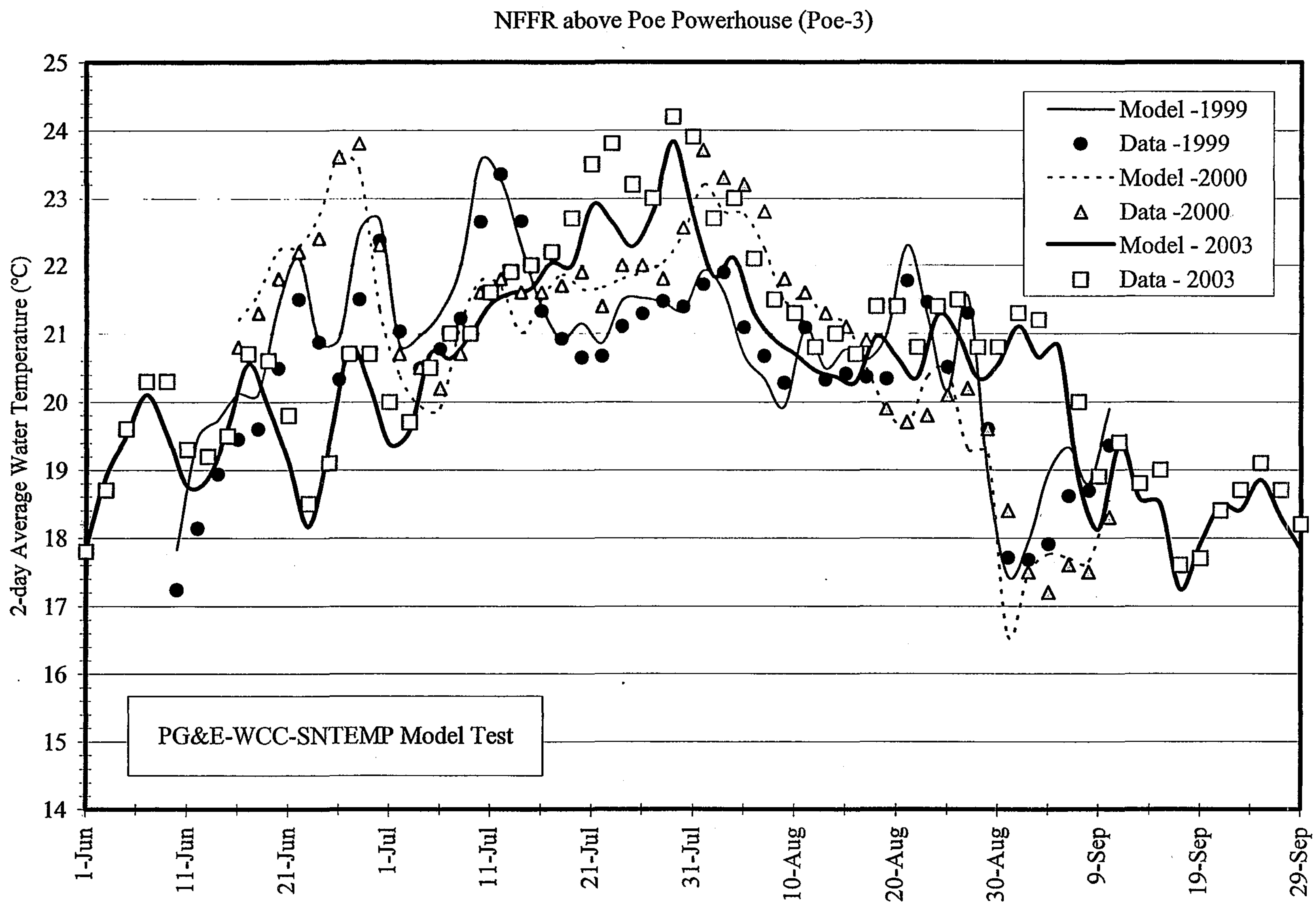



Figure E2.5-21 Predicted and observed water temperature in the NFFR above Poe Powerhouse (Poe-3).

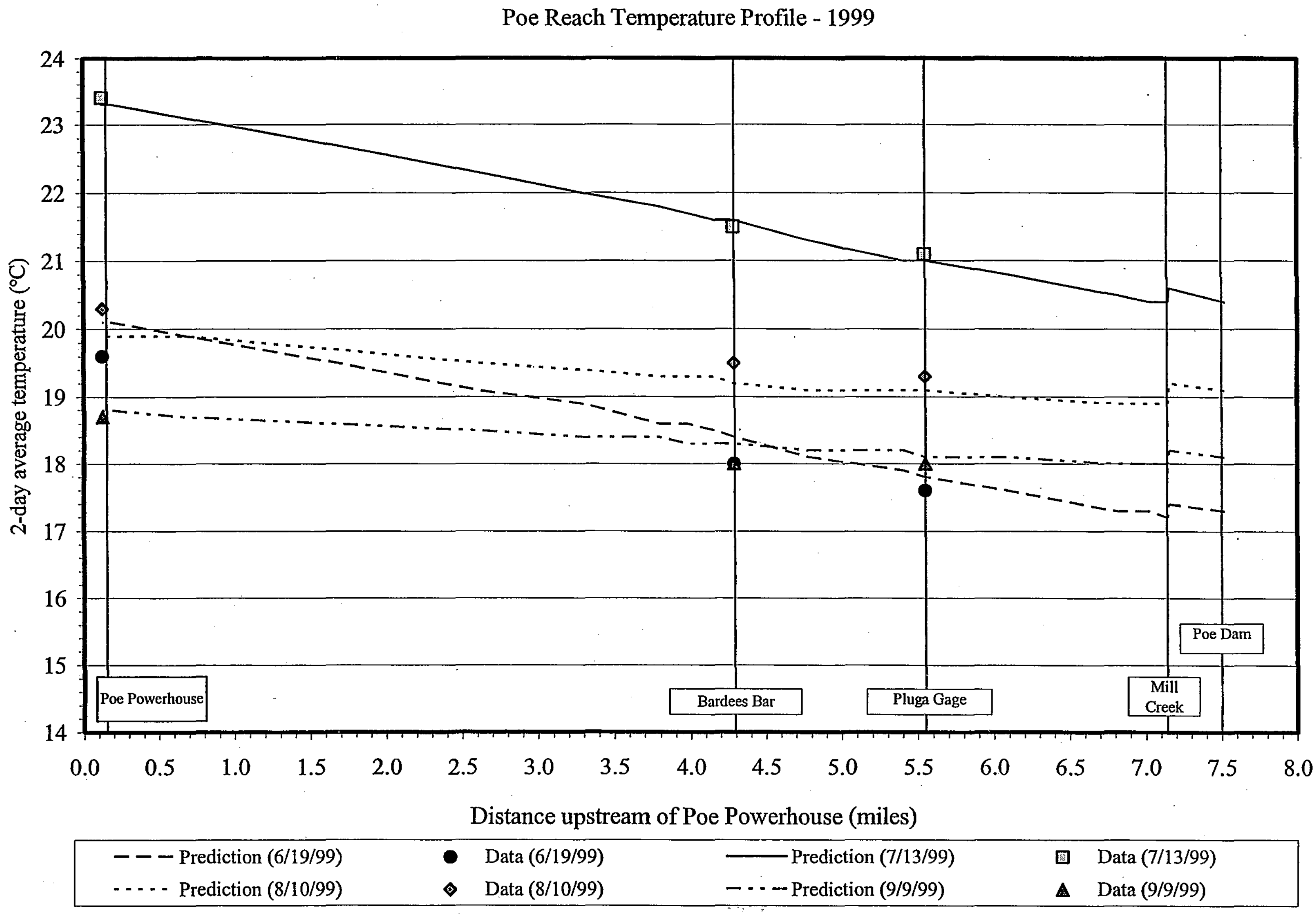



Figure E2.5-22 Predicted and observed longitudinal temperature profiles in Poe Reach - 1999.

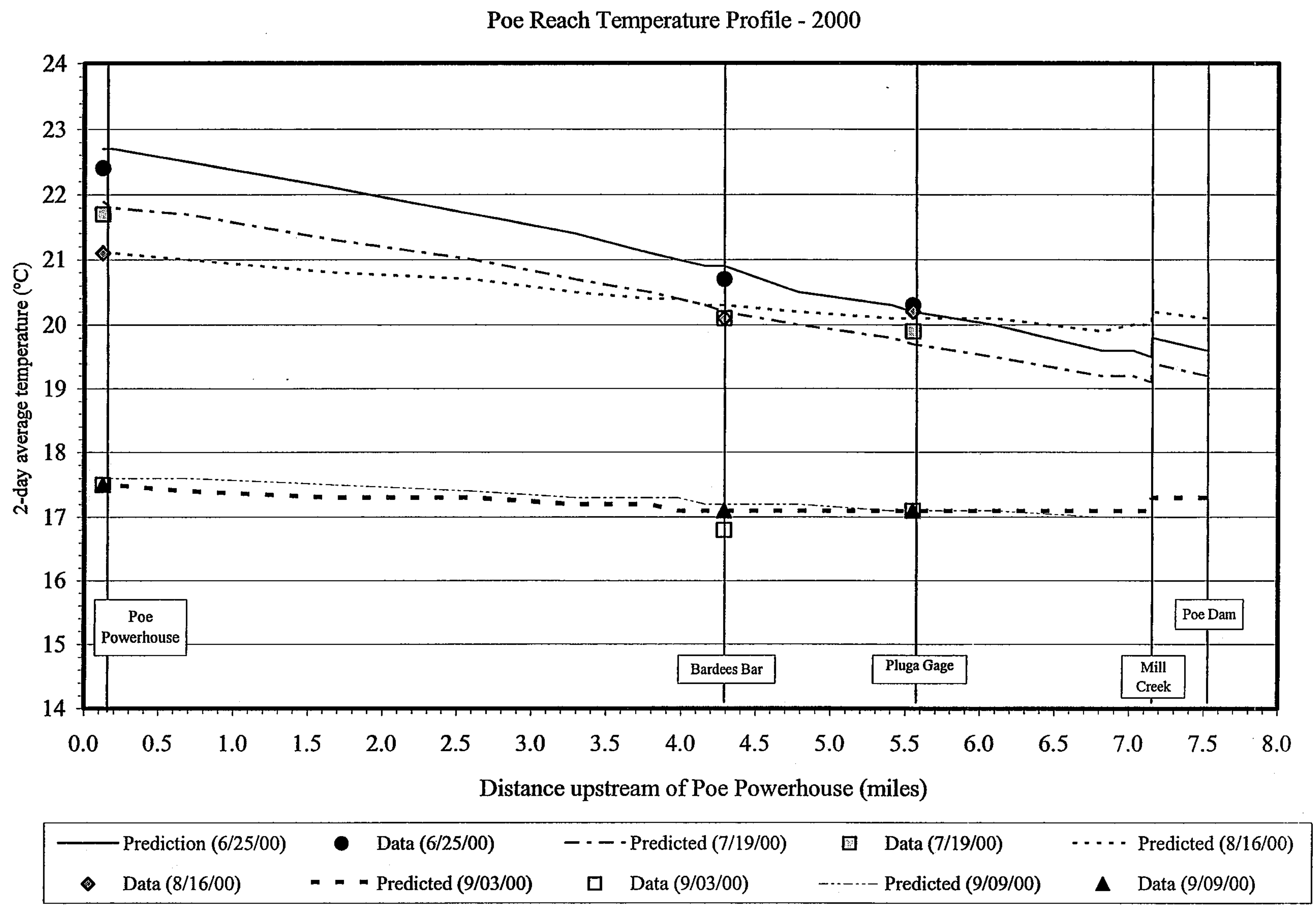



Figure E2.5-23 Predicted and observed longitudinal temperature profiles in Poe Reach – 2000.

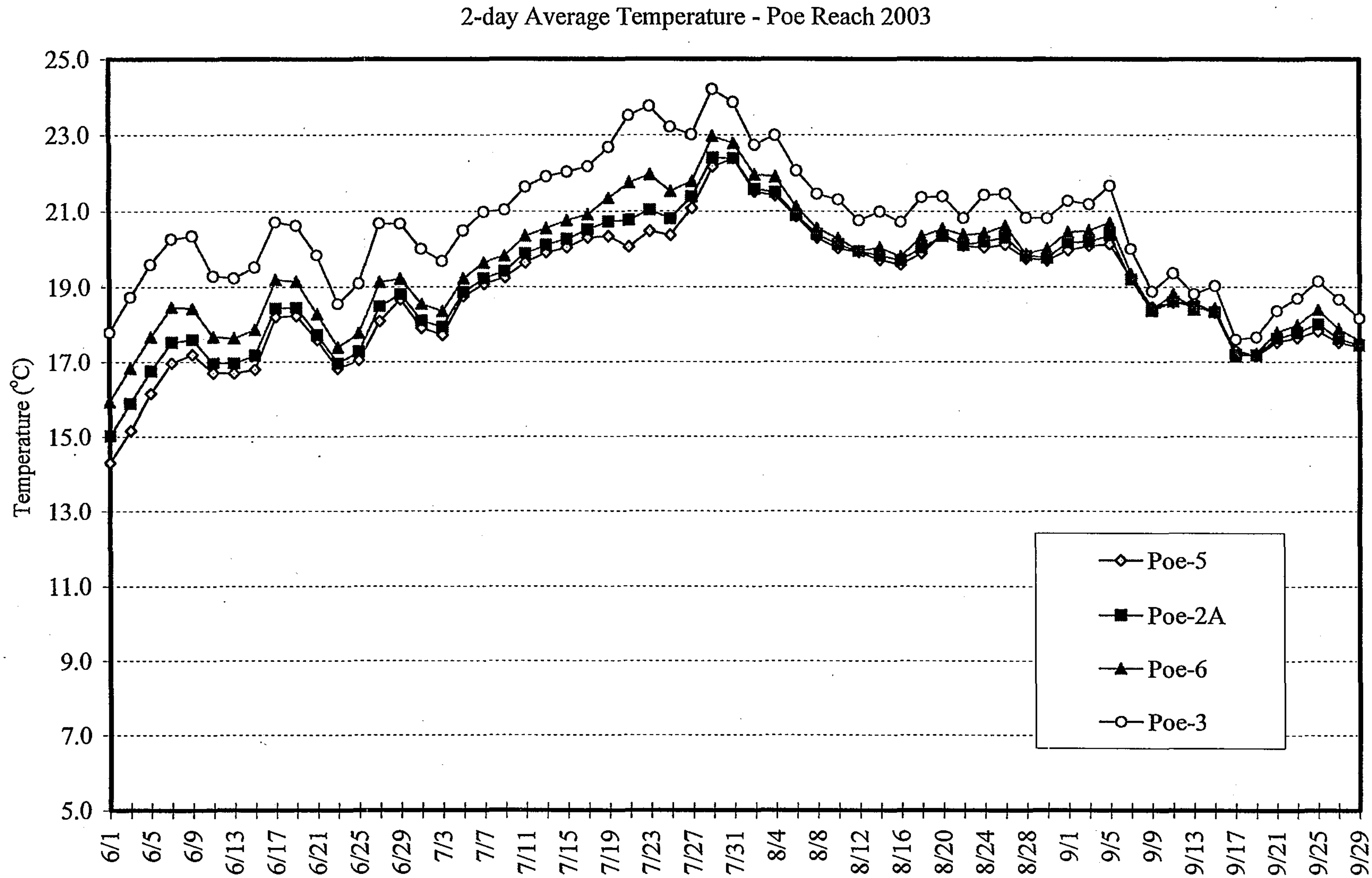



Figure E2.5-24 Comparison of 2-day average water temperature in Poe Reach of the NFFR in 2003.

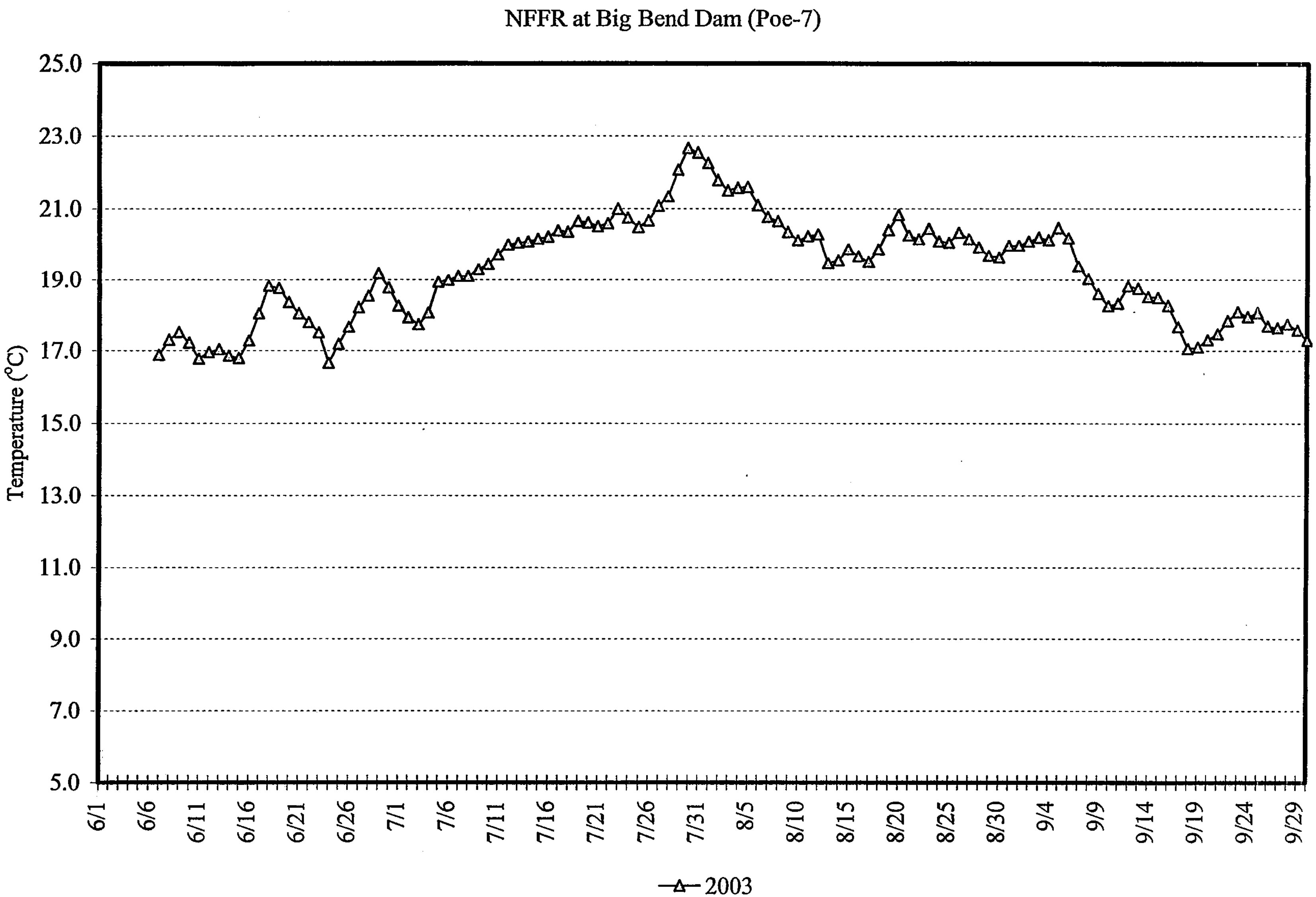



Figure E2.5-25 2003 daily average water temperature in the NFFR at Big Bend Dam (Poe-7).

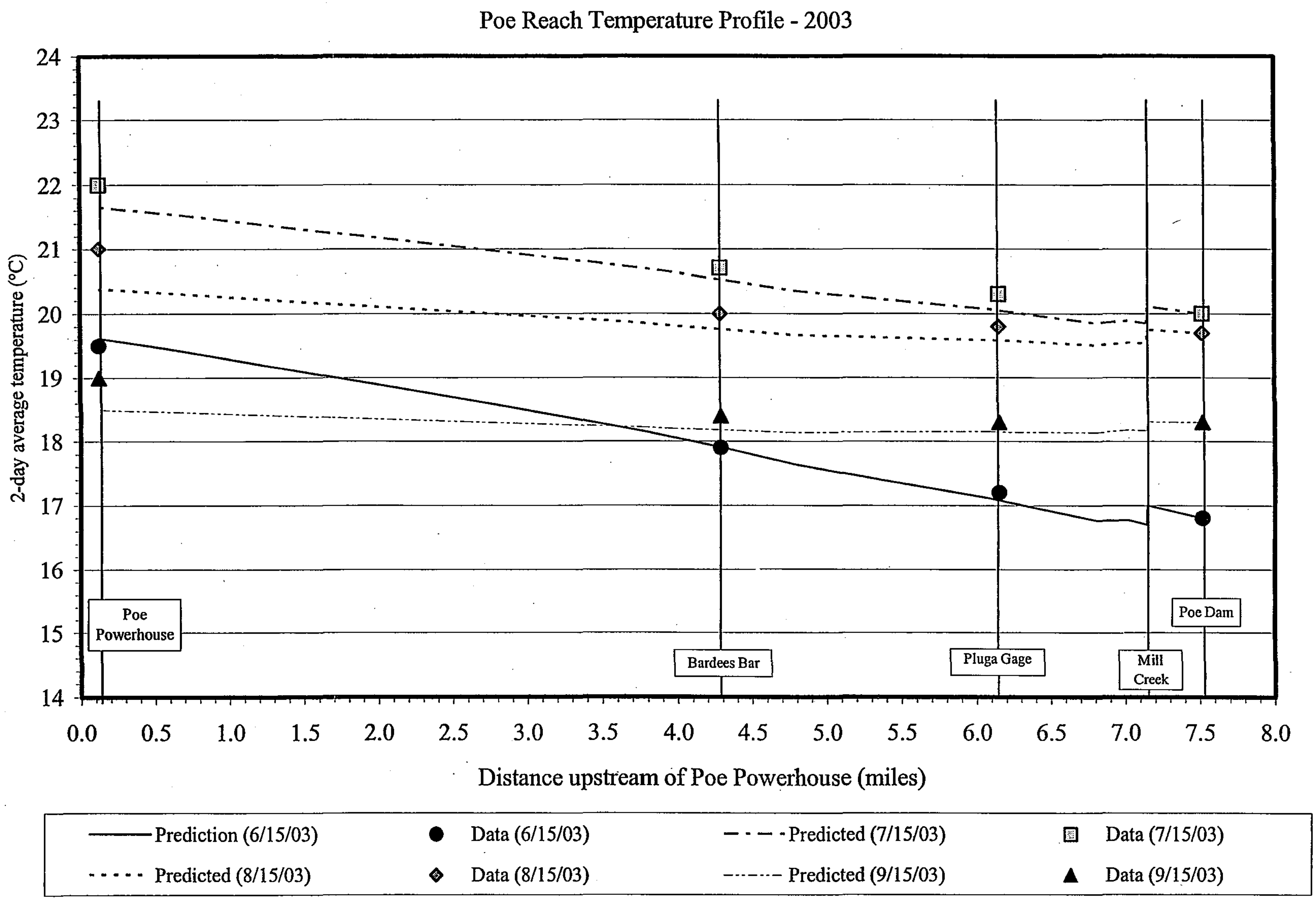



Figure E2.5-26 Predicted and observed longitudinal temperature profiles in Poe Reach – 2003.

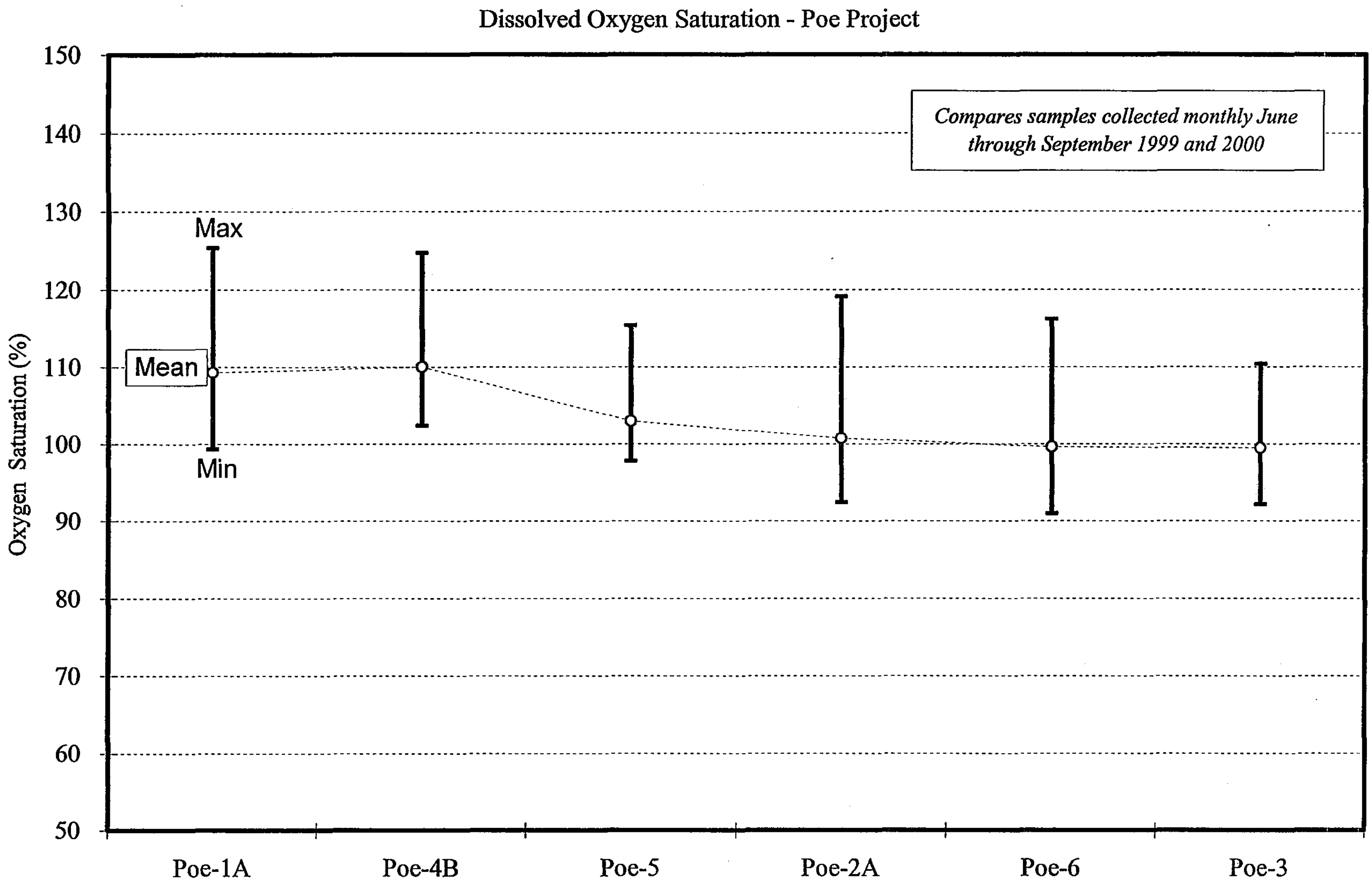



Figure E2.5-27 Comparison of dissolved oxygen saturation in the Poe Project

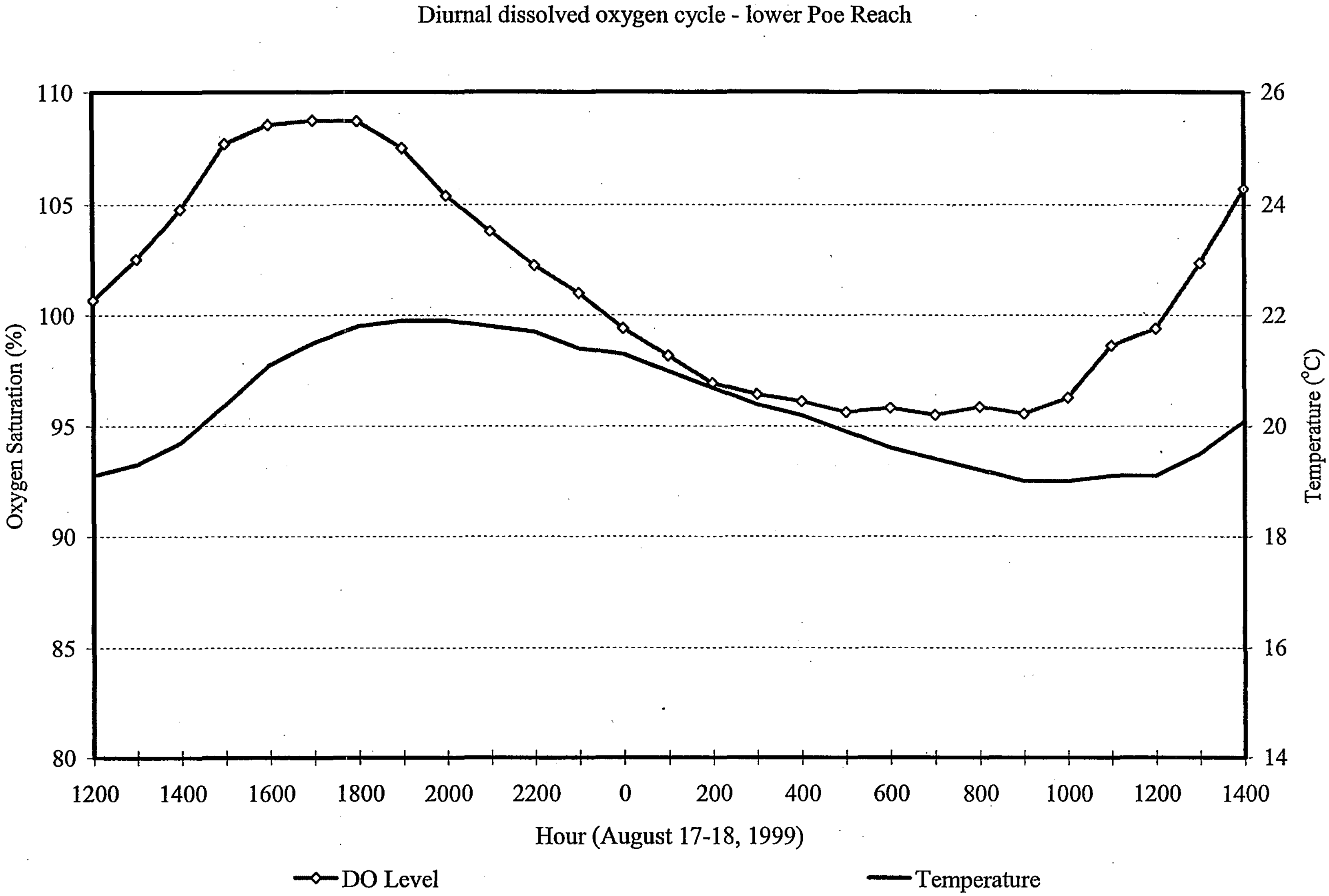



Figure E2.5-28 Results of diel dissolved oxygen monitoring in the NFFR above Poe Powerhouse.

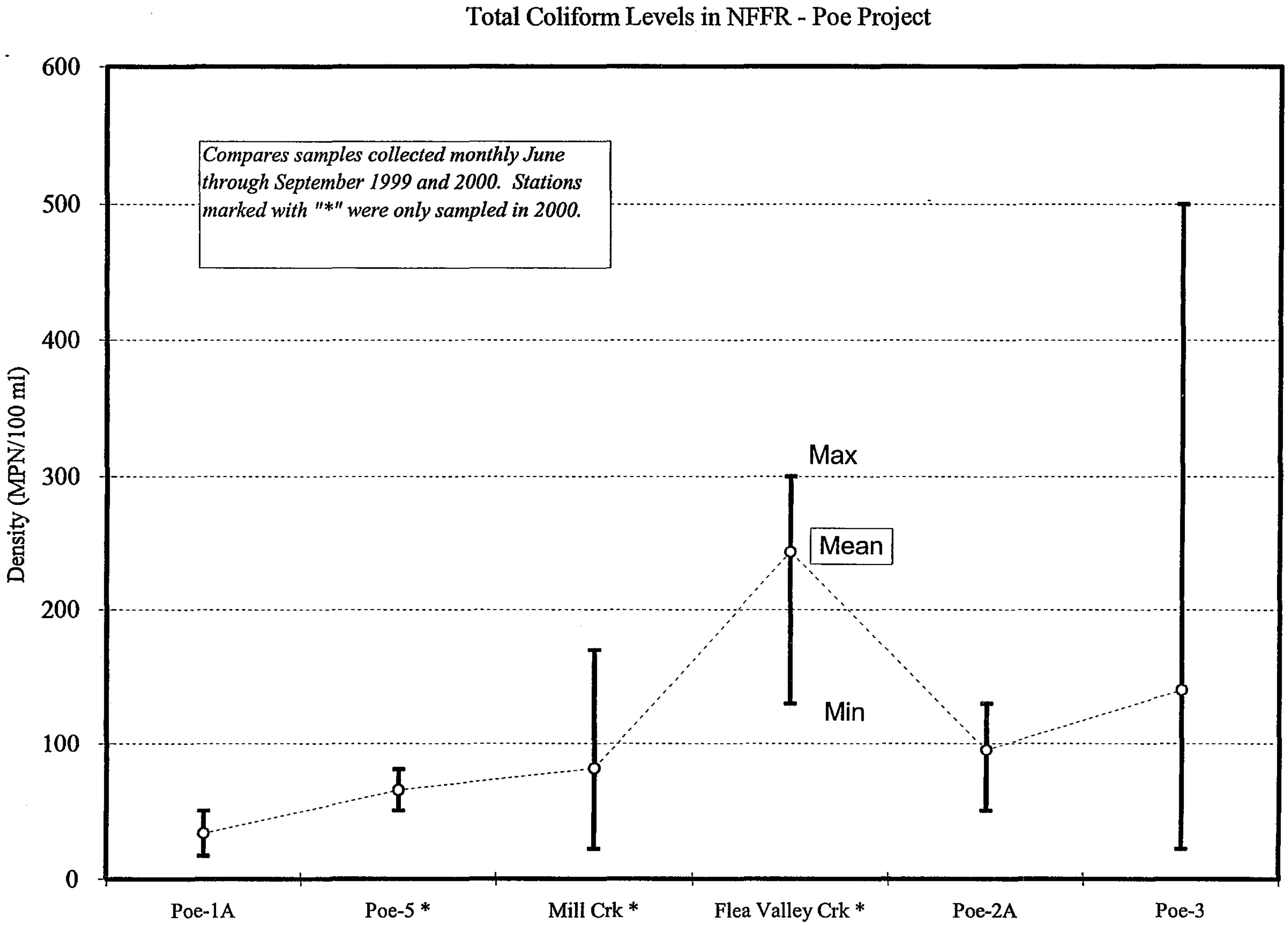



Figure E2.5-29 Comparison of total coliform levels in the Poe Project.

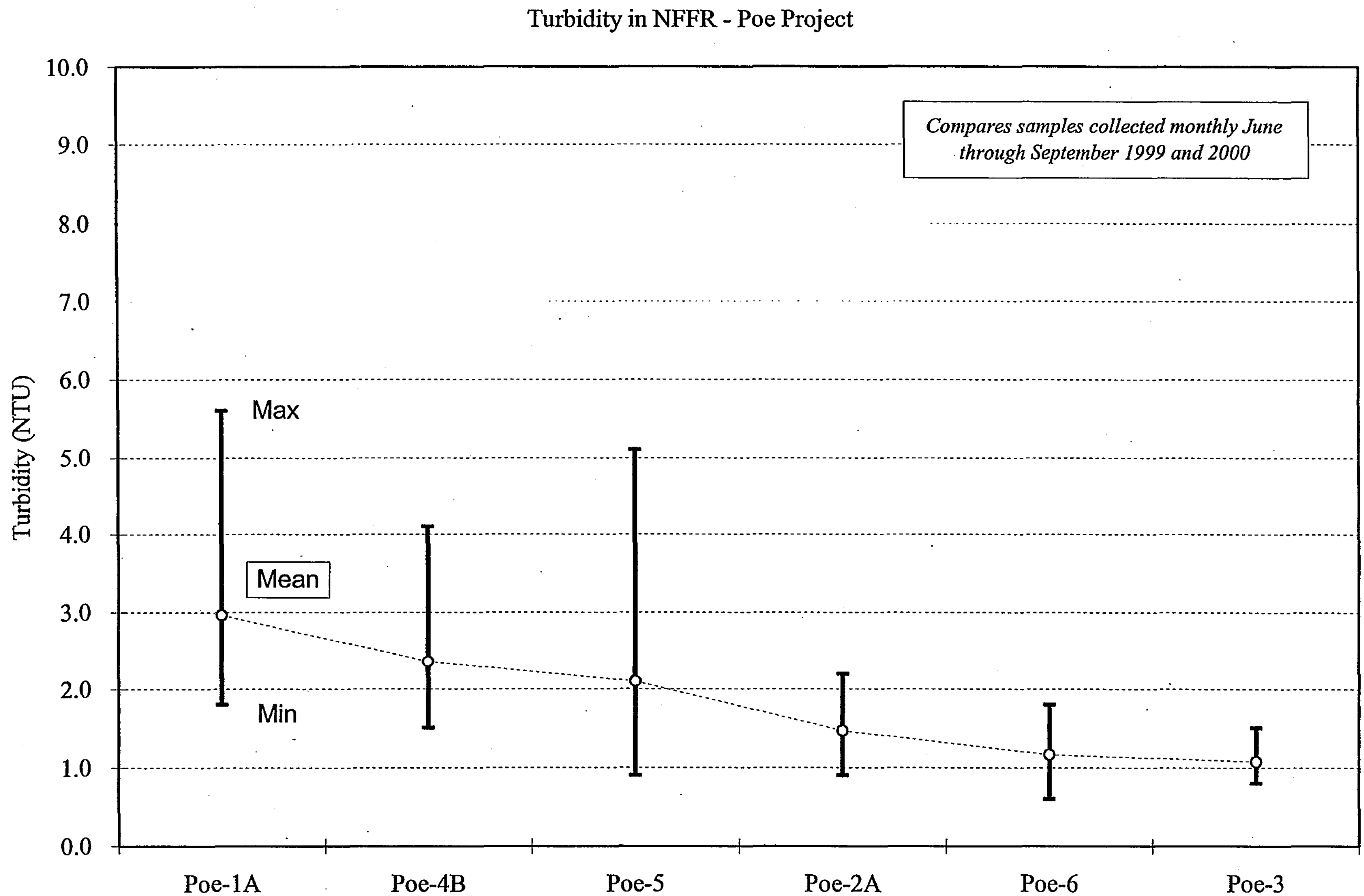



Figure E2.5-30 Comparison of turbidity levels in the Poe Project.

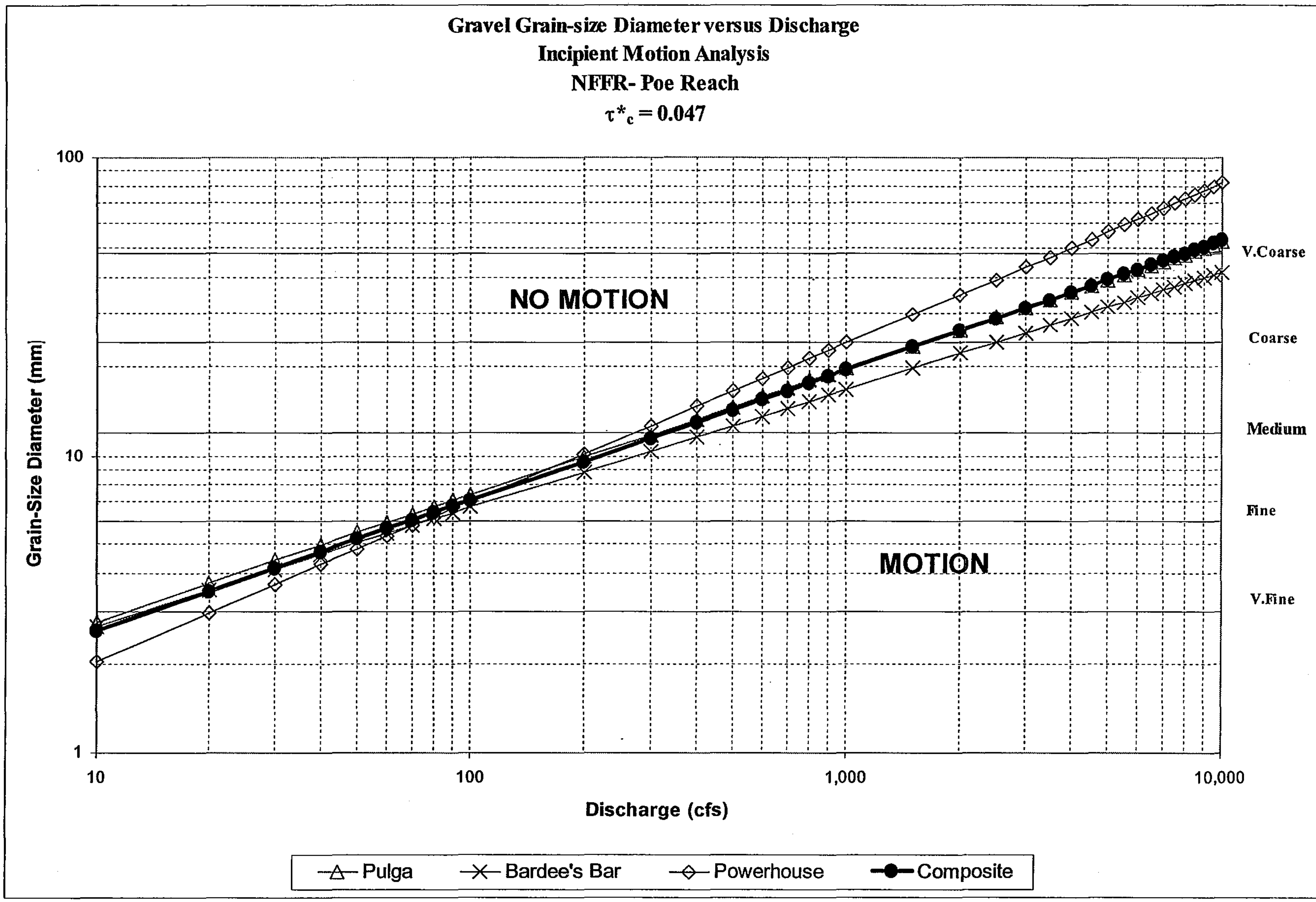



Figure E2.5-31 Gravel Grain Size versus Discharge, Incipient Motion Analysis, NFFR – Poe Reach $\tau^*_c = 0.047$

## E2.6 IMPACTS RELATED TO EXISTING PROJECT

### E2.6.1 Applicable Agency Criteria and Resource Management Plans

Appendix E2-4 presents comparisons of applicable regulatory criteria with the water quality data collected by the Licensee in the Poe Project area. Most constituents that were analyzed during the 1999-2000 and 2003 monitoring programs were within the limits specified by regulatory agencies for fish and wildlife habitat, recreation, or domestic purposes.

Water quality in the NFFR River system is generally good. Bacterial quality does meet the Basin Plan criteria for contact recreation. The water chemistry conditions meet most of the objectives for the beneficial uses identified in the CVRWQCB Water Quality Control Plan (Basin Plan) and other applicable regulatory criteria. However, some constituents were measured at levels that exceeded one or more regulatory criteria. These exceedances were typically associated with high runoff periods and the associated increase in suspended sediment. When exceedance conditions occurred they typically occurred at multiple stations including unregulated tributary streams. All data collected in the Project area is compared with the applicable regulatory criteria in Appendix E2-4.

### E2.6.2. Hydrology Impacts

The principal change in the hydrologic properties of the NFFR created by the Project is the impoundment of the NFFR water at Poe Reservoir and the subsequent diversion of water through Poe Powerhouse, resulting in less than natural flows in the Poe Reach of the NFFR during most of the year. Additionally, by storing and delivering water on demand, the extensive hydropower development throughout the entire NFFR watershed greatly alters the river's upstream hydrology. Under the true natural flow condition, which excludes both the storage effect from all upstream reservoirs and the Project operation, the estimated monthly mean flows, already presented in Figure E2.3-11, ranged from 800 cfs in August to 6,200 cfs in April for the period 1935-1958 (Pacific Gas and Electric Company 1994).

Comparatively, the mean monthly flows under the Project (for the period 1958-1998) ranged from a regulated minimum of 61 cfs in August to 1,700 cfs in March. While the magnitude of flows in the bypass reach has been reduced, the hydrographic pattern of peak flows occurring between January and April and the low flow period occurring between July and September is retained.

Flow duration curves, based on the monthly mean flow data from the same database above, were computed for each month under both natural flow (1935-1958, pre-Poe Project operations) and Project operation (1958-1998) conditions. These two sets of curves are presented in a series of figures in Appendix E2-5. Each set provides the monthly flow duration curves for the above two conditions. The 50% value of each curve represents the median, which is the flow value for which 50% of the flows are greater and the other 50% are less. It should be noted that there are differences between the medians presented in Appendix E2-5 and the averages that were previously presented in Figure E2.3-11. For the NFFR at Pulga, the average values are larger than the medians because of the very high episodic flood events that ranged several orders of magnitudes higher than the median flow.

In addition to changing the daily or monthly quantity of water that flows in the NFFR reach between Poe Dam and Poe Powerhouse, the Project alters the rate of change in the flow experienced in this reach. Once the flow in the NFFR reaches the maximum flow capability of the powerhouse (approximately 4,000 cfs) the Project would have a decreasing influence on the rate of change unless a unit is taken off-line. However, it is reasonable to note that the slope of the natural hydrograph (representing the rate of change in flow) is less steep at flows below 4,000 cfs than at flows above 4,000 cfs. Section E2.3.4 considered ramping rates experienced below Poe Dam during a typical wet year (1998) based on current operation. Instances of flow rate changes in excess of 2,000 cfs per hour were experienced. While this rate of change might be experienced at high flows (greater than 10,000 cfs) it would not be expected to occur at flow levels less than 4,000 cfs.

The operation of Poe Powerhouse and Big Bend Dam also alters the rate of change in the flow below the powerhouse. As noted in Section E2.3.4, this impact is dampened by the notch that was cut in Big Bend Dam.

The SWRCB has requested in a letter dated March 12, 2003, that the Licensee should conduct a feasibility study to assess the removal of Big Bend Dam and the hydraulic need for a replacement structure. The Licensee will address this issue in Appendix E3-16.

### E2.6.3. General Water Chemistry Impacts

As discussed previously, the Poe Project alters the NFFR's hydrology between Poe Reservoir and Big Bend Dam. However, except for water temperature, this change in hydrology is not believed to have a significant impact on water quality.

Available water quality (water chemistry) information indicates that the use of Project waters for hydroelectric generation is consistent with the beneficial uses identified in the Water Quality Control Plan Report for the Sacramento River Basin (CVRWQCB 1998). The steep gradient and resulting turbulent flows in the Poe Reach of the NFFR aerate the stream and increase its natural assimilative capacity, which tends to maintain high water quality. On the basis of available data, water quality impacts related to the Project are believed to be minimal. Parameters of special concern are discussed in the following sections.

As detailed in Appendix E2.4, the only constituent that exceeded regulatory criteria was total iron during the 1999-2000 monitoring period and total aluminum during the 2003 monitoring effort. All instances of exceedance occurred during periods of elevated suspended sediment, which was the result of naturally elevated runoff conditions originating in the upper portions of the NFFR watershed and not a function of Project operation. Both of the unregulated, non-Project tributaries (Mill Creek and Flea Valley Creek) were monitored in 2003. These stream exhibited water quality (water chemistry) conditions that were similar to samples collected from the main stem of the NFFR. Specifically, trace metal concentrations showed similar trends and exceedance patterns to those from the NFFR.

### E2.6.4 Water Temperature Impacts

Conditions within the Project are primarily derived from conditions at the Licensee's existing upstream projects. Potential changes to water quality and water temperature associated with changes in the operational regime of the upstream projects are currently being evaluated by the Licensee as part of the on-going relicensing and/or license conditions effort for each of the projects (Rock Creek-Cresta [FERC 1962] and Upper North Fork Feather River [FERC 2105]). The feasibility of withdrawing cold water from the large upstream storage reservoirs is being investigated as part of the Rock Creek-Cresta license, while characterizing the water quality condition of Lake Almanor on downstream stream reaches is being investigated under the Upper North Fork Feather River license.

#### E2.6.4.1 Existing Conditions

Development of the Poe Project has resulted in reduced flows in the Poe Reach of the NFFR. This, in turn, has no doubt resulted in increased summer temperatures through most of the reach, although the magnitude of this increase is unknown. Under existing streamflow conditions, temperature characteristics vary from the upper portion of the Poe Reach to the lower portion. In the upper portion, where the stream gradient is steeper (1% to 2%) and the river channel is narrower, the travel time is shorter. Additionally, there is significant topographic shading, as well as the contribution of cooler water from

Mill Creek and Flea Valley Creek. Consequently, temperatures remain similar to upstream sources. In the lower portion of the reach, as the stream gradient lessens, and as the river channel widens, combined with the lower elevation (near 1,000 ft above mean sea level [MSL]), daily average water temperatures readily warm to temperatures that are above 20°C during normal summer conditions.

The highest daily average water temperatures were observed in the NFFR immediately upstream of Poe Powerhouse (Poe-3). The greatest change in daily average temperatures occurred between stations located at Bardees Bar (Poe-6) and upstream of Poe Powerhouse (Poe-3), reflecting the fact that physical conditions in the lower section of the bypass reach contribute to a higher level of heating.

Diel fluctuations were relatively low (less than 1.0°C) in the upper portion of the Project area (Poe-1A, Poe 4, Poe 5), reflecting the large volume of flow passing from Cresta Powerhouse through Poe Reservoir. The small diel cycle was essentially the same between these upper stations, with only a small increase observed as the water passes through Poe Reservoir. As water passes downstream through the bypass reach, the magnitude of the diel cycle increased to levels (2.5 to 3.0°C) comparable with those observed in local unimpaired streams (Mill Creek and Flea Valley Creek). The diel cycle was largest at the station located at Pulga bridge (Poe-2A), reflecting the influence of the tributary streams upstream. As flows moved through the lower sections of the bypass reach, the diel cycle stabilized at around 3.0°C. The diel cycles remained consistent between years. Figure E2.6-1 compares the diel cycle at three NFFR stations and Mill

Creek on July 14-16, 2000.

The result of increased flows released to the bypass reach during test flow events indicated that there was little change in daily average temperature with increasing volumes of water during the mild ambient conditions present during May and September. The effect of increased release flows during this period was to dampen the diel cycle (reduced daily maximum and increased daily minimum), particularly in the upper portion of the reach. The increased flows in the lower portion of the reach appear to have little effect on the temperature regime. This is largely the result of the long travel time associated with the middle and lower portions of the reach, which causes release waters to reach an equilibrium condition as it passes downstream. The effect of increased flows on temperatures during the July-August period was not directly measured. The following presentation of simulation results from the PG&E-WCC-SNTEMP temperature model will address the effect of increased flows and potentially improved upstream conditions on temperatures throughout the Project area.

Temp/Flow Simulations

See Table E2.6-~~4~~ E2.6-2

### E2.6.4.2 Temperature Model Simulation

The SNTEMP model was used to simulate temperature in the Poe Reach, both spatially and temporally, and to assess long-term temperature characteristics under various flow management scenarios. This type of simulation required that a range of starting temperatures for the Poe Reach (as defined by upstream hydrology and operational conditions) and meteorological conditions (climate) be defined. In addition, the effect of possible changes in operations upstream of the Project on conditions in the bypass reach were evaluated.

Summer period (June through September) water temperatures in the Project area are largely a function of discharges from Cresta Powerhouse (2,000 to 4,000 cfs), and to a less extent, a function of flows from the Cresta Reach of the NFFR upstream of Cresta Powerhouse (100 to 200 cfs). Water temperatures at Cresta Powerhouse are closely related to the source conditions as discharged from Lake Almanor and Butt Valley Reservoir, which are dependent on hydrological conditions at these facilities. Under the existing operating condition, water temperature data obtained in 1999 and 2000 for the Cresta Powerhouse Tailrace were ranked to determine the starting temperatures (or hydrological condition) in the Poe Reach under normal and extreme environmental conditions. Data ranked at the 50-percentile level defined the normal condition, whereas the 90-percentile values (or 10-percentile for flow) represented the extreme condition. These rankings were also established for the tributaries (Mill Creek and Flea Valley Creek). Temperatures under normal and extreme conditions are provided in Table E2.6-1. Meteorological conditions were also ranked to define normal and extreme conditions. Meteorological data from 1948-1985 that were compiled by Woodward-Clyde (1986a) were used for this purpose (Table E2.6-1).

## Table E2.6-1

## Summary of input conditions used for SNTEMP Model simulations

| Description | Normal | | | | Extreme | | | |
|---|---|---|---|---|---|---|---|---|
| | June | July | August | September | June | July | August | September |
| **Below Poe Dam** [1] | | | | | | | | |
| Water Temperature (°C) | 17.5 | 19.3 | 19.4 | 17.4 | 19.5 | 20 | 20.7 | 18.3 |
| **Mill Creek** [1] | | | | | | | | |
| Water Temperature (°C) | 14.9 | 15.1 | 15 | 13.4 | 16.4 | 16 | 16.6 | 14.4 |
| Flow (cfs) | 7.1 | 6.4 | 4.6 | 3.9 | 6.7 | 5.7 | 4.2 | 3.5 |
| **Flea Valley Creek** [1] | | | | | | | | |
| Water Temperature (°C) | 14.7 | 15.1 | 15.2 | 13.9 | 16.1 | 15.9 | 16.4 | 14.7 |
| Flow (cfs) | 2.8 | 2.1 | 1.8 | 1.4 | 2.5 | 1.8 | 1.4 | 1.1 |
| **Meteorological Condition** [2] | | | | | | | | |
| Air Temperature (°C) | 20.2 | 23.9 | 22.2 | 18.7 | 21.8 | 24.8 | 23 | 20 |
| Relative Humidity (%) | 34.4 | 41.5 | 45.1 | 54 | 41.4 | 42.7 | 38 | 60.5 |
| Wind Speed (m/s) | 0.7 | 0.7 | 0.8 | 0.5 | 1.2 | 0.7 | 0.7 | 0.6 |
| Solar radiation ($J/M^2/s$) | 279 | 262 | 241 | 202 | 275 | 276 | 281 | 174 |

[1] Pacific Gas and Electric Company data from 1999-2000

[2] Data from California Data Exchange Center from the station at Canyon Dam (1948-1985), adjusted to a location equivalent to Poe Powerhouse; the adjustment coefficients were from the regression analysis based on data of 1985 (Woodward-Clyde 1986a).

For the purposes of this model simulation effort, two ambient conditions were selected to bracket conditions of typical concern: a normal-normal condition (normal condition), consisting of normal hydrology and normal meteorology; and a dry-warm condition (extreme condition), consisting of dry hydrology and warm meteorology. The normal condition represents the expected condition (50 percentile), while the extreme condition represents a conservative worst-case evaluation with a 10 percent probability of occurrence. Under each of these environmental conditions, the SNTEMP model was used to predict water temperatures under various flow releases. The simulated flows ranged from the current FERC requirement of 50 cfs up to 1,250 cfs. The 1,250 cfs flow corresponds to a 50-percentile flow level under July natural flow conditions. A total of eight release scenarios were considered: 50, 100, 150, 200, 300, 500, 850 and 1,250 cfs.

The potential for operational changes at upstream reservoirs to reduce temperatures in the Project area were also included in this modeling effort. Work is in progress to determine the feasibility of increasing cold water entrainment at Lake Almanor for delivery to downstream river reaches (including the Poe Reach) by modifying the Licensee's Prattville Intake (FERC 2105). Based on previous modeling results, a temperature reduction of 0.9 to 1.2°C (relative to the existing operation) was predicted at Rock Creek Dam using a conceptual 'skimmer wall' installed at Prattville Intake (Table 3.3-3 in Woodward-Clyde 1986b). The same study suggested that up to a 2.0°C reduction could be accomplished if 'skimmer walls" were installed at both the Prattville Intake and the Caribou No. 2 Intake (Butt Valley Reservoir). These predictions are subject to verification, which is currently being addressed under the Rock Creek-Cresta Project

(FERC 1962) Settlement Agreement (Pacific Gas and Electric Company 2000b).

Based on the previous simulations, two potential changes were hypothesized with regard to the effect of upstream modifications on inflow conditions to the Poe Project. These hypothesized changes were used to further develop the SNTEMP model simulation. Hypothesis 1 assumes that upstream modification efforts result in a 1°C reduction in inflow temperatures relative to current operations. Hypothesis 2 assumes that upstream modification efforts result in a 2°C reduction.

The following conditions were used to develop a temperature simulation matrix for the Poe Project.

- Three upstream Prattville/Caribou conditions: existing, 1°C reduction, and 2°C reduction.
- Two environmental conditions: normal and extreme.
- Eight release flows at Poe Dam: existing (50), 100, 150, 200, 300, 500, 850 and 1,250 cfs.

The results of the temperature simulations are discussed in the following paragraphs. Table E2.6-2 summaries the results of the simulation matrix.

## Table E2.6-2

**Summary of results from PG&E-WCC-SNTEMP model simulation matrix**

**Daily Average Water Temperature at NFFR above Poe Powerhouse**

| | Normal | | | | Extreme | | | |
|---|---|---|---|---|---|---|---|---|
| Flow Release | June (°C) | July (°C) | August (°C) | September (°C) | June (°C) | July (°C) | August (°C) | September (°C) |
| **Existing upstream operation** | | | | | | | | |
| 50 | 19.8 | 22.2 | 21.7 | 18.5 | 21.4 | 23.1 | 22.3 | 19.5 |
| 100 | 19.1 | 21.3 | 21.0 | 18.1 | 20.8 | 22.2 | 21.8 | 19.2 |
| 150 | 18.8 | 20.9 | 20.6 | 18.0 | 20.6 | 21.7 | 21.6 | 19.0 |
| 200 | 18.6 | 20.6 | 20.4 | 17.9 | 20.4 | 21.4 | 21.4 | 18.9 |
| 300 | 18.3 | 20.3 | 20.2 | 17.8 | 20.2 | 21.0 | 21.3 | 18.8 |
| 500 | 18.1 | 20.0 | 20.0 | 17.7 | 20.0 | 20.7 | 21.1 | 18.7 |
| 850 | 17.9 | 19.8 | 19.8 | 17.7 | 19.8 | 20.5 | 21.0 | 18.6 |
| 1250 | 17.9 | 19.7 | 19.7 | 17.6 | 19.8 | 20.4 | 20.9 | 18.6 |
| **Modified upstream operation resulting in a 1°C reduction in initial temperature** | | | | | | | | |
| 50 | 19.5 | 21.9 | 21.4 | 18.1 | 21.1 | 22.8 | 22.0 | 19.2 |
| 100 | 18.6 | 20.8 | 20.5 | 17.6 | 20.3 | 21.5 | 21.3 | 18.6 |
| 150 | 18.1 | 20.2 | 20.0 | 17.3 | 19.9 | 21.0 | 20.9 | 18.3 |
| 200 | 17.8 | 19.8 | 19.7 | 17.2 | 19.7 | 20.7 | 20.7 | 18.2 |
| 300 | 17.5 | 19.5 | 19.4 | 17.0 | 19.4 | 20.3 | 20.5 | 18.0 |
| 500 | 17.2 | 19.2 | 19.1 | 16.9 | 19.1 | 19.9 | 20.3 | 17.8 |
| 850 | 17.0 | 18.9 | 18.9 | 16.8 | 19.0 | 19.6 | 20.1 | 17.7 |
| 1250 | 16.9 | 18.8 | 18.8 | 16.7 | 18.9 | 19.5 | 20.0 | 17.6 |
| **Modified upstream operation resulting in a 2°C reduction in initial temperature** | | | | | | | | |
| 50 | 19.1 | 21.5 | 21.1 | 17.7 | 20.8 | 22.5 | 21.7 | 18.8 |
| 100 | 18.0 | 20.2 | 19.9 | 17.0 | 19.8 | 21.1 | 20.7 | 18.0 |
| 150 | 17.5 | 19.6 | 19.4 | 16.6 | 19.3 | 20.4 | 20.3 | 17.6 |
| 200 | 17.1 | 19.2 | 19.0 | 16.4 | 19.0 | 20.0 | 20.0 | 17.4 |
| 300 | 16.7 | 18.7 | 18.6 | 16.2 | 18.6 | 19.5 | 19.7 | 17.2 |
| 500 | 16.4 | 18.3 | 18.3 | 16.0 | 18.3 | 19.0 | 19.4 | 16.9 |
| 850 | 16.1 | 18.0 | 18.0 | 15.8 | 18.0 | 18.7 | 19.2 | 16.8 |
| 1250 | 16.0 | 17.9 | 17.9 | 15.8 | 17.9 | 18.5 | 19.1 | 16.7 |

Temperatures under existing inflow conditions were simulated for the range of environmental and release conditions outlined previously. Longitudinal water temperature profiles were created for the Poe Reach based on the results of these simulations. Figure E2.6-2 depicts monthly (June-September) temperatures at various flow releases (50 – 1,250 cfs) under normal ambient conditions. In general, water temperatures under the 50 cfs release increased through the Poe Reach from 19.4°C to approximately 22.0°C in July and August, while temperatures were below 20.0°C for the months of June and September. Mill Creek and Flea Valley Creek reduced temperatures in the NFFR by approximately 0.6 °C at the minimum flow release. Water temperatures tended to increase more in the lower Poe Reach (below Bardees Bar at River Mile 4.3) when compared to the upper reach. The longitudinal thermal gradient became flatter with increasing flow. As flows increase to 300 cfs and above, temperature profiles in July and August converge into a single curve. At 500 cfs, temperatures fall below 20°C at all stations in the Poe Reach. There is little change in temperature at flows between 850 and 1,250 cfs.

Figure E2.6-3 shows the predicted relationship of temperatures with flows in the NFFR just above Poe Powerhouse under normal conditions (the temperature values are also tabulated in Table E2.6-2). July and August, the warmest months, have similar temperatures and show similar trends with increasing flow. July temperatures decrease asymptotically from 22.2°C at 50 cfs to 19.7°C at 1,250 cfs, a temperature reduction of 2.5°C. Temperature reduction is more significant (from 22.2°C to 20.6°C) in the lower flow range (from 50 cfs to 200 cfs) and levels-off gradually above 200 cfs. The July and

August temperature levels drop below 20°C at flows higher than 500 cfs. In June and September, temperatures were less than 20°C for the entire range of flow releases. As expected, the September curve shows the mildest change with flow increases due to cooler climatic conditions in late summer. This is consistent with what was observed during the high flow test release on September 8-10, 2000; based on that test, it was concluded that temperature changes are negligible regardless of the magnitude of the flow release at this time of the year.

The data indicate that the relationship between temperature and flow is not uniform throughout the reach due to differences in topographic shading and stream hydraulics. In contrast to the lower portion of the Poe Reach, temperatures in the upper portion of the reach show little effect with increasing flow. The station located 1 mile below Pulga Bridge (Poe-2B) marks the end of significant topographic shading by Pulga Gorge. The predicted relationship at this location shows little temperature change with increasing flow, and is representative of the upper portion of the bypass reach (Figure E2.6-4). At this location, the temperature variation is narrow, and the temperature is below 20°C for all flow releases over the entire summer period for the normal condition. As discussed earlier, the predicted temperature under the normal condition represents a level where 50% of the time the predicted temperature value will be exceeded and 50% of the time temperatures will be below the predicted value.

Figures E2.6-5 and E2.6-6 show the counterparts of Figures E2.6-3 and E2.6-4 for the extreme conditions at the NFFR above Poe Powerhouse and below Pulga Bridge, respectively. Generally, the pattern of temperature change with increasing flow is similar for the extreme and normal conditions at each location; however, the temperatures are typically 1 to 2°C higher under extreme conditions than under normal conditions. For the warmest month, July, at the NFFR above Poe Powerhouse, temperatures decreased from 23.1 to 20.4°C (a temperature reduction of 2.7°C) as flows increased from 50 to 1,250 cfs under the extreme condition. Under the normal July condition, temperatures decreased from 22.2 to 19.7°C (temperature reduction of 2.5°C) over the same range of flows. Under the extreme conditions, the July and August water temperatures remain above 20°C throughout the Poe Reach for the range of modeled flow releases. It should be noted that the extreme conditions represent a rare type of event that occurs about 10% or less of the time.

Under the hypothesis that the modification of the Prattville Intake at Lake Almanor would result in a 1°C reduction at the Poe Dam release, the entire series discussed above was repeated using the SNTEMP model. Figures E2.6-7 and E2.6-8 show the temperature and flow relationship at NFFR above Poe Powerhouse under the normal and the extreme conditions, respectively. Generally, the significant cooling predicted in the low flow range (50-200 cfs) is more pronounced under the 1°C reduction scenario (e.g., changing from 21.9 to 19.9°C, or a 2.0°C reduction in July with normal conditions) than under existing upstream operations (e.g., changing from 22.2 to 20.6°C, a reduction of 1.6°C, see Table E2.6-2). Under normal conditions with the 1°C reduction, water temperatures above Poe Powerhouse are predicted to be below 20°C in all months for flow releases higher than 200 cfs. Under extreme conditions with a 1°C reduction, a flow release of

400 cfs is required in July to maintain water temperatures in the NFFR above Poe Powerhouse below 20°C, while a much higher flow release (1,200 cfs) is required in August to compensate for the higher starting water temperatures at Poe Dam.

Under the hypothesis that the modification in upstream operations could result in a 2°C reduction at the Poe Dam release, another series of simulation runs was made using the SNTEMP model. Figures E2.6-9 and E2.6-10 show the relationship between temperature and flow at the NFFR above Poe Powerhouse under normal and extreme conditions, respectively. Under the normal conditions with a 2°C reduction (Figure E2.6-9), a cooling of 2.3°C (from 21.5°C to 19.2°C) is achieved with increases in flow from 50 to 200 cfs demonstrating a continuously improving trend over the other two upstream operating cases. Under normal conditions with a 2°C reduction, water temperatures in the NFFR above Poe Powerhouse are predicted to be below 20°C in all months for flow releases of 100 to 150 cfs. Under the extreme conditions with a 2°C reduction (Figure E2.6-10), a flow release of 200 cfs is required to maintain water temperatures below 20°C in the NFFR above Poe Powerhouse in all months.

### E2.6.5 Dissolved Oxygen Impacts

The impact of Project operations on DO levels is minimal. Currently, DO levels are maintained above or near saturation throughout the system. Data from the 1999-2000, and 2003 monitoring efforts were similar with levels compliant with regulatory criteria during all periods. In the bypass reach, the stable turbulent flow regime maintains DO concentrations at near optimum levels. The short retention time and large volume of water moved through the upstream reservoirs combine to prevent conditions that could degrade DO levels. The lack of nutrients also prevents the development of large algae populations, which can cause large diel cycles in DO concentrations that might stress aquatic life. These fluctuations were monitored during the 1999 program and were found to be small and within the range observed in other regional stream systems (Pacific Gas and Electric Company 1993, 1998a).

### E2.6.6 Nutrient Load Impacts

Nutrients in Project waters were typically at or below the minimum detection limits during the 1999-2000 sampling. Nutrient levels measured during the 2003 monitoring effort were also low, and were similar to those measured in 1999-2000. The data indicates that the level of nutrients coming into the Project from the upstream sources was also less than minimum detection limits, indicating that there is not a significant source of biostimulatory compounds in the upstream watershed. Nutrient levels within the Project area were similar to those in the upstream samples indicating that the operation of the Project does not directly contribute nutrients to the NFFR.

### E2.6.7 Coliform Bacteria Impacts

The Poe Project receives low levels of bacterial inputs from sources upstream of the Project primarily through inflows from the NFFR. Tributaries within the Project area also act as a source of low-level inputs of bacteria. The operation of the Project does not directly contribute Coliform bacteria to the NFFR. The operation of septic systems associated with Poe Powerhouse is maintained by the Licensee as part of a routine maintenance program.

The Licensee does not operate recreational facilities that use leach field type systems in the project area. Informal recreational areas are located throughout the Project area. These locations may contribute seasonal pulses of Coliform bacteria to the system. However, the Licensee conducted separate 5 samples in 30 day sampling events in 2001 and 2003. Both events were located downstream of know recreational areas and were conducted before and after major summer period Holiday's. Results of both sampling efforts indicated that Fecal Coliform levels were below the Basin Plan objective for contact recreation.

### E2.6.8 Sedimentation Impacts

The NFFR is typically a low-turbidity mountain stream. However, during high-runoff periods, turbidity can increase dramatically. Sediment flow in the Project area is episodic in nature. The occurrence and magnitude of elevated sediment loads are associated with high-flow events. Heavy sediment loading is known to occur in the upper NFFR drainage. Land use practices well upstream of the Poe Project, particularly in the subdrainage basins of the East Branch of the NFFR, have increased erosion greatly, resulting in high levels of sediment accumulation in NFFR reservoirs. For Poe Reservoir, sediment accumulation has not been as significant as for the Rock Creek and Cresta reservoirs. These reservoirs have been the subject of numerous recent evaluations concerning sediment control (Bechtel 1987, 1990; Pacific Gas and Electric Company 1992, 1995a).

The sediment transport capacity is very much affected by the very coarse bed materials and the step-pool morphology of the channels. In steep, coarse-grained streams such as the NFFR, the sediment transport capacity exceeds the actual rate of sediment transport by orders of magnitude. Such streams can be classified as supply-limited systems, in contrast to lowland streams where sediment yield is controlled by available energy.

Sedimentation within Poe Reservoir is minimal because of the configuration of the spillway gates. Four radial flood-gates, which open at the invert of the dam, allow spill flows and incoming sediments to pass through the reservoir during high-flow events. The stream reach below Poe Dam is characterized by moderate to steep gradients, varying from 1.0%–2.0% in the upper portion to 0.75% in the lower portion. The typical channel width varies from 150 ft in the upper portion to 200 ft in the lower portion. In a supply-limited channel system, sediment deposition tends to be controlled by local factors such as flow expansion and contraction zones, which in turn are controlled by the resistance to erosion of the lithologic units traversed by the river, or by depositional features such as tributary alluvial fans. An extensive baseline geomorphological study conducted in 1992 (Pacific Gas and Electric Company 1992) and numerical modeling for the feasibility study of sediment pass-through operations (Pacific Gas and Electric 1995a) indicated that, except for local deposition areas, most of the sediment travels through the stream reach and ultimately enters Lake Oroville.

Rock Creek and Cresta reservoirs cut off the major source of gravel and sediment recruitment to the Poe Project area. The unregulated tributaries, Mill Creek and Flea Valley Creek, which are downstream of Poe Dam, are the only natural sources left to replenish gravel and other sediment that is carried downstream during high flows. Studies were done in the Rock Creek-Cresta portion of the NFFR to evaluate the effects of spills and flushing flows on the NFFR. These studies found that the NFFR in these reaches was dominated by cobbles and boulders, with small-scattered pockets of spawning-sized gravel (Bechtel 1987). The Poe Reach is expected to be similar in bed composition to the Rock Creek and Cresta reaches, but with more spawning-sized gravel because of the radial gate configuration at Poe Dam; nonetheless, levels of spawning-sized gravel are relatively low. The spill/flushing evaluation study also reported that flows of 2,000 cfs occurring for 1-3 days would be sufficient to transport sand-sized sediment through the stream reaches (Bechtel 1987).

In a typical spill flow condition at Poe Dam, a high-elevation radial gate is used first to pass the spills. The crest of the gate is at a higher elevation (1,376 feet MSL, USGS datum) than the reservoir bottom (approximately 1,350 feet MSL, USGS datum). Any accumulated sediments trapped behind the dam would not be flushed past the dam under the lower flow spill condition. When the spill exceeds the capacity of the gate (about 3,800 cfs), the radial flood-gates are operated. The crest of the radial flood-gates is at elevation 1,350 ft near the invert of the dam. Thus, sediments entering Poe Reservoir will pass downstream during high-flow events. Most of the sediments that pass through the dam will continue to Lake Oroville, with some deposition occurring locally in areas controlled by lithologic features. As discussed earlier, field studies have shown that sand-sized sediments would pass through the Poe Reach during flows that exceed 2,000 cfs for 1–3 days. Therefore, when significant sediment flows occur during high-flow events, no significant sand deposition is expected to occur in the stream reach. The more recent studies also revealed that the Poe Reach is sediment supply-limited and that the sediment transport capacity far exceeds the sediment supply (Pacific Gas and Electric Company 1992, 1995a). Observed deposition of sediment and spawning gravel was found to be limited as a result of local lithologic factors.

Overall, the operation of the Poe Project has little impact on the sediment characteristics in the Project area. However, release of sediment from Poe Reservoir to the Poe Reach can occur during unusual events, as evidenced by the release of a significant amount of sediment when the reservoir was drained during maintenance activities on a spillway gate at Poe Dam in February 1988. After the event, most of the sediment remained in the first three pools below the dam. In October of that year, the Licensee initiated a dredging project at the site to remove the deposited sediment. However, an early November storm caused Rock Creek, Cresta, and Poe reservoirs to spill for a 24-hour period. The Licensee followed the storm event with a two-day spill release to further mobilize the fine sediment deposited in the river section and to move the sediment out of the system. A post-release monitoring program was conducted by Bechtel National, Inc. This monitoring demonstrated that the combination of storm event spill and the additional releases successfully moved most of the fine sediment out of the Poe Reach (Bechtel 1990).

The operation of Project facilities does not contribute sediment to the NFFR. Unpaved roadways associated with the Project may act as sources of sediment during periods of high runoff. The Licensee currently maintains the drainage systems on these roadways as part of the routine maintenance program. Soil erosion from spoil piles located throughout the Project may contribute to suspended sediments in the river. These sources are composed of well-consolidated material derived from local sources. The volume of material contributed by these sources to the NFFR is believed to be minimal and associated with periods of high runoff when suspended sediment in the system is naturally elevated. A detailed study was done on the primary Project spoil pile at Bardees Bar. This report is included as Appendix E2-6.

### E2.6.9 Groundwater Impacts

The operation of the Project is expected to have little impact on either the quality or hydrological characteristics of local and regional groundwater regimes. Because the Project only diverts the flow of the NFFR, it is likely that the Project has negligible effects on the volume or on the chemical and physical characteristics of groundwater resources.

The only groundwater-related issue is an ongoing program to recover petroleum product from the soil at the Poe Powerhouse. In 1994, an inventory loss of turbine oil was discovered. The lines from turbine oil storage tanks in the switchyard to the turbine building were pressurized, and a leak was found in the feed line near the point where the line enters the turbine building, approximately 6 ft below grade (Pacific Gas and Electric Company 1995b). In August 1995, a passive product removal system was installed (Pacific Gas and Electric Company 1998b), consisting of a skimmer that floats at the product-water interface. The skimmer uses a series of metal screens to passively remove the free phase product and collect it in an integrated storage container. Since the installation of the recovery system, 22.6 liters of product have been removed from the monitoring well. A second well closer to the NFFR continues to have low levels of detectable petroleum hydrocarbon (Pacific Gas and Electric Company 1998b). The Licensee conducts annual monitoring of these wells and continues to operate and maintain the product recovery system.

### E2.6.10 Existing Protection and Mitigation

The Poe Project diverts water from the NFFR at the Poe Dam into a tunnel and penstock that leads to the Poe Powerhouse. Releases are made at Poe Dam to meet minimum instream flow requirements and spill water that cannot be used at the Poe Powerhouse. At the powerhouse the diverted water passes through a Francis turbine and is released to a short tailrace channel leading to the NFFR. A small quantity of water is taken from the penstock ahead of the turbine for equipment cooling purposes including generator cooling using a heat exchanger, and generator and turbine bearing cooling. Bearing cooling is performed by passing the cooling water through coils placed in lubricating oil tanks and then discharging the water to the tailrace. Licensee is also proposing to include the Big Bend Dam downstream of the Poe Powerhouse as part of the Project, which provides tail-water elevation for the powerhouse and regulation of the flows.

The Licensee currently maintains minimum reservoir water levels and instream flow releases at Project facilities in accordance with applicable water right agreements, permits, license, and court orders. Specifically, minimum flow releases are made to the bypass reach of the NFFR below Poe Reservoir to maintain aquatic habitat.

Petroleum products, chemicals, and other substances associated with the operation and maintenance of Project facilities are carefully handled and stored to minimize the potential for spills or releases to waters in the Project area. The Licensee has developed and implemented a Spill Prevention Control and Countermeasure Plan to address specific actions to be taken in the event of a release of potentially toxic or hazardous substances. The Poe Project is operated in compliance with all applicable federal, state, and local regulations pertaining to the protection of the quality and beneficial uses of waters used by the Project. The Licensee believes that the Poe Project continues to maintain and protect the existing beneficial uses. The Licensee's operating practices that protect water quality are summarized in the Water Quality Protection Plan (Appendix E2-7).

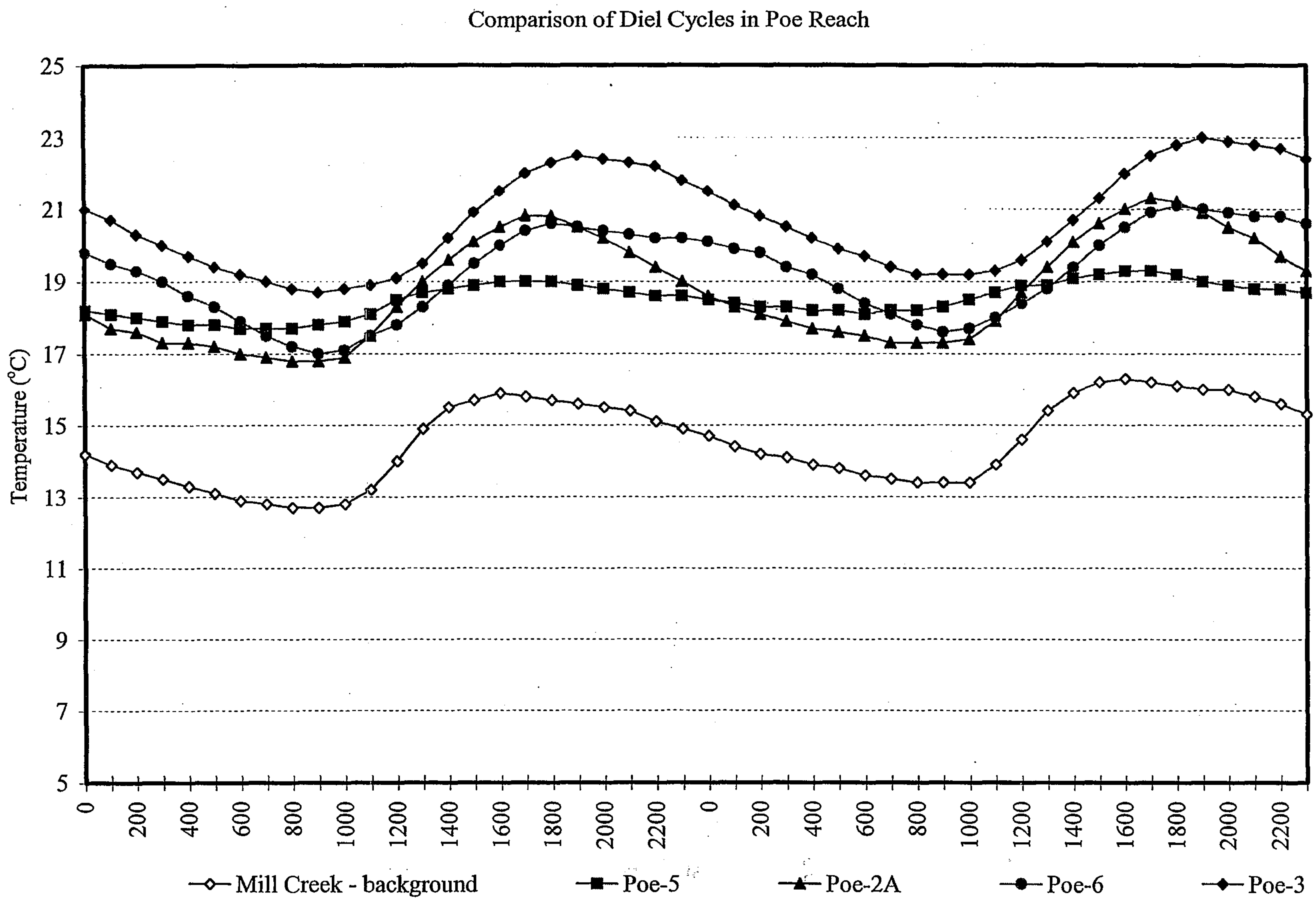
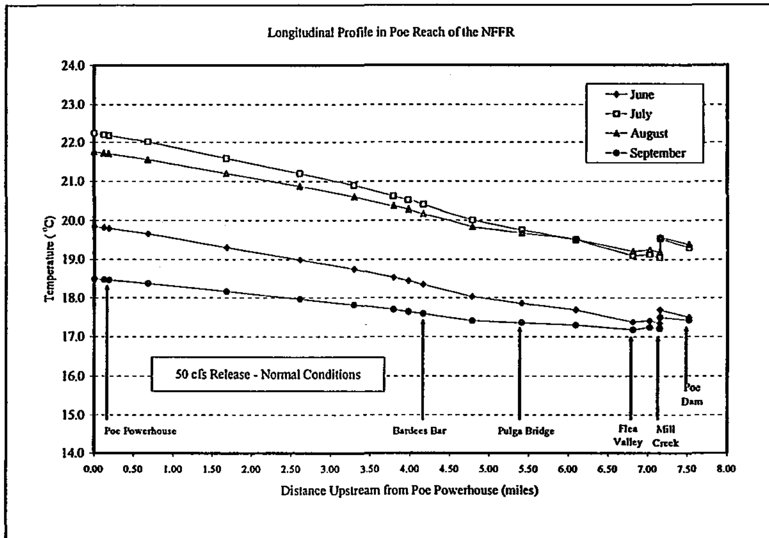
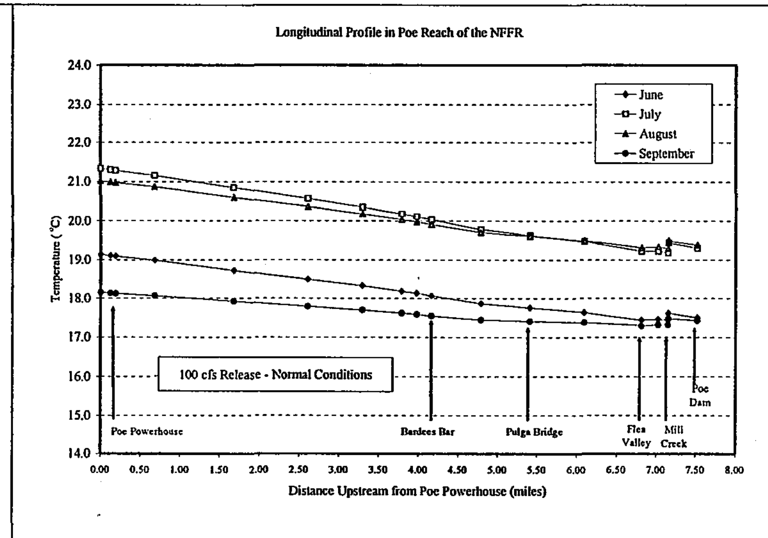


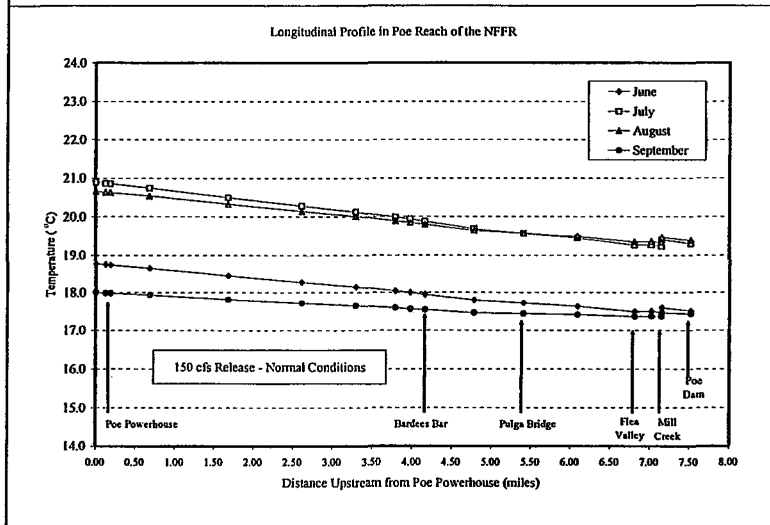

Figure E2.6-1 Comparison of diel temperature cycle from stations in Poe Reach with cycle from Mill Creek.



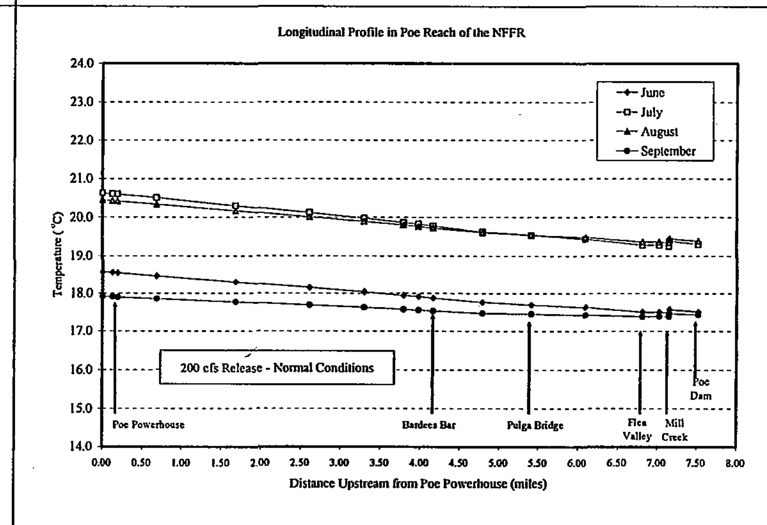

A. 50 cfs Release – Normal Conditions




B. 100 cfs Release – Normal Conditions

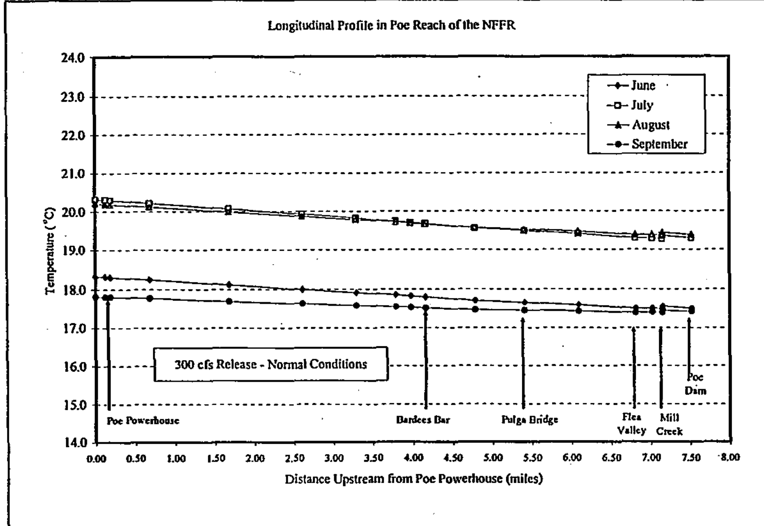



C. 150 cfs Release – Normal Conditions

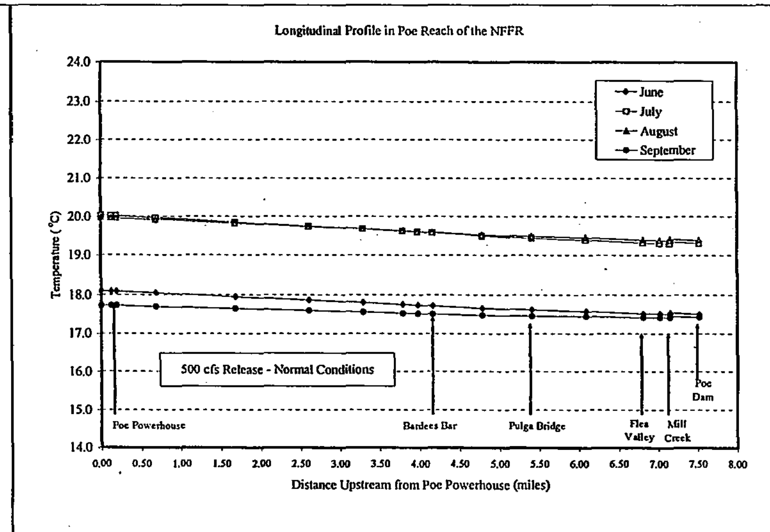



D. 200 cfs Release – Normal Conditions

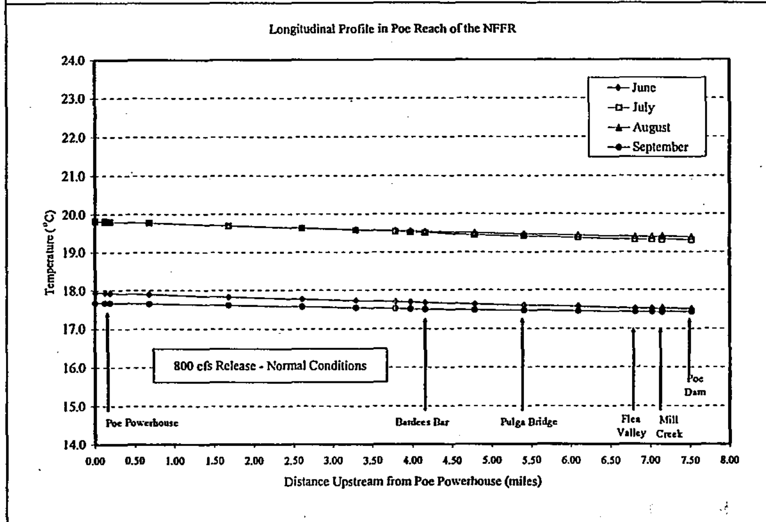
Figure E2.6-2 Longitudinal water temperature profiles for June-September normal condition, 50-1250 cfs release.



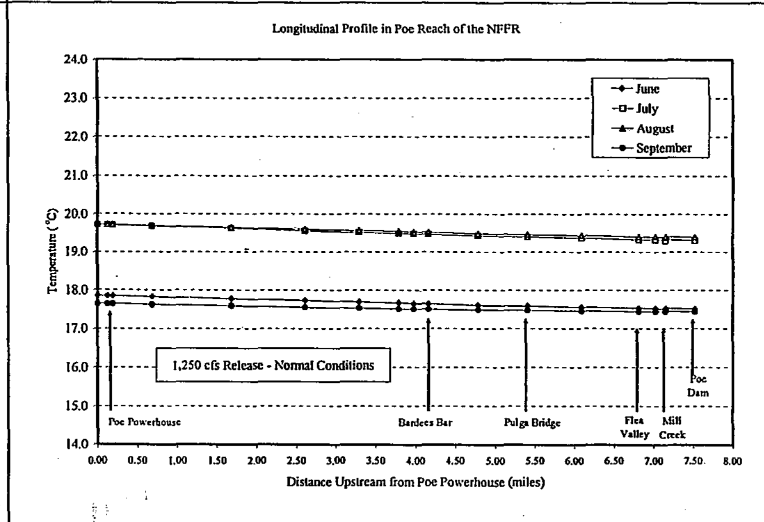

E. 300 cfs Release – Normal Conditions




F. 500 cfs Release – Normal Conditions




G. 800 cfs Release – Normal Conditions




H. 1,250 cfs Release – Normal Conditions

Figure E2.6-2. (Continued)

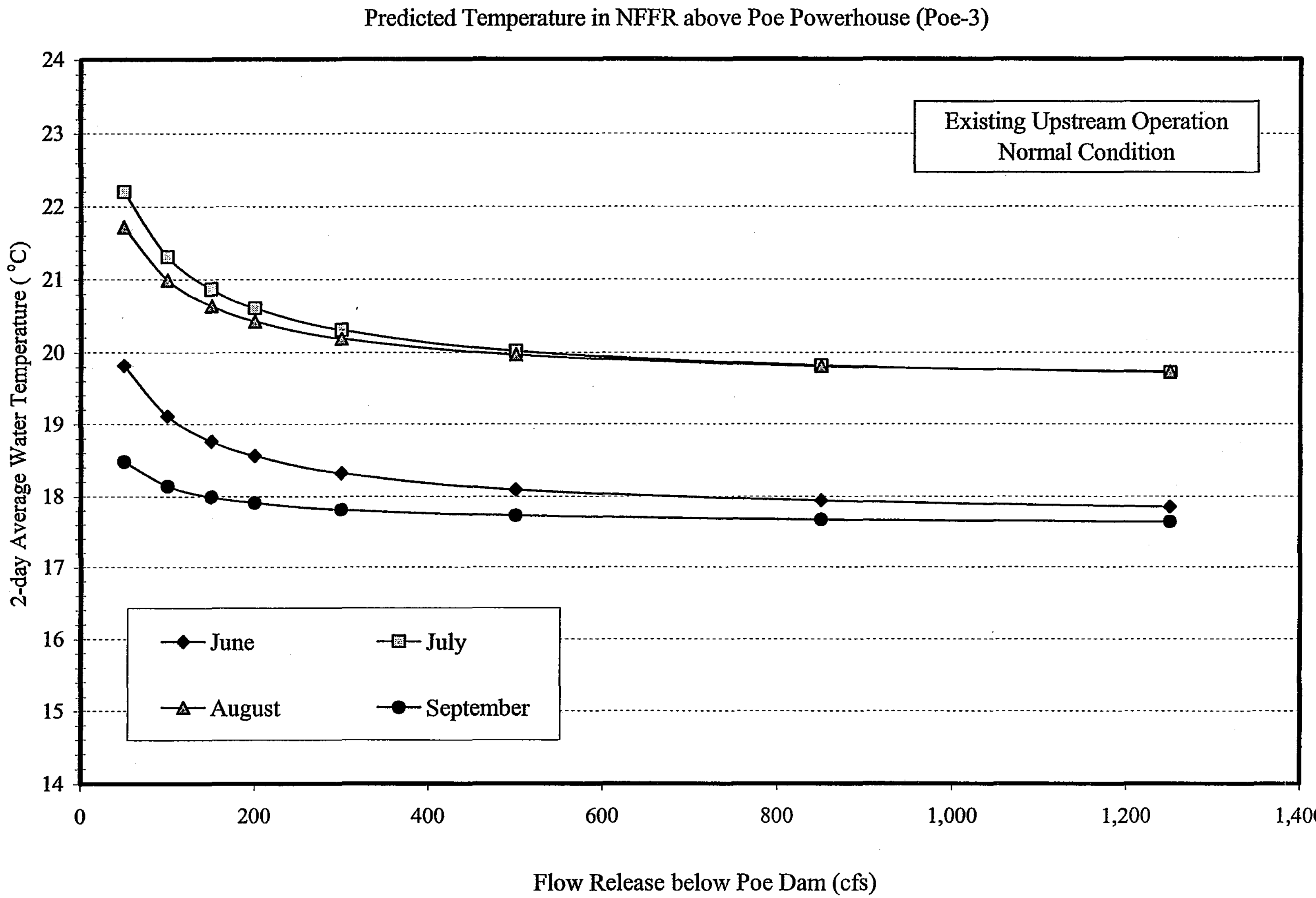



Figure E2.6-3 Relationship of water temperature with flow in the NFFR above Poe Powerhouse under normal conditions.

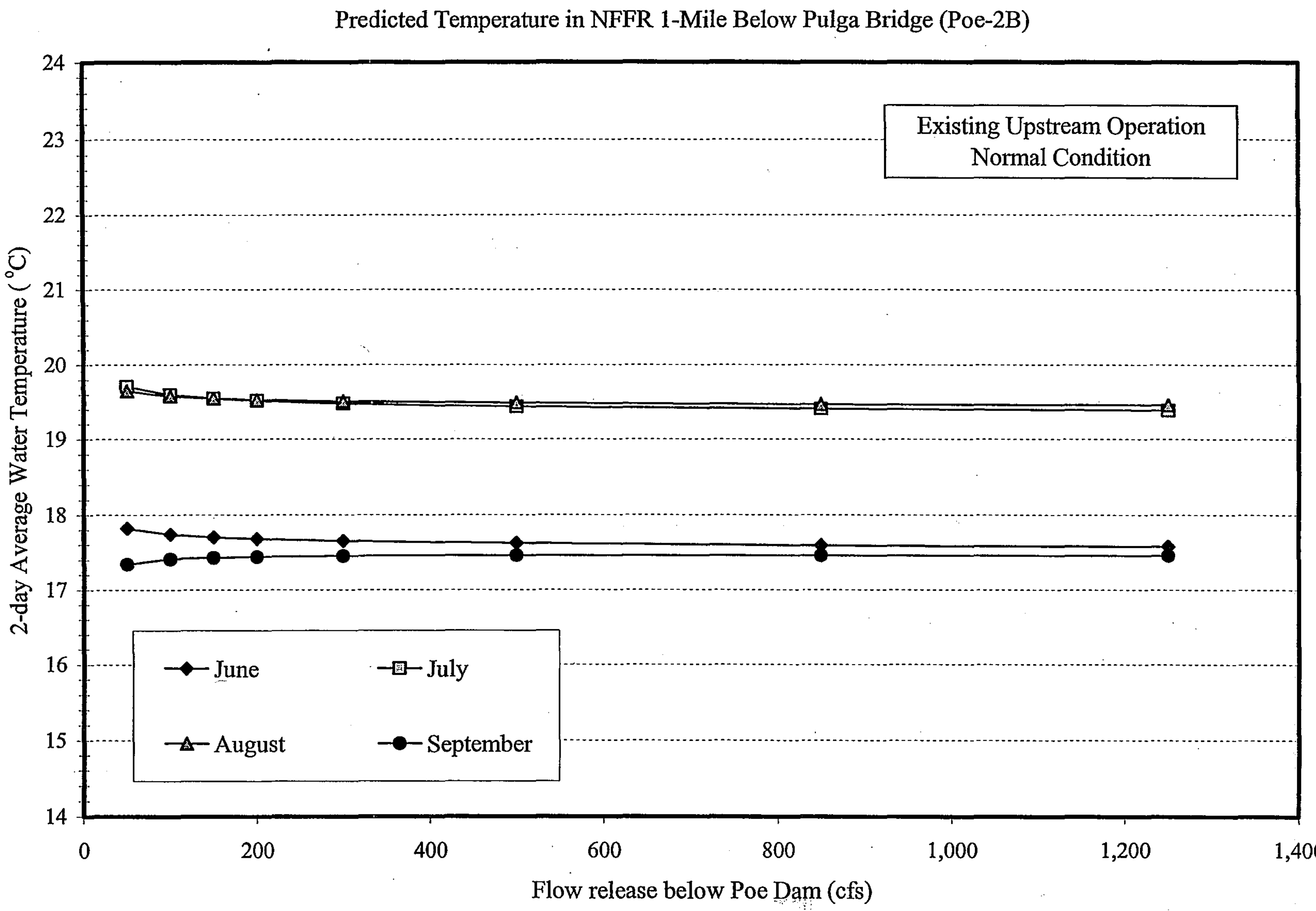



Figure E2.6-4 Relationship of water temperature with flow in the NFFR 1-mile below Pulga Bridge under normal conditions.

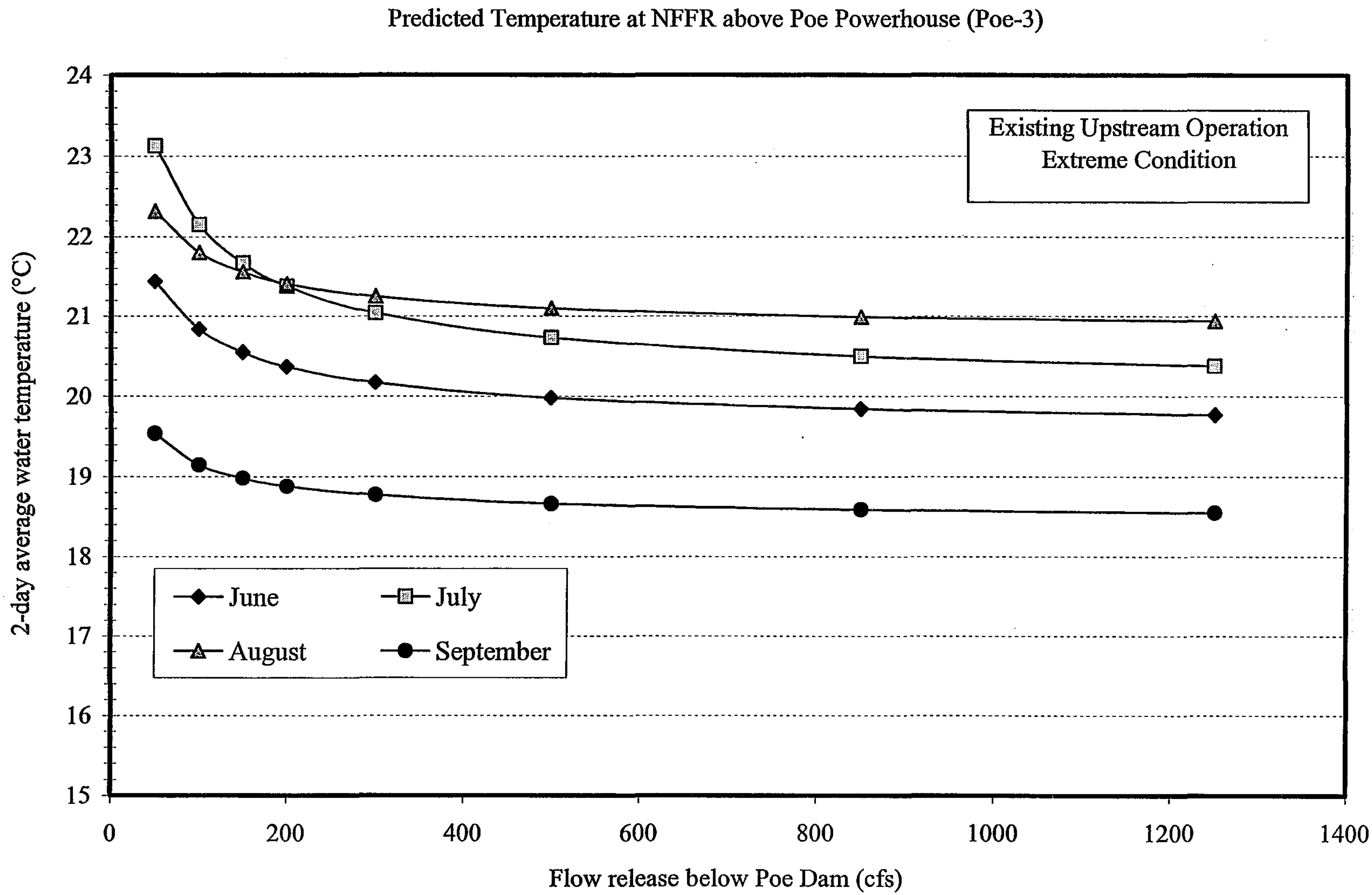



Figure E2.6-5 Relationship between water temperature and flow at NFFR above Poe Powerhouse under extreme conditions.

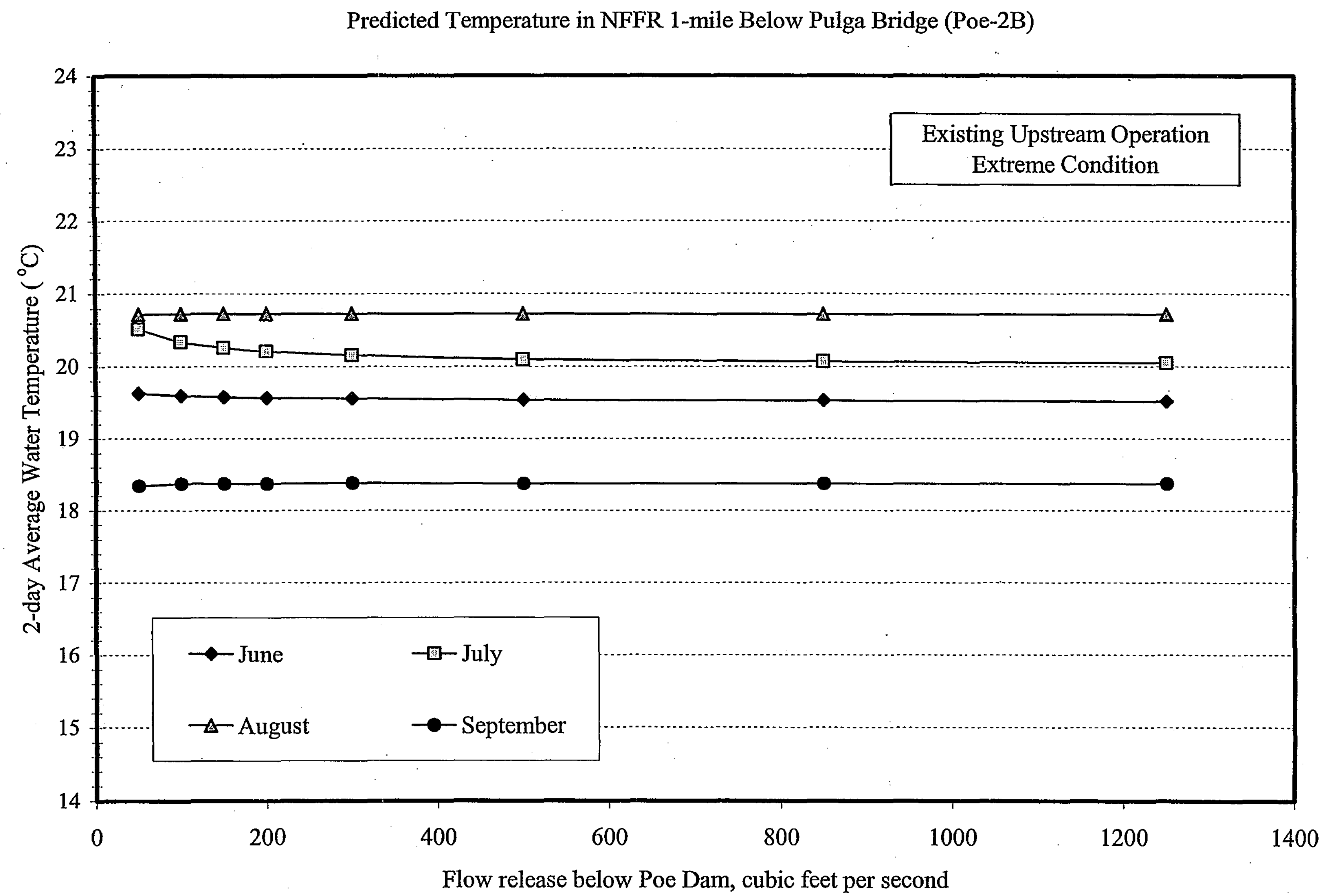



Figure E2.6-6 Relationship between water temperature and flow at NFFR one mile below Pulga Bridge under extreme conditions.

Predicted Temperature in NFFR above Poe Powerhouse (Poe-3)

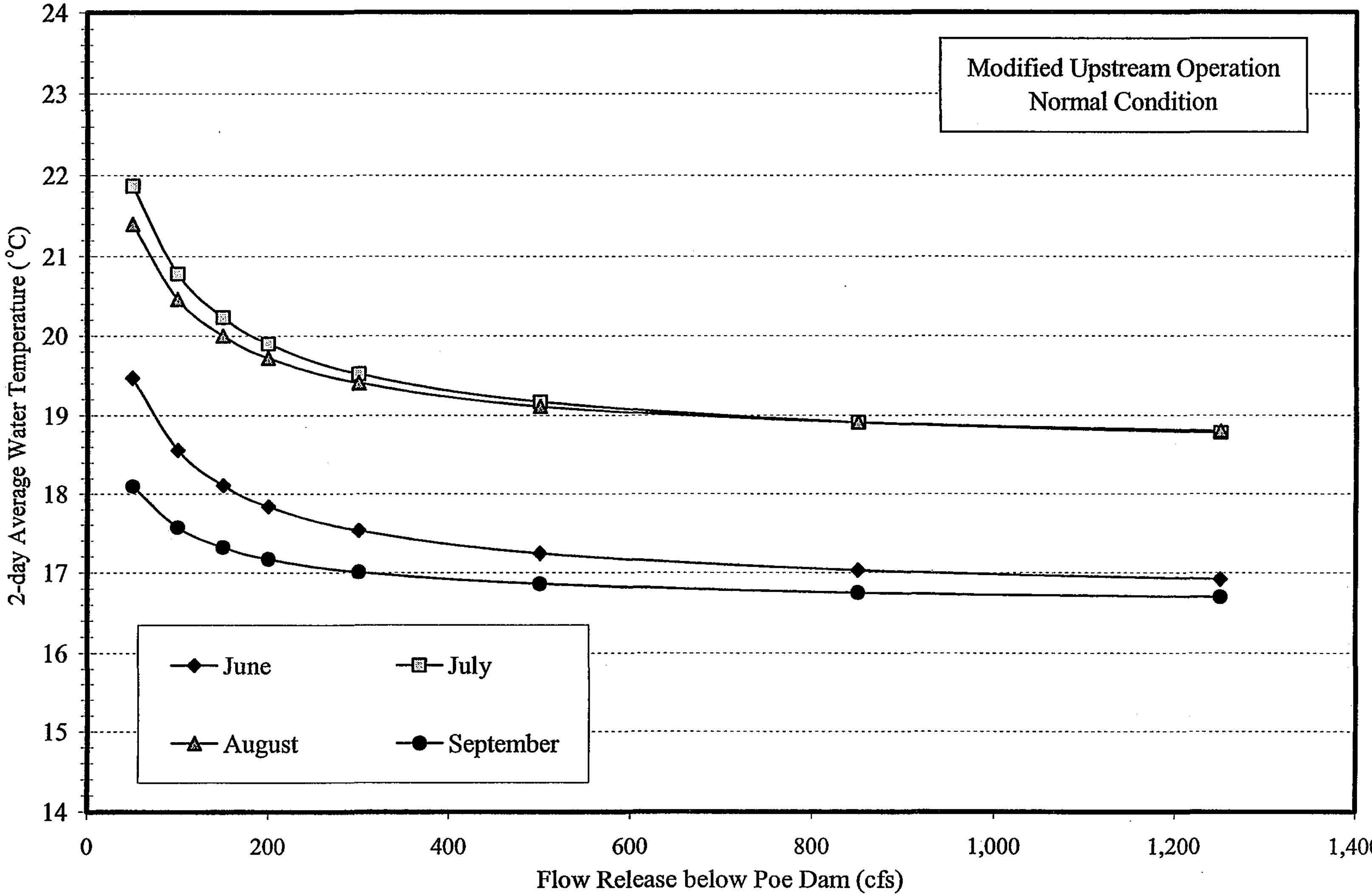



Figure E2.6-7 Relationship between water temperature and flow in NFFR above Poe Powerhouse under normal conditions with upstream operational changes producing a hypothetical 1°C reduction.

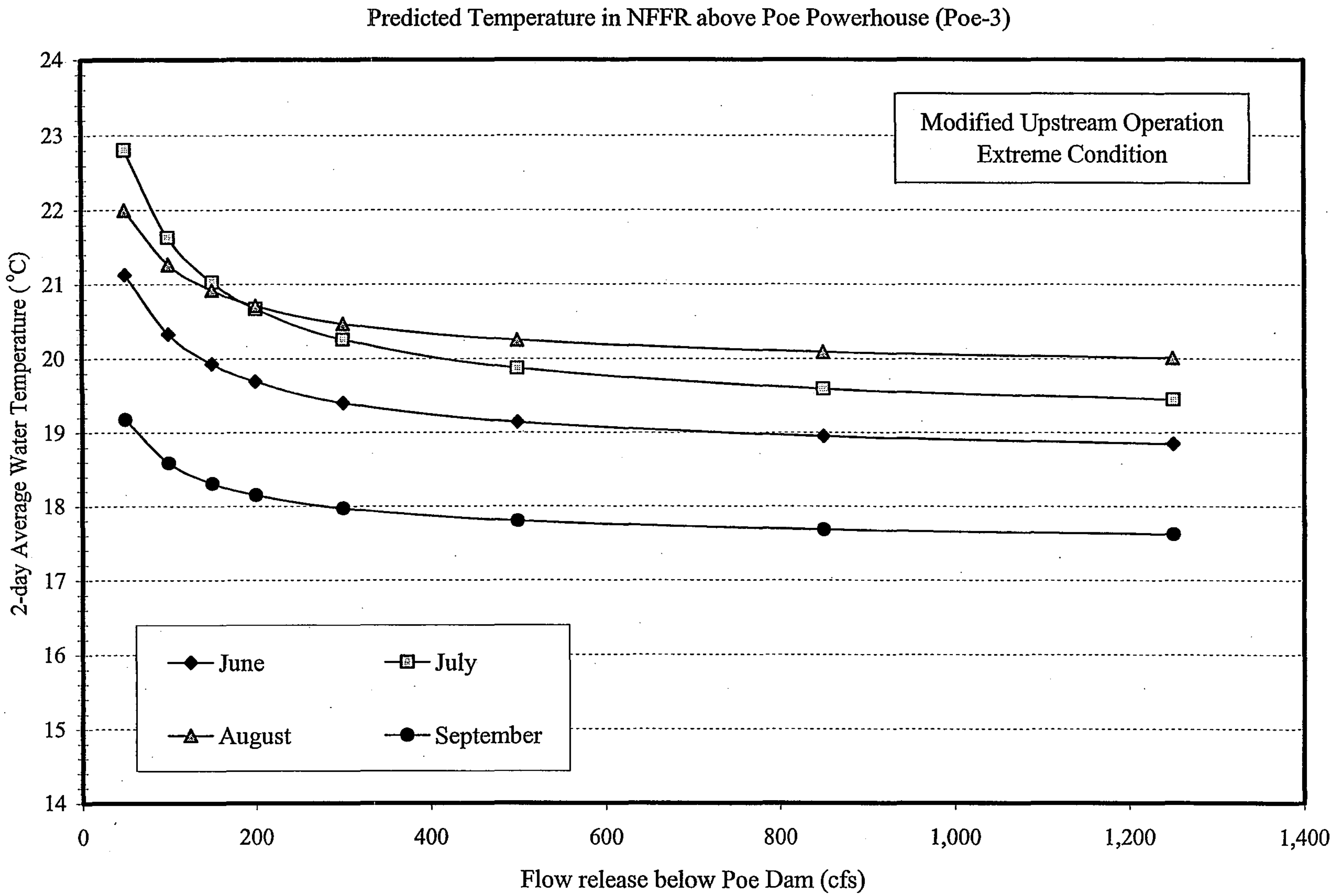



Figure E2.6-8 Relationship between water temperature and flow in NFFR above Poe Powerhouse under extreme conditions with upstream operational changes producing a hypothetical 1°C reduction.

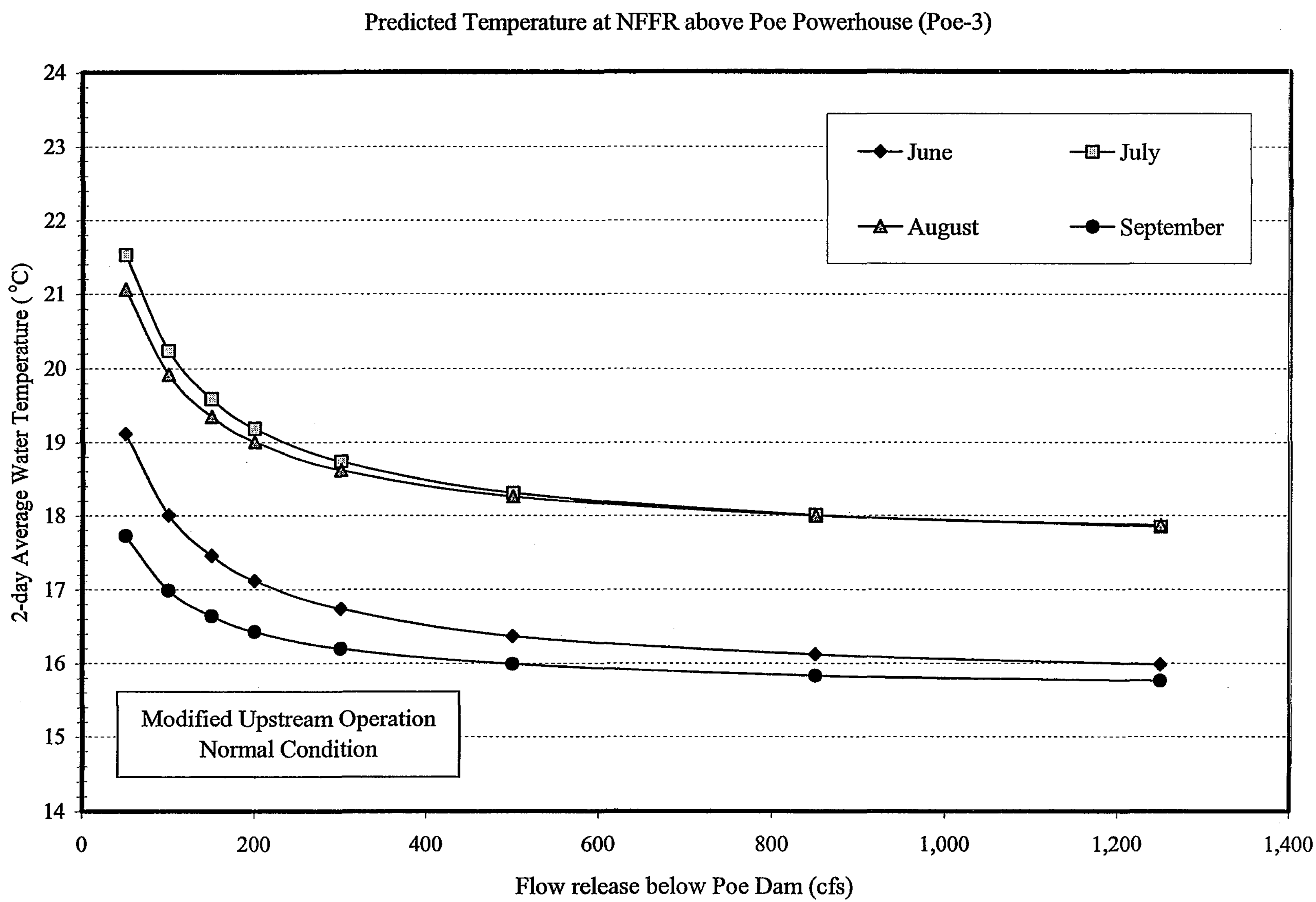



Figure E2.6-9 Relationship of water temperature and flow release at NFFR above Poe Powerhouse under normal conditions with upstream operational changes producing a hypothetical 2°C reduction.

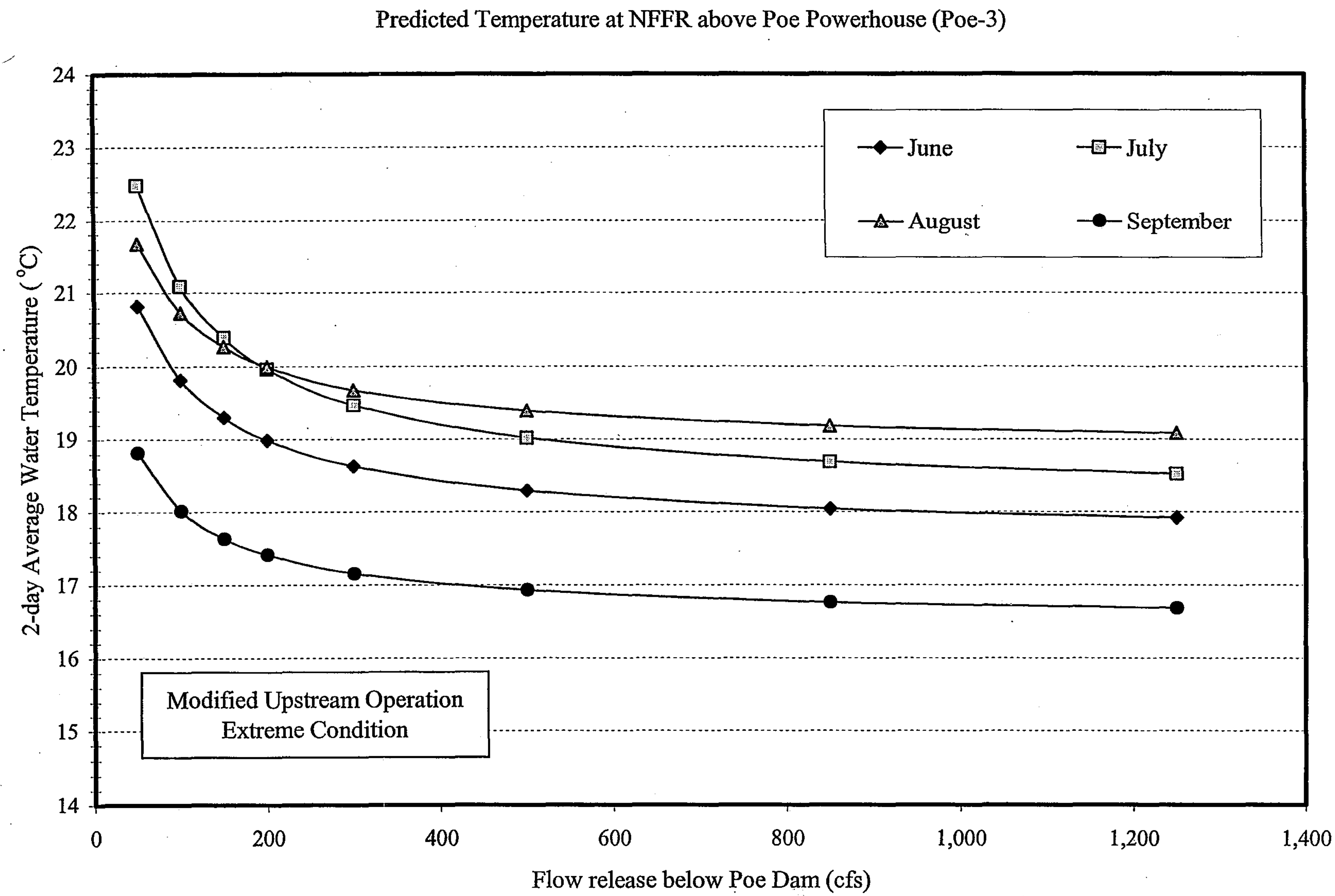



Figure E2.6-10 Relationship of water temperature and flow release at NFFR above Poe Powerhouse under extreme conditions with upstream operational changes producing a hypothetical 2°C reduction.

## E2.7 AGENCY RECOMMENDED MEASURES

The Licensee acknowledges that selected agencies may have provided specific recommendations for resource protection, mitigation, and enhancement measures through their comments on the Draft Application for New License. Recent recommendations are included in the respective agency comment letters addressed in Section E2.10. Historical recommendation letters and Licensee responses were included in the Supplement to the Fist Stage Consultation Document sent in November 2002 (Pacific Gas and Electric Company 2002).

The primary recommendation advanced by the collective body of agencies and NGOs was to have the Licensee initiate a collaborative process through which all interested parties could have input into the development of such measures. As indicated in the following section, the Licensee has agreed to initiate a collaborative effort to address this recommendation.

## E2.8 LICENSEE PROPOSED MEASURES

### E2.8.1 Minimum Streamflows

Licensee proposes to maintain a continuous, year-round, minimum instream flow of 150 cfs in the NFFR, as measured at the Pulga gage (NF-23). This proposed streamflow has been based on the balancing of numerous resource considerations, as discussed in the Project Resource Summary. Recognizing that there are uncertainties related to the actual responses of habitat characteristics (e.g., water temperature) and affected resources (e.g., fish, amphibians, macroinvertebrates, bald eagles, and riparian vegetation) to changes in streamflow, the Licensee proposes to monitor those responses.

### E2.8.2 Recreation and Pulse Flows

Licensee proposes no recreation or pulse flow releases due to the potential for impact on foothill yellow-legged frog (most importantly, egg masses, tadpoles, and metamorphs) and bald eagles (foraging habitat and forage fish species). Under current Project operations, high flow events occur in the Poe Reach of the NFFR on a periodic basis as a result of natural spills at Poe Dam during winter storms and the spring run-off period. These flow events will continue to provide ecological and recreational benefits.

### E2.8.3 Ramping Rates

Licensee proposes to implement the same ramping rate requirements as those recently developed for the upstream Rock Creek and Cresta dams under the Rock Creek-Cresta Relicensing Settlement Agreement to protect aquatic resources. During periods when ramping can be controlled at spill flows less than 3,000 cfs at Poe Dam, the initial ramping rates shown below are proposed. These rates would be followed as close as reasonably practicable given radial gate operating limitations. It should be understood that certain operating situations, such as a unit trip when incoming flows to Poe Reservoir cannot be controlled, would likely cause an exceedance of these rates. Revision to these rates could occur as the result of monitoring Rock Creek-Cresta flow impacts.

- March, April, and May – 250 cfs/hr up-ramp and 150 cfs/hr down-ramp
- June 1 – June 15 – 300 cfs/hr up-ramp and 150 cfs/hr down-ramp
- Remainder of the year – 400 cfs/hr up-ramp and 150 cfs/hr down-ramp

### E2.8.4 Collaborative Process for Developing Protection, Mitigation, and Enhancement Measures

The goal of the collaborative is to reach agreement with all stakeholders willing to fully participate on appropriate protection, mitigation, and enhancement measures for the Project.

## E2.9 ANTICIPATED IMPACT OF CONTINUED OPERATION

The water resources of the NFFR in the Poe Project provide for most beneficial uses identified by the CVRWQCB in the Water Quality Control Plan Report (CVRWQCB 1998), including contact and non-contact recreation, power production, and wildlife use. These waters are also suitable for most domestic uses, although bacteriological quality and some aesthetic constituents (turbidity and iron) may not be satisfactory for untreated domestic use. Temperatures in the lower Poe Reach periodically exceed conditions recommended for cold freshwater habitat, and spawning. Impacts associated with reduced flow and water temperature will be addressed through collaborative efforts with resource agencies and the Licensees water temperature mitigation efforts upstream of the Project.

Implementation of the Licensee's proposed resource mitigation measures will serve to further protect and enhance the beneficial uses of the NFFR in the vicinity of the Poe Project. Under existing operational and normal meteorological conditions in August, the daily average water temperatures in the upper 35% of the Poe Reach are below 20°C under the currently required 50-cfs flow. At the proposed flow increase to 150 cfs, the coldwater habitat would be extended further downstream; resulting in the upper 57% of the Poe Reach with daily average temperatures below the 20°C level (more detailed information is provided in the Licensee's response to the State Water Quality Control Board's letter, Comment 19, in Appendix E5-1).

Project operation will continue to impact the streamflow and temperature regimes present in the Poe Reach of the NFFR. The level of impact will be dependent on the streamflow-related mitigation measures that are ultimately developed as part of the collaborative process. The Licensee has an extensive program to study, protect, and enhance the coldwater habitat of the NFFR, including the Poe Project area. This effort includes commitments to a temperature control structure at the Prattville Intake in Lake Almanor made under the Rock Creek-Cresta Relicensing Settlement Agreement.

**E2.10 AGENCY CONSULTATION**

For a chronology of agency consultation on resource issues, including water use and quality, please refer to Section E3.4 (Agency Consultation) within Report E3 (Fish, Wildlife, and Botanical Resources).

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# Report E3

# FISH, WILDLIFE, AND BOTANICAL RESOURCES

## Section E3.1

## AQUATIC RESOURCES

## E3.1 Aquatic Resources

### E3.1.1 Introduction

The aquatic resources section provides a description of existing aquatic resources in the Project vicinity. The information presented is a combination of historical material and more recent material from studies conducted between 1999 and 2003 in support of the relicensing effort. The additional 1999-2003 studies were completed in consultation with the federal and state resource agencies (i.e., U.S. Forest Service (USFS), U.S. Fish and Wildlife Service (USFWS), NOAA, National Marine Fisheries Service (NMFS), California Department of Fish and Game (CDFG), and State Water Resources Control Board (SWRCB)). As background, a general discussion of historical project operations and fish community structure within the NFFR Feather River (NFFR) precedes the discussion of the current, existing aquatic community.

**Historical Operations and Fish Communities.** The historical assemblage of fish that have utilized the Poe Reach of the North Fork Feather River (NFFR) can be viewed in various phases over time: 1) the pre-development phase prior to construction of the Big Bend Powerhouse (1908) and formation of the first Lake Almanor dam (1913), 2) the intermediate phase between the construction of the Big Bend Project (1908) and the Rock Creek-Cresta Project (1949 and 1950), 3) and the fully-developed phase with the Rock

Creek-Cresta Project and Poe Project in full operation. The Poe Project was completed in 1958, and Lake Oroville was filled in 1963.

During the early period (pre-1909), the NFFR was a major anadromous fish channel with migrations of salmon moving into the upper reaches of the river (California Department of Water Resources 1986 (DWR)). A 10-foot high falls near the town of Seneca acted as a barrier to salmon migration except under high flow conditions (DWR 1986). Some salmon were able to pass the barrier and were reported as far upriver as the Big Meadows area, now inundated by Lake Almanor (DWR 1986, Hazel et al. 1976). Steelhead also were likely users of the NFFR and its tributaries (Adams 1973), but no actual documentation has been found.

Following the expansions of Lake Almanor in 1916 and 1927 and the construction of the Big Bend Dam Project and prior to 1950, the trout fishing in the NFFR, especially in the section below Caribou Powerhouse, became famous as a quality trout fishery. Large opening day crowds were common by the 1930s and 1940s (Rowley 1954). Both rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) contributed to the fishery. After the Feather River Highway opened in 1937, the pressure on the fishery grew as the access to the Feather River canyon and the upper river was improved. During this period, the normal summer flow regime below Caribou was well-suited for a weekend fishery. The flow through the Caribou Powerhouse and into the river on the weekdays was typically 1,000-1,500 cfs, and dropped off to 150-200 cfs on the weekends because of reduced power demand. The calculated minimum summer flows for this section of the NFFR without any development was estimated to be about 225 cfs, and the average about 500 cfs (Pacific Gas and Electric Company 1957). Responding to the Licensee's 1937 request to the FPC for a Preliminary Permit to develop the NFFR between Caribou Powerhouse and the Las Plumas intake, the USFS (1938) described the trout fishery in the Cresta, Pulga, and Poe reaches as occurring principally during the early part of the fishing season, and that during the summer months, high temperatures and slower waters made these areas less desirable than the upstream portions of the river as habitat for trout.

Prior to the construction of the Licensee's Rock Creek and Cresta facilities in 1949 and 1950, the trout and non-game species in the NFFR had attained a balance, with trout predominating (DWR 1986). It is not clear if, during this time period, trout dominated throughout the downstream section of the NFFR now known as the Poe Reach. A balance between trout and non-game species was likely reached in this section also, but with the non-game species dominating. The high flows in the river during weekday periods affected the complete length of river from Caribou to the Big Bend Dam, but higher water temperatures during the weekend lower flow periods may have discouraged the dominance of trout populations in the Poe Reach.

After 1950, the trout populations decreased in the NFFR while the non-game species continued to do well. In 1962, a USFWS post-project sampling of the Rock Creek-Cresta section showed a very low number of trout and a proliferation of Sacramento sucker, hardhead, Sacramento pikeminnow, carp, and sculpin (USFWS 1962). In 1966 and 1977, CDFG made large-scale efforts to control the numbers of non-game fish by treating various sections of the NFFR with a commonly-used fish toxicant, rotenone. Following the treatments, extensive trout planting was conducted in the NFFR. These attempts to reestablish trout dominance were unsuccessful, and, in each case, the fish community reverted back to a community dominated by non-game fish following the treatment (Kubicek 1978, CDFG 1988, and Applied Systems Research (ASR) 1990).

### E3.1.2 Existing Aquatic Habitats

The major water bodies that are either components of the Poe Project's operating system, or are directly affected by Project operations, include Poe Reservoir, the 7.6-mile section of the NFFR between the Poe Reservoir Dam and Poe Powerhouse (Poe Reach), the Poe Powerhouse tailrace, and Big Bend Reservoir (Poe Afterbay) (Figure E3.1-1). Two major tributaries (i.e., Mill Creek and Flea Valley Creek) enter the upper Poe Reach between Poe Dam and the Highway 70 Bridge.

#### E3.1.2.1 Poe Reservoir

Poe Reservoir functions primarily as a regulating forebay for hydroelectric operations. Due to its small size, with a maximum surface area of approximately 53 acres and a gross holding capacity of 1,203 acre-feet, the reservoir has the hydrologic characteristics of an oversized pool and run complex, rather than a storage impoundment. It is long and narrow, with a maximum width of about 400 feet near the dam and 150 feet near the top end, and extends from Poe Dam upriver to the lower end of the Cresta Powerhouse

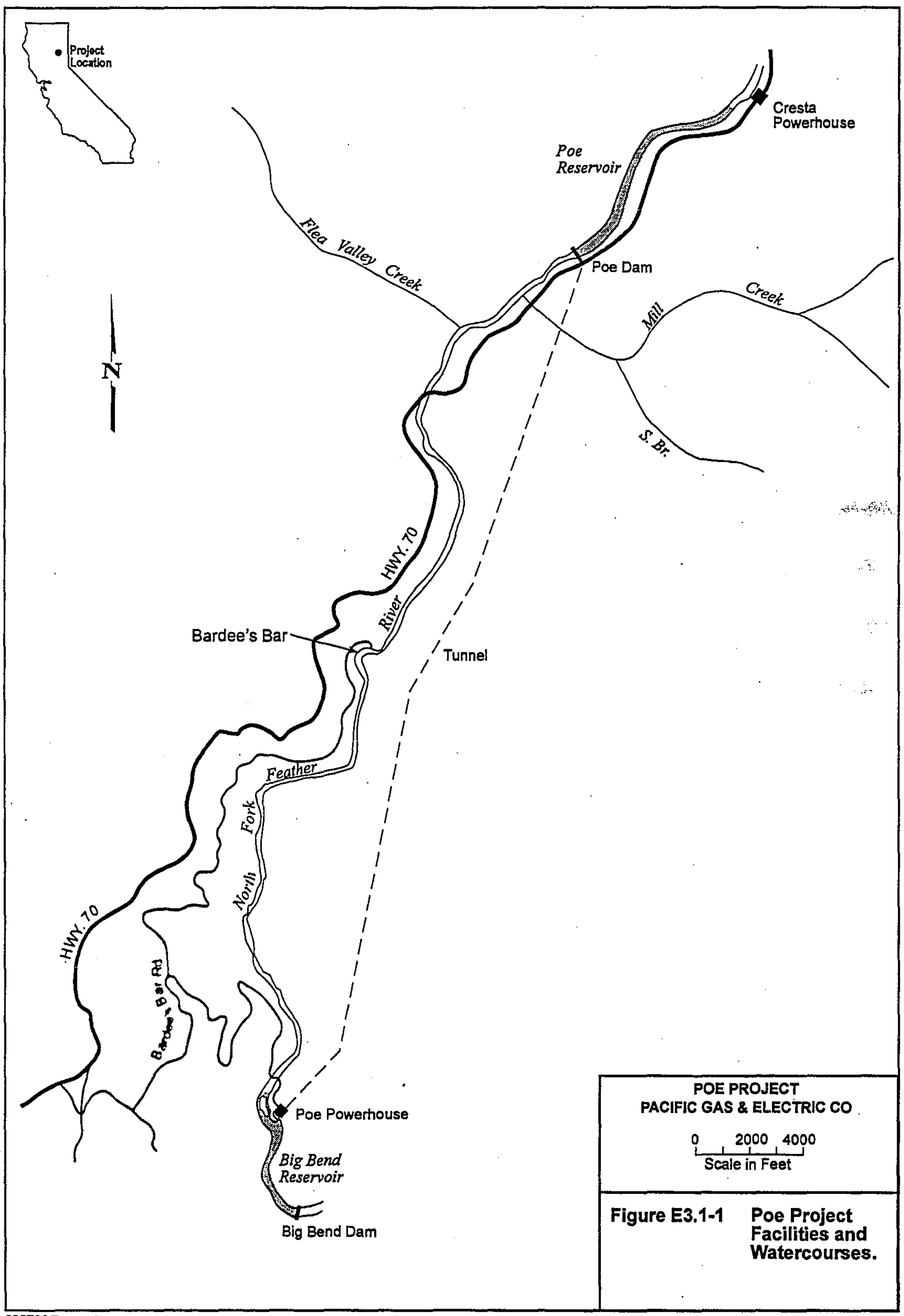



**Figure E3.1-1 Poe Project Facilities and Watercourses.**

980780/Poe water

tailrace, inundating about 1.63 miles (8,600 ft) of the NFFR. The water is well mixed as it enters the reservoir, and exhibits minimal thermal stratification.

Because of its limited capacity and the high volume of inflow, the residency time for the water is short. As a result, changing load demands and water flow through Poe Powerhouse can cause daily fluctuations in reservoir water surface elevation. These fluctuations affect the use of shoreline habitats by the fish residing in the reservoir.

**E3.1.2.2 Poe Reach of the NFFR**

The Poe Reach of the NFFR is 7.6 miles in length and extends from Poe Dam to Poe Powerhouse. The reach starts off as a wide channel, with a slight gradient from Poe Dam to a point immediately downstream from the mouth of Flea Valley Creek, a distance of about 5,350 feet (1.01 miles). At this point, the river enters a narrower, steeper canyon section dominated by bedrock canyon walls and large boulders; this section continues for an estimated 13,360 feet (2.53 miles) to Bardee's Bar. At Bardee's Bar, the river returns to a wider, flat channel with long pools, runs, and pocket water areas separated by short sections of riffles and/or cascades; this lower section extends from Bardee's Bar to Poe Powerhouse (an approximate distance of 21,560 feet or 4.08 miles). All three sections of the reach are dominated by large pools, which tend to be shorter and deeper in the middle canyon section, and longer and wider in the upper and lower sections.

Under the terms of the current FERC License, the minimum flow release from Poe Dam into the NFFR has two components 1) a minimum release of 25 cfs from the dam, and 2) an additional release necessary to maintain a minimum of 50 cfs measured at the Pulga gauging station. The Pulga gage is located 1.6 miles downstream from Poe Dam and from the confluences with Mill Creek and Flea Valley Creek. However, the flow levels during the two-year study period for the relicensing were higher than the required minimum due to leakage from the seals on the dam's radial gates. During the June through August periods in 1999 and 2000, flows at Pulga averaged 99 and 106 cfs, respectively. The leakage was estimated to be 41 cfs in 1999 and 48 cfs in 2000.

**Habitat Surveys in the Poe Reach (1992 and 1999).** Aquatic habitat surveys were conducted in the Poe Reach, first as part of the 1992 baseline sampling program for a proposed sediment management program known as the Sediment Pass-Through (SPT) Project (Li and ENPLAN 1994), and again in October 1999 as an element of the instream flow study conducted in September 2000. The habitat surveys were completed by two-person crews walking the NFFR from Big Bend Dam to the Poe Dam. The crews categorized the habitats into five macrohabitat types that included: 1) pools, 2) run and glide complexes, 3) cascades and high gradient riffles, 4) low gradient riffles, and 5) pocket water areas. Figure E3.1-2 shows the percentages of the habitat types found in the 1999 survey within the whole reach and separately for the three river sections described above. The 1999 mapping effort was used as the basis for the study site and transect selection for the instream flow evaluation.

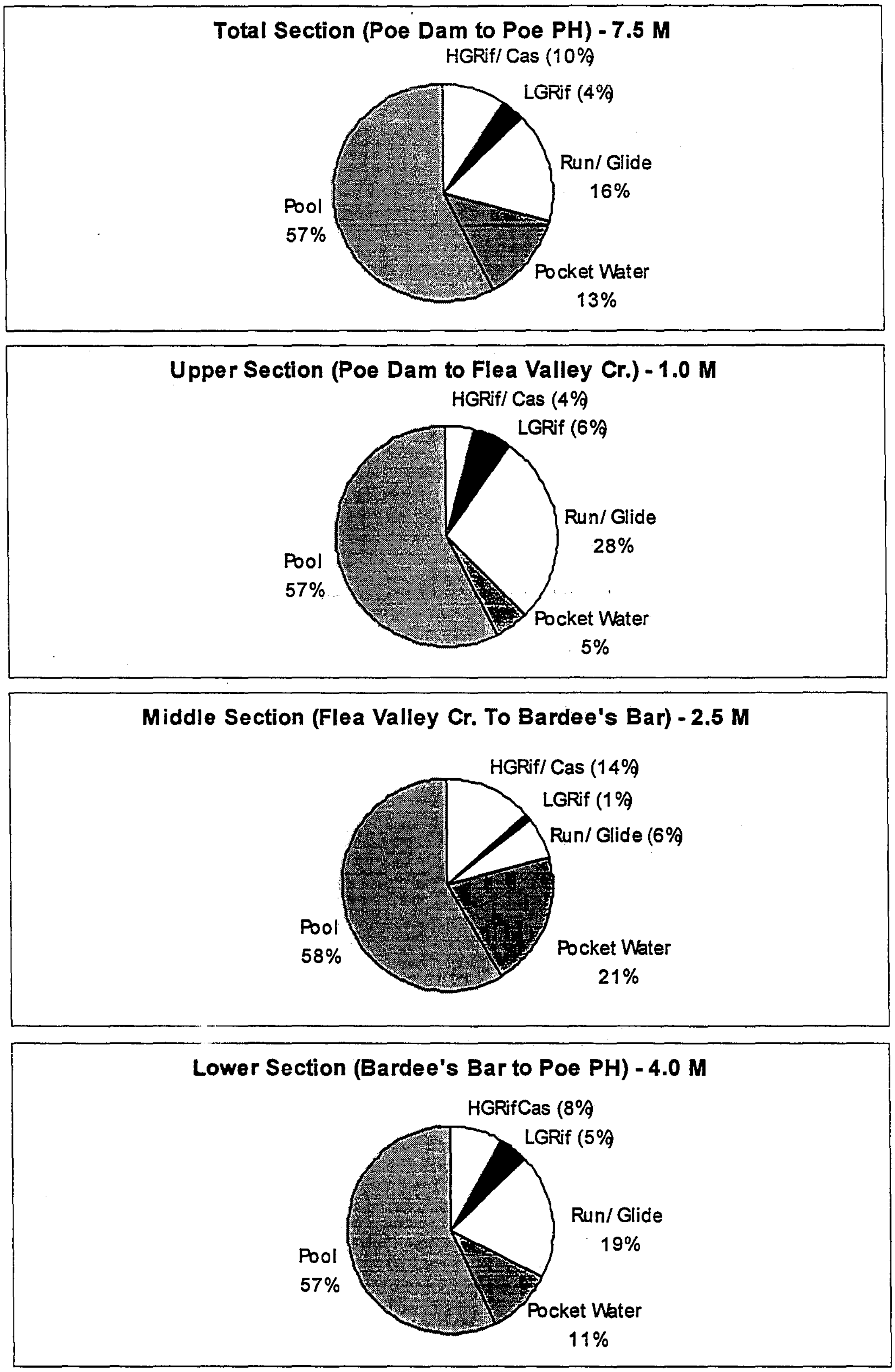



**Figure E3.1-2 Poe Reach Habitat Mapping Results – 1999.**

### E3.1.2.3 Tributaries

Two primary tributaries, Mill Creek and Flea Valley Creek, enter the Poe Reach between Poe Dam and the Highway 70 Bridge (Figure E3.1-1). The relative inflow from these tributaries into the NFFR can be significant during the late spring and early summer, especially when the main river is under control (i.e., at the minimum release level from Poe Dam).

By late summer and fall in normal years, the flow in Mill Creek can drop as low as 3 cfs, while the flow in Flea Valley can fall to 0.5 cfs. Flea Valley is known as a heavily used spawning tributary for NFFR rainbow trout. Adult rainbows move up into Flea Valley Creek from the main river during the early spring period. Mill Creek also provides some spawning area for main river rainbows, but movement past the mouth and through the Highway 70 road culvert is difficult, or nearly impossible, under many flow conditions. Natural falls above the Highway 70 culvert further limits access for adult NFFR rainbows into the lower end of Mill Creek, even if they do pass successfully through the culvert.

### E3.1.2.4 Big Bend Reservoir (Poe Afterbay)

Big Bend Reservoir is located immediately below Poe Powerhouse. It is formed by Big Bend Dam, which backs up water a distance of about 4,500 ft into the powerhouse tailrace. This reservoir is shaped as a continuous long run, which tracks the original river channel into the top end of the horseshoe bend in the main river known as Big Bend. The reservoir is between 200 and 250 feet across for its whole length. It is very shallow and has minimal water volume. The elevation of the reservoir fluctuates directly with the operation of the two units at the powerhouse (i.e., reaching its highest elevation with both units at full load). The change in elevation can be rapid, depending on the speed of the operation change (i.e., flow through the powerhouse).

When Lake Oroville is full, the lake extends upriver to the Big Bend Dam site. As the water level in Lake Oroville drops, typically during the summer and early fall, more riverine habitat is exposed as the NFFR reclaims its natural channel. Under these low pool conditions in Lake Oroville, flow fluctuations due to changing load demand and water flow through Poe Powerhouse are minimized in the NFFR below Big Bend Dam by the buffering effect of Big Bend Reservoir. Additional information on Big Bend Dam is provided in Sections E3.1.3.2.3 and E3.1.9.9.

### E3.1.3 Fish Community, Distribution, and Abundance

Prior to the Licensee conducting fish population surveys in the Project area for relicensing purposes in 1999 and 2000, information on the fish community, distribution, and abundance was compiled from the following sources: resource agency files, past studies conducted in the NFFR watershed above the Poe Project area (i.e., Rock Creek-Cresta Project and Upper NFFR Project), a habitat characterization survey in the Poe Reach in 1992, and fish population surveys in the Poe Reach (i.e., snorkeling) and in Poe Reservoir (i.e., boat electrofishing) also in 1992. The 1999 / 2000 fisheries studies included: more extensive fish population surveys in the Poe Reach and tributary streams (i.e., multiple snorkeling surveys, electrofishing/gill netting surveys in large pools, and tributary electrofishing and spawning surveys); boat electrofishing surveys in Poe

Reservoir (i.e., a repeat of the 1992 survey) and in Big Bend Reservoir; an instream flow study in the Poe Reach (including added habitat mapping, hydraulic modeling, and species suitability curve development); a year of monthly powerhouse tailrace netting; two years of baseline macroinvertebrate surveys; and a limited fishing census. Follow-up aquatic survey efforts or assessments have also been conducted between 2001 and 2003 in support of the 1999 / 2000 surveys and in response to regulatory agency comments on the Supplement to First Stage Consultation Package Supplement (submitted November 2003). The added efforts include macroinvertebrate CSBP surveys (2001 and 2002), surveys for adult spawning rainbow trout within the main river reach (2003), an added survey of salmonid spawning gravels within the main river reach (2003), an expanded assessment of the 'pros and cons' of removing Big Bend Dam (2003), collection of fish specimens from Poe Reservoir and Big Bend Dam reservoir for PCB and mercury tissue analysis (2003), an assessment of existing and potential fish diseases within the Project waters (2003), a large woody debris (LWD) evaluation (2003), and a feasibility assessment of a 'trap and haul' program for Chinook salmon and steelhead proposed by the National Marine Services (2003).

The current distribution and abundance of fish species in the Poe Reach are determined by four major factors: 1) the magnitude and distribution of water temperature during the summer and fall periods, which ultimately impacts the suitability of various sections of the Poe Reach to support trout populations, 2) yearly production and movement of fish within the river reach, 3) downstream movement of fish into Poe Reservoir and the NFFR below, and 4) the upstream movement of fish from Big Bend Reservoir into the lower section of the Poe Reach. Movement of fish into and out of Project waters and within the river reach is a function of upstream spawning migrations, natural dispersal mechanisms (upstream and downstream), and involuntary downstream movement due to high winter or spring flood flows. In addition, some fish from Lake Oroville are able to move through the permanent slot in the Big Bend Dam and into Big Bend Reservoir and the Poe Reach when the lake level is high.

The level of impact that each one of these factors may have on the fish populations in various locations in the Project area can vary each year, and is, to a high degree, dependent on the magnitude and timing of the annual winter and spring runoff. In addition, the impacts of the water-year type on fish populations can be felt for multiple years, as favorable or adverse conditions in one year can affect year class strength in subsequent years (Seegrist & Gard 1972, Elwood & Waters 1969). For example, a series of consecutive dry or wet years can alter the structure of the fish population within the Poe Reach, particularly in the lower sections of the reach where spill flows are highest and tributary spawning is limited.

#### E3.1.3.1 General Fish Community

The fish community associated with Project area water bodies is comprised of a combination of native and introduced species. The common native species that have been found include rainbow trout (*Oncorhynchus mykiss*), hardhead (*Mylopharadon conocephalus*), Sacramento pikeminnow (*Ptychocheilus grandis*), Sacramento sucker (*Catostomas occidentalis*), and riffle sculpin (*Cottus gulosus*) (Li and ENPLAN 1994).

The introduced species are smallmouth bass (*Micropterus dolomieui*), brown bullhead (*Ictalurus nebulosus*), largemouth bass (*Micropterus salmoides*), spotted bass (*Micropterus punctulatus*), carp (*Cyprinus carpio*), and brown trout (*Salmo trutta*).

Table E3.1-1 contains all of the species of fish known or likely to occur in the Poe Project vicinity. Some of the species listed are primarily associated with the upper NFFR drainage, including Lake Almanor, Butt Valley Reservoir, and Bucks Lake, and only occasionally might be found in Poe Reservoir or in the Poe Reach of the NFFR.

## Table E3.1-1

## Fish Species Present in the Poe Project Vicinity

| | |
|---|---|
| **Poe Project Area (Poe Reservoir, the Poe River Reach, and the Big Bend Dam Reservoir)** | |
| | |
| Native Species | |
| Rainbow trout | *Oncorhynchus mykiss* |
| Sacramento sucker | *Catostomus occidentalis* |
| Sacramento pikeminnow | *Ptychocheilus grandis* |
| Hardhead | *Mylopharadon conocephalus* |
| Riffle sculpin | *Cottus gulosus* |
| | |
| Introduced Species | |
| Smallmouth bass | *Micropterus dolomieui* |
| Brown bullhead | *Ictalurus nebulosus* |
| Brown trout | *Salmo trutta* |
| Largemouth bass | *Micropterus salmoides* |
| Spotted bass | *Micropterus punctulatus* |
| Carp | *Cyprinus carpio* |
| | |
| **Upper Drainage (Lake Almanor, Butt Valley Reservoir, and Bucks Lake)** | |
| | |
| Rainbow trout | *Oncorhynchus mykiss* |
| Chinook salmon (Lake Almanor) | *Oncorhynchus tshawytscha* |
| Brown trout | *Salmo trutta* |
| Lake Trout (Bucks Lake) | *Salvelinus namaycush* |
| Brook Trout (Bucks Lake) | *Salvelinus fontinalis* |
| Kokanee salmon (Bucks Lake) | *Oncorhynchus nerka* |
| Sacramento sucker | *Catostomus occidentalis* |
| Tahoe sucker (Lake Almanor) | *Catostomus tahoeensis* |
| Sacramento pikeminnow | *Ptychocheilus grandis* |
| Hardhead | *Mylopharadon conocephalus* |
| Tui Chub | *Gila bilcolor* |
| Carp | *Cyprinus carpio* |
| Lahonton redside (Bucks Lake) | *Richardsonious egregius* |
| Sacramento perch | *Archoplites interruptus* |
| Smallmouth bass | *Micropterus dolomieui* |
| Largemouth bass | *Micropterus salmoides* |
| Bluegill | *Lepomis macrochirus* |
| Brown bullhead | *Ictalurus nebulosus* |
| Channel catfish | *Ictalurus punctatus* |
| Wakasagi | *Hypomesus nipponensis* |
| Riffle sculpin | *Cottus gulosus* |

### E3.1.3.2 Fish Population Surveys

#### E3.1.3.2.1 Poe Reservoir Fish Population Surveys

**Electrofishing/Gill Netting Surveys - 1992 and 2000.** Poe Reservoir was sampled with a Smith-Root electrofishing boat in November 1992 and September 2000. The 1992 fish population sampling (Li and ENPLAN 1994) was conducted to support the Licensee's proposed SPT project for the Rock Creek-Cresta Project. The purpose of the sampling was to provide background species composition and relative abundance data to help assess the impacts of the SPT project. The 2000 effort was an element of the relicensing studies, and was conducted to supplement the data collected in 1992. Gill netting was also done along with the electrofishing as part of the relicensing studies. These nets were of variable mesh sizes (i.e., 1/2" to 2", and 2" to 4"), and were set in the middle portion of the reservoir.

Three sections of the reservoir were electrofished during both the 1992 and 2000 efforts, including a lower section near the dam, a middle section, and an upper section near the top end of the reservoir. Typically, boat electrofishing in steep-sided reservoirs like Poe is only effective in shallow areas along the shoreline or where the inflow enters the top end of the reservoir. In many cases, these upper areas include a section of flowing water over moderately-deep gravel bars where suckers and trout are often concentrated. As expected, this pattern was seen in the Poe results in 1992, but the Cresta Powerhouse tailrace flows, which provide the primary inflow to the reservoir, were too swift and deep during the 2000 effort to sample safely in the upper-most portion of the tailrace.

The results of the 1992 and 2000 electrofishing efforts are shown in Table E3.1-2 and in Figure E3.1-3. The same species and relative abundances were found during both years in the lower and middle sections of the reservoir, where the most numerous species were hardhead, smallmouth bass, Sacramento pikeminnow, and Sacramento sucker. Riffle sculpin were collected in 2000, along with the recording of several non-netted fish at some of the sites (i.e., unknown cyprinids). A single largemouth bass was found in 1992, but no largemouth were collected in 2000. The two rainbow trout collected in 1992 were found at the upper end in the Cresta Powerhouse tailrace, while the two rainbow trout collected in 2000 were found near a small tributary inflow from Camp Creek located in the lower portion of the reservoir.

**Gill Netting Survey Results - 1981-84 and 2000.**

During the 2000 effort, the gill nets were checked on a periodic basis during the electrofishing effort and were purposely not set over night to avoid net-caused mortalities. Unfortunately, over the series of sets, no fish were collected in the gill nets.

Poe Reservoir was previously sampled with gill nets by CDFG in 1981-84, along with upstream migrant trapping above the Cresta Powerhouse. This more extensive sampling was associated with CDFG's six-year Fisheries Management Study for the Rock Creek-Cresta Project (CDFG 1988). The Poe Reservoir gill netting was conducted during three years (1982, 1983, and 1984), and reservoir inlet trapping was conducted in 1981 and 1982. The reservoir inlet trap was placed 0.8 km above Cresta Powerhouse, and was

**Table E3.1-2**

**Summary of Boat Electrofishing Results in Poe Reservoir - 1992 (Li and ENPLAN 1994) and 2000**

| Reservoir Section | Rainbow Trout | Hardhead | Sacramento Pikeminnow | Sacramento Sucker | Smallmouth Bass | Riffle Sculpin | Largemouth Bass | Cyprinids (Unknown) | Total |
|---|---|---|---|---|---|---|---|---|---|
| **1992** | | | | | | | | | |
| Lower | 0 | 35 | 5 | 2 | 16 | 0 | 1 | | 59 |
| Middle | 0 | 9 | 4 | 3 | 9 | 0 | 0 | | 25 |
| Upper | 2 | 1 | 0 | 28 | 1 | 0 | 0 | | 30 |
| **Total** | **2** | **45** | **9** | **33** | **26** | **0** | **1** | | **116** |
| **2000** | | | | | | | | | |
| Lower | 2 | 26 | 1 | 1 | 6 | 1 (8) | 0 | (25) | 37 (33) |
| Middle | 0 | 5 | 3 | 1 | 4 | 1 (2) | 0 | (5) | 14 (7) |
| Upper | 0 | 5 | 1 | 5 | 5 | (2) | 0 | (8) | 16 (10) |
| **Total** | **2** | **36** | **5** | **7** | **15** | **2 (12)** | **0** | **(38)** | **67 (50)** |

[redacted]

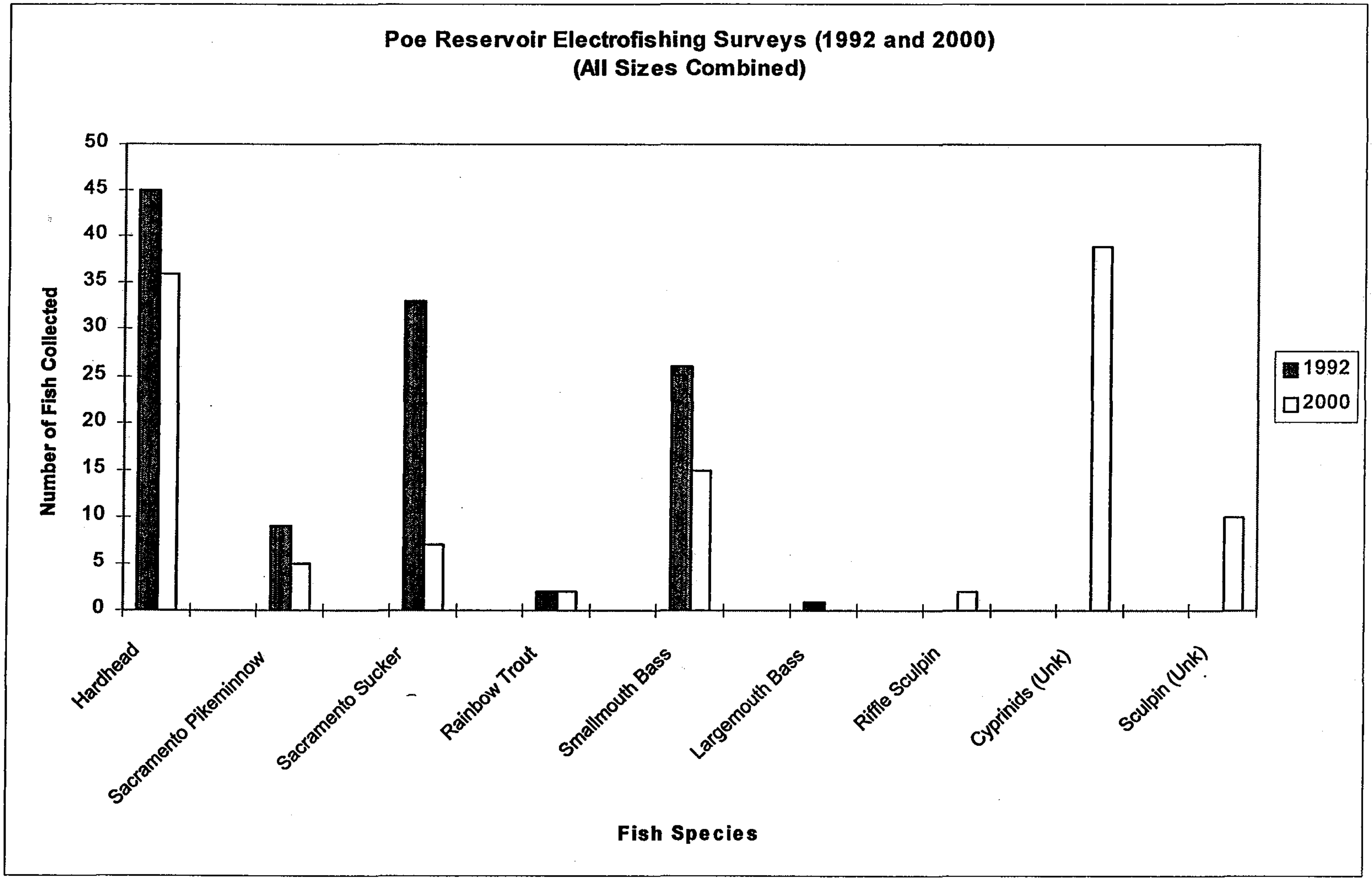



**Figure E3.1-3 Poe Reservoir Electrofishing Surveys - 1992 and 2000**

positioned to capture fish moving upstream out of Poe Reservoir into the Cresta Reach of the NFFR.

Brown trout, rainbow trout (wild and hatchery), Sacramento sucker, Sacramento pikeminnow, hardhead, smallmouth bass, and brown bullhead were all found during the gill netting efforts in Poe Reservoir. The majority of the fish were adult-sized. Most of these species were also collected during electrofishing surveys in 1992 (Li and ENPLAN 1994) and in 2000. However, higher relative numbers of rainbow trout were found during the 1981-83 sampling than in 1992 or in 2000.

The reservoir inlet trap was fished from late April to October 1981, and from late June to early September in 1982. A total of 338 fish was collected during both years combined, with the most upstream movement in June and July (Table E3.1-3). Suckers were the most common fish collected in the trap, followed by rainbow trout (wild and hatchery), pikeminnow, hardhead, smallmouth bass, and finally brown trout.

**Table E3.1-3**

**Poe Reservoir Inlet Trap Results (1981-82) (CDFG 1988)**

| | Brown Trout | Rainbow Trout (Wild) | Rainbow Trout (Hatchery) | Sacramento Sucker | Sacramento Pikeminnow | Hardhead | Smallmouth Bass | Total |
|---|---|---|---|---|---|---|---|---|
| 1981 | 6 | 64 | 22 | 94 | 23 | 21 | 12 | 242 |
| 1982 | 4 | 9 | 23 | 41 | 5 | 6 | 8 | 96 |
| Total | 10 | 73 | 45 | 135 | 28 | 27 | 20 | 338 |

The inlet trapping indicates that upstream movement by all of these species occurs in the NFFR system. Most of these fish collected in 1981-82 probably originated from the reservoir.

The hardhead, pikeminnow, suckers, riffle sculpin, and rainbow trout collected in Poe Reservoir are all native species, and were no doubt distributed through much of the NFFR system prior to any development. The single largemouth bass and the numerous smallmouth bass collected in the reservoir are non-native fish. Both species of black bass were introduced into Lake Almanor following its construction, along with many other fish species that could potentially be found all the way down the NFFR through the Project area. All of the species collected in Poe Reservoir during both the 1992 and 2000 efforts, native and non-native, were also collected in Rock Creek Reservoir and Cresta Reservoir during SPT sampling efforts in 1992.

The results from the reservoir sampling not only in Poe Reservoir, but also in Rock Creek and Cresta reservoirs, suggest that the habitat within these reservoirs is well-suited for native minnow species like hardhead and pikeminnow. These species are doing well in Poe Reservoir, even though a potential predator species (i.e., smallmouth bass) has also been well established in the reservoir for quite some time. Rainbow trout are more concentrated at the upper end of Poe Reservoir in the Cresta tailrace area and near the mouths of small tributaries entering the main body of the reservoir. Past surveys suggest that Sacramento sucker and brown trout may be more abundant in the reservoir than the recent surveys indicate.

#### E3.1.3.2.2 Poe Reach - Fish Population Surveys

**USFS 1978 Stream Survey.** A survey of the NFFR from Big Bend Dam to the Highway 70 crossing was conducted in 1978 by the Plumas National Forest (USFS 1978). Even though this survey was done following the 1977 CDFG chemical treatment of the Rock Creek-Cresta reaches of the NFFR, the treatment did not seem to affect the sucker populations in the Poe Reach. Suckers were observed throughout the reach by the surveyors. In addition, rainbow trout and smallmouth bass were also found in the lower section near the powerhouse. The only barrier to upstream fish movement along this section of the NFFR at the time of this survey (May 25-June 2) was Big Bend Dam itself, which created a waterfall of approximately 15 feet into Lake Oroville.

**Fish Snorkeling Surveys - Fall 1992, Spring and Fall 1999, and Spring 2000.** In conjunction with the aquatic habitat surveys conducted in 1992 (Li and ENPLAN 1994), fish snorkeling surveys were completed in the Poe Reach of the NFFR. These surveys were repeated in the spring and fall of 1999 and in the spring of 2000. The initial repeat survey in the spring of 1999 was in the same general area as in 1992, and the added surveys in the fall of 1999 and spring of 2000 were done at the same specific habitat units. The surveys were done by snorkeling at selected stations in pools, runs, pocket water, and riffles located in four different sub-reaches distributed between Poe Dam and the Poe Powerhouse bridge (Figure E3.1-4). A crew of snorkelors moved slowly

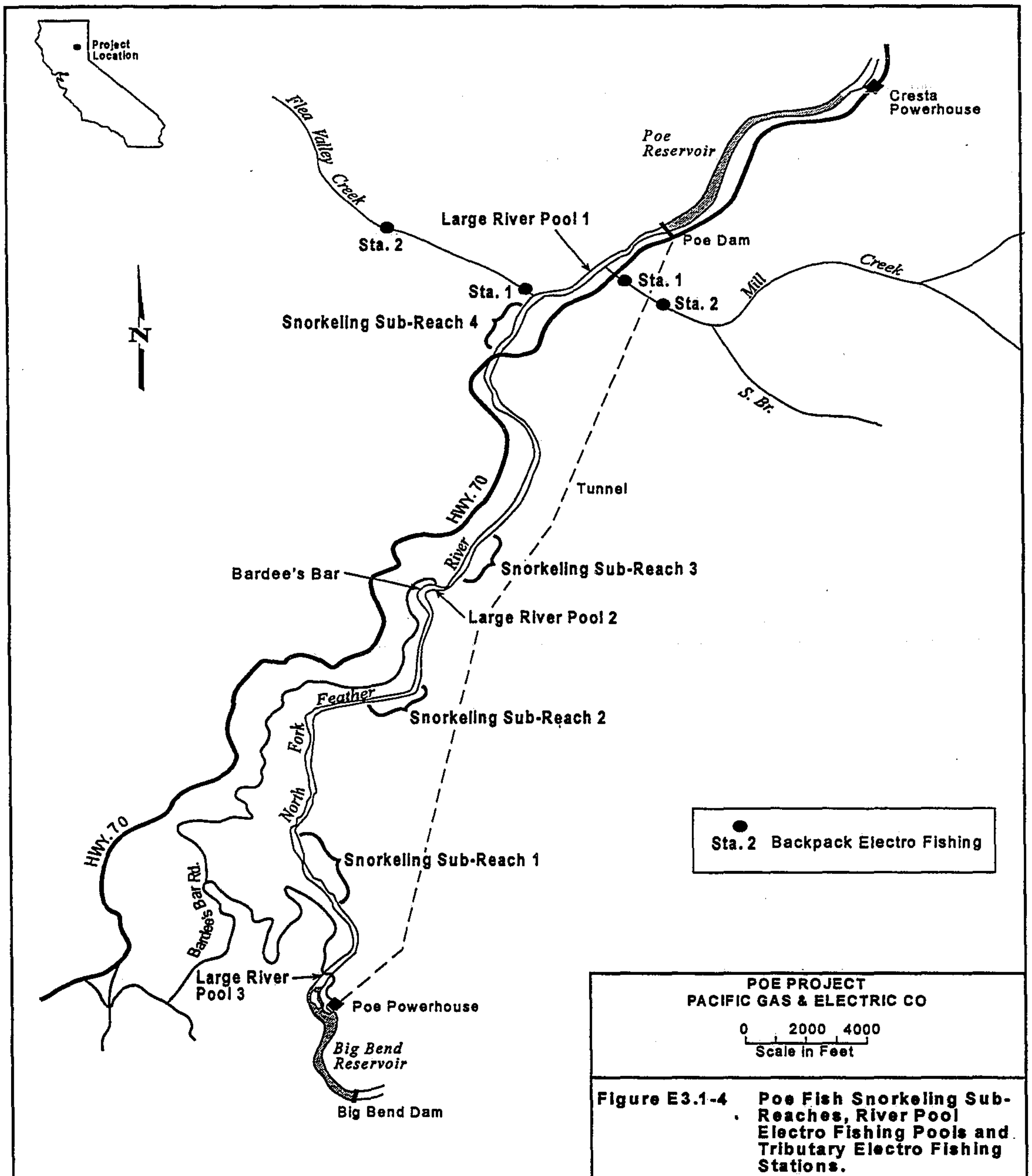



**Figure E3.1-4** **Poe Fish Snorkeling Sub-Reaches, River Pool Electro Fishing Pools and Tributary Electro Fishing Stations.**

980780/Poe snorkeling

upstream through a selected habitat unit, making observations of fish as they passed downstream of the crew. Observations included species and life stage (adult, juvenile, and young-of-the- year) of each individual fish observed.

The results of the snorkeling surveys are shown in Tables E3.1-4, E3.1-5, and E3.1-6 for all four sub-reaches combined. The original numbers of fish collected during each effort are provided in Appendix E3-1. Even though all species observed were recorded and are included in Appendix E3-1, only the following five most abundant species are discussed in detail in this section: Sacramento sucker, Sacramento pikeminnow, hardhead, rainbow trout, and smallmouth bass. Other species observed during the surveys included carp, speckled dace, and riffle sculpin.

**Species Densities.** The values provided in Tables E3.1-4, E3.1-5, and E3.1-6 are density values corrected to numbers of fish per 100 feet of habitat covered rather than absolute numbers of fish observed at each site. Table E3.1-4 combines values for all of the habitat types, while Tables E3.1-5 and E3.1-6 provide the results for pools, runs, pocket waters, and riffles separately. In addition, separate values are provided for all sizes of fish combined, for adults and juveniles combined, and for young-of-the-year (YOY) only.

For adult and juvenile-sized fish, Sacramento suckers showed the highest concentration of all species during each of the sampling efforts, except for the fall of 1992 when smallmouth bass had a slightly higher density (Table E3.1-4). Smallmouth densities

## Table E3.1-4

## Poe Snorkeling Results - All Habitats Combined *(# of Fish Observed/100 ft)*
## (Fall 1992, Spring 1999, Fall 1999, Spring 2000)

| Fish Species / Life Stage | | Fall 1992 | Spring 1999 | Fall 1999 | Spring 2000 |
|---|---|---|---|---|---|
| Hardhead | - All Sizes | 0.1 | 1.2 | 1.2 | 0.2 |
| | **- Adults & Juveniles** | **0.1** | **1.1** | **0.1** | **0.2** |
| | - YOY | 0.0 | 0.1 | 1.1 | 0.0 |
| Sacramento | - All Sizes | 2.7 | 2.9 | 3.5 | 2.2 |
| Pikeminnow | **- Adults & Juveniles** | **1.3** | **2.5** | **2.9** | **2.2** |
| | - YOY | 1.4 | 0.4 | 0.6 | 0.0 |
| Sacramento | - All Sizes | 4.2 | 54.3 | 8.5 | 20.8 |
| Sucker | **- Adults & Juveniles** | **4.2** | **17.1** | **8.3** | **19.9** |
| | - YOY | 0.0 | 37.3 | 0.3 | 1.2 |
| Rainbow | - All Sizes | 1.5 | 10.4 | 2.6 | 28.1 |
| Trout | **- Adults & Juveniles** | **1.5** | **8.1** | **2.6** | **11.0** |
| | - YOY | 0.0 | 2.4 | 0.0 | 17.1 |
| Smallmouth | - All Sizes | 5.2 | 1.0 | 0.0 | 0.5 |
| Bass | **- Adults & Juveniles** | **5.1** | **1.0** | **0.0** | **0.5** |
| | - YOY | 0.1 | 0.0 | 0.0 | 0.0 |
| Others (Unk) | - All Sizes | 0.2 | 487.7 | 1.5 | 178.3 |
| | - Adults & Juveniles | 0.2 | 0.0 | 0.0 | 0.0 |
| | **- YOY** | **0.0** | **487.7** | **1.5** | **178.3** |

## Table E.3.1-5

**Poe Snorkeling Results - Pools and Runs *(# of Fish Observed/100 ft)***
**(Fall 1992, Spring 1999, Fall 1999, Spring 2000)**

| Fish Species / Life Stage | | Fall 1992 | Spring 1999 | Fall 1999 | Spring 2000 |
|---|---|---|---|---|---|
| **POOLS** | | | | | |
| Hardhead | - All Sizes | 0.2 | 1.8 | 1.4 | 0.2 |
| | **- Adults & Juveniles** | **0.2** | **1.6** | **0.2** | **0.2** |
| | - YOY | 0.0 | 0.1 | 1.2 | 0.0 |
| Sacramento Pikeminnow | - All Sizes | 8.1 | 3.6 | 5.7 | 2.3 |
| | **- Adults & Juveniles** | **2.3** | **3.5** | **5.5** | **2.3** |
| | - YOY | 5.8 | 0.2 | 0.2 | 0.0 |
| Sacramento Sucker | - All Sizes | 6.4 | 53.9 | 10.0 | 19.9 |
| | **- Adults & Juveniles** | **6.4** | **13.8** | **9.9** | **18.6** |
| | - YOY | 0.0 | 40.1 | 0.1 | 1.4 |
| Rainbow Trout | - All Sizes | 0.9 | 6.2 | 1.5 | 14.8 |
| | **- Adults & Juveniles** | **0.9** | **5.4** | **1.5** | **10.2** |
| | - YOY | 0.0 | 0.8 | 0.0 | 4.6 |
| Smallmouth Bass | - All Sizes | 8.9 | 1.4 | 0.0 | 0.6 |
| | **- Adults & Juveniles** | **8.9** | **1.4** | **0.0** | **0.6** |
| | - YOY | 0.1 | 0.0 | 0.0 | 0.0 |
| **RUNS** | | | | | |
| | | Fall 1992 | Spring 1999 | Fall 1999 | Spring 2000 |
| Hardhead | - All Sizes | 0.0 | 0.9 | 1.3 | 0.2 |
| | **- Adults & Juveniles** | **0.0** | **0.9** | **0.0** | **0.2** |
| | - YOY | 0.0 | 0.0 | 1.3 | 0.0 |
| Sacramento Pikeminnow | - All Sizes | 0.0 | 1.1 | 1.7 | 1.4 |
| | **- Adults & Juveniles** | **0.0** | **0.4** | **0.3** | **1.4** |
| | - YOY | 0.0 | 0.7 | 1.4 | 0.0 |
| Sacramento Sucker | - All Sizes | 2.9 | 54.9 | 9.1 | 29.4 |
| | **- Adults & Juveniles** | **2.9** | **19.3** | **8.3** | **29.0** |
| | - YOY | 0.0 | 35.6 | 0.8 | 0.4 |
| Rainbow Trout | - All Sizes | 0.8 | 18.0 | 4.1 | 49.8 |
| | **- Adults & Juveniles** | **0.8** | **12.0** | **4.1** | **11.4** |
| | - YOY | 0.0 | 6.0 | 0.0 | 38.4 |
| Smallmouth Bass | - All Sizes | 3.8 | 0.7 | 0.1 | 0.1 |
| | **- Adults & Juveniles** | **3.6** | **0.7** | **0.1** | **0.1** |
| | - YOY | 0.2 | 0.0 | 0.0 | 0.0 |

## Table E.3.1-6

**Poe Snorkeling Results - Pocket Water and Riffles *(# of Fish Observed/100 ft)***
**(Fall 1992, Spring 1999, Fall 1999, Spring 2000)**

**POCKET WATER**

| Fish Species / Life Stage | | Fall 1992 | Spring 1999 | Fall 1999 | Spring 2000 |
|---|---|---|---|---|---|
| Hardhead | - All Sizes | 0.0 | 0.4 | 0.0 | 0.2 |
| | **- Adults & Juveniles** | **0.0** | **0.4** | **0.0** | **0.2** |
| | - YOY | 0.0 | 0.0 | 0.0 | 0.0 |
| Sacramento Pikeminnow | - All Sizes | 0.0 | 3.6 | 0.0 | 6.0 |
| | **- Adults & Juveniles** | **0.0** | **3.4** | **0.0** | **6.0** |
| | - YOY | 0.0 | 0.2 | 0.0 | 0.0 |
| Sacramento Sucker | - All Sizes | 4.8 | 77.0 | 6.3 | 27.9 |
| | **- Adults & Juveniles** | **4.8** | **20.1** | **6.3** | **26.6** |
| | - YOY | 0.0 | 56.8 | 0.0 | 1.3 |
| Rainbow Trout | - All Sizes | 4.0 | 13.5 | 5.2 | 30.3 |
| | **- Adults & Juveniles** | **4.0** | **12.2** | **5.2** | **15.6** |
| | - YOY | 0.0 | 1.3 | 0.0 | 14.7 |
| Smallmouth Bass | - All Sizes | 1.6 | 0.0 | 0.0 | 1.1 |
| | **- Adults & Juveniles** | **1.6** | **0.0** | **0.0** | **1.1** |
| | - YOY | 0.0 | 0.0 | 0.0 | 0.0 |

**RIFFLES**

| | | Fall 1992 | Spring 1999 | Fall 1999 | Spring 2000 |
|---|---|---|---|---|---|
| Hardhead | - All Sizes | 0.0 | 0.0 | 0.0 | 0.0 |
| | **- Adults & Juveniles** | **0.0** | **0.0** | **0.0** | **0.0** |
| | - YOY | 0.0 | 0.0 | 0.0 | 0.0 |
| Sacramento Pikeminnow | - All Sizes | 0.0 | 4.3 | 0.6 | 2.8 |
| | **- Adults & Juveniles** | **0.0** | **4.3** | **0.6** | **2.8** |
| | - YOY | 0.0 | 0.0 | 0.0 | 0.0 |
| Sacramento Sucker | - All Sizes | 2.0 | 24.3 | 2.2 | 3.7 |
| | **- Adults & Juveniles** | **2.0** | **13.0** | **2.2** | **3.7** |
| | - YOY | 0.0 | 11.3 | 0.0 | 0.0 |
| Rainbow Trout | - All Sizes | 3.0 | 12.2 | 3.6 | 46.4 |
| | **- Adults & Juveniles** | **3.0** | **8.3** | **3.6** | **8.5** |
| | - YOY | 0.0 | 4.0 | 0.0 | 38.0 |
| Smallmouth Bass | - All Sizes | 1.6 | 0.0 | 0.0 | 0.0 |
| | **- Adults & Juveniles** | **1.6** | **0.0** | **0.0** | **0.0** |
| | - YOY | 0.0 | 0.0 | 0.0 | 0.0 |

dropped to lower levels during the 1999 and 2000 surveys. The second most abundant fish observed during the spring surveys in 1999 and 2000 surveys were rainbow trout. However, the density of rainbows in the fall of 1999 (between the two spring surveys) was at a much lower level, closer to their 1992 density. Pikeminnow densities during each of the efforts were close to the fall densities for rainbows, while hardhead were found at lower levels. The densities for both pikeminnow and hardhead were fairly consistent in all of the efforts. For young-of-the-year, relatively low densities of identifiable specimens were observed during each effort, except for suckers in the spring of 1999 and for rainbow trout in the spring of 2000. The low densities of YOY were a result of not being able to identify the smallest specimens in the field rather than a lack of small fish being present.

The "others " category was used in Appendix E3-1 for fish that were too small to identify. During both of the spring snorkeling efforts, large numbers of small, unidentified fish were observed along the river margins (Table E3.1-4). These fish were likely a combination of YOY suckers, pikeminnow, and hardhead.

**Species Distribution - Between Habitat Types.** Tables E3.1-5 and E3.1-6 provides the fish densities for pools and runs and for pocket waters and riffles, respectively. As expected, the different species utilized the available habitats in various ways. The highest concentrations of pikeminnow, hardhead, and smallmouth bass were found in the pools, while rainbow trout were distributed more evenly throughout pools, runs, pocket waters, and riffles. The rainbow trout found in pools were concentrated at the top end of the pools. Suckers were also found to be distributed in all habitat types.

**Species Distribution - Between River Sub-Reaches.** The four sub-reaches were selected to cover the complete river length from Poe Dam to Poe Powerhouse. The upper site was just below the mouth of Flea Valley Creek; the middle two sites were within 1 mile upriver and downriver from Bardee's Bar; and the lower site was ½ mile above the Poe Powerhouse Bridge (Figure E3.1-4).

One secondary factor that affects the results of any snorkeling survey is water clarity. In general during each of the four snorkeling efforts, the water was clearest at the lowest site, and became progressively less clear at the upriver sites. For suckers, water clarity is not as significant a factor as with other species, because suckers can be approached under marginal visibility without being disturbed. However, trout have the opposite response. Even under good conditions (e.g., > 4-meter visibility), trout appear to sense the presence of a line of observers and sometimes avoid being detected by moving between adjacent observers. This avoidance also occurs, but to a lesser degree, with pikeminnow and hardhead. Smallmouth bass appear to not be as wary, and even seem to be attracted to observers under the water. This reduced fear level is also observed with juvenile-sized fish and YOY of all species. The avoidance response thresholds may be reduced for these smaller individuals. During the Poe surveys, these general species-specific and size-related patterns were found to be true also.

*Sacramento Sucker* - Sacramento suckers were found throughout the Poe Reach during each effort (i.e., 1992, 1999, and 2000), with the highest densities usually at the middle two sites near Bardee's Bar (Figure E3.1-5). The only exception was in the fall 1999 survey, when the highest density was found at the lowest site near the Poe Powerhouse bridge. A review of the data on a seasonal basis indicates a significant change in density levels between spring and fall. At the upper three sites, spring density levels were similar in 1999 and 2000, but much lower than levels during the intervening fall. In contrast, at the lowest site, the 1999 fall density was greater than the spring densities. These data indicate the likelihood of seasonal migrations and summer mortality. The overall higher density levels found in the fall of 1999 compared to the fall of 1992 indicate that the current sucker population is higher than in the early 1990s.

*Rainbow Trout and Brown Trout* - Rainbow trout were observed throughout the Poe Reach during each of the snorkeling surveys (i.e., 1992, 1999, and 2000). However, the density varied greatly between the four study sites, between spring and fall values, and between years (Figure E3.1-6). In the fall of 1992, rainbow abundances were higher in the upper two sub-reaches than in the lower two sub-reaches; while in the fall of 1999, the distribution was reversed with higher densities in the lower two sub-reaches. A comparison of densities between the falls of 1992 and 1999 shows that the overall density (i.e., with all four sub-reaches combined) was higher in 1999 than in 1992. For the spring surveys, densities in 2000 were higher than 1999 in the upper three sub-reaches, but lower than the 1999 level in the lowest sub-reach. Finally, spring densities in 1999 and

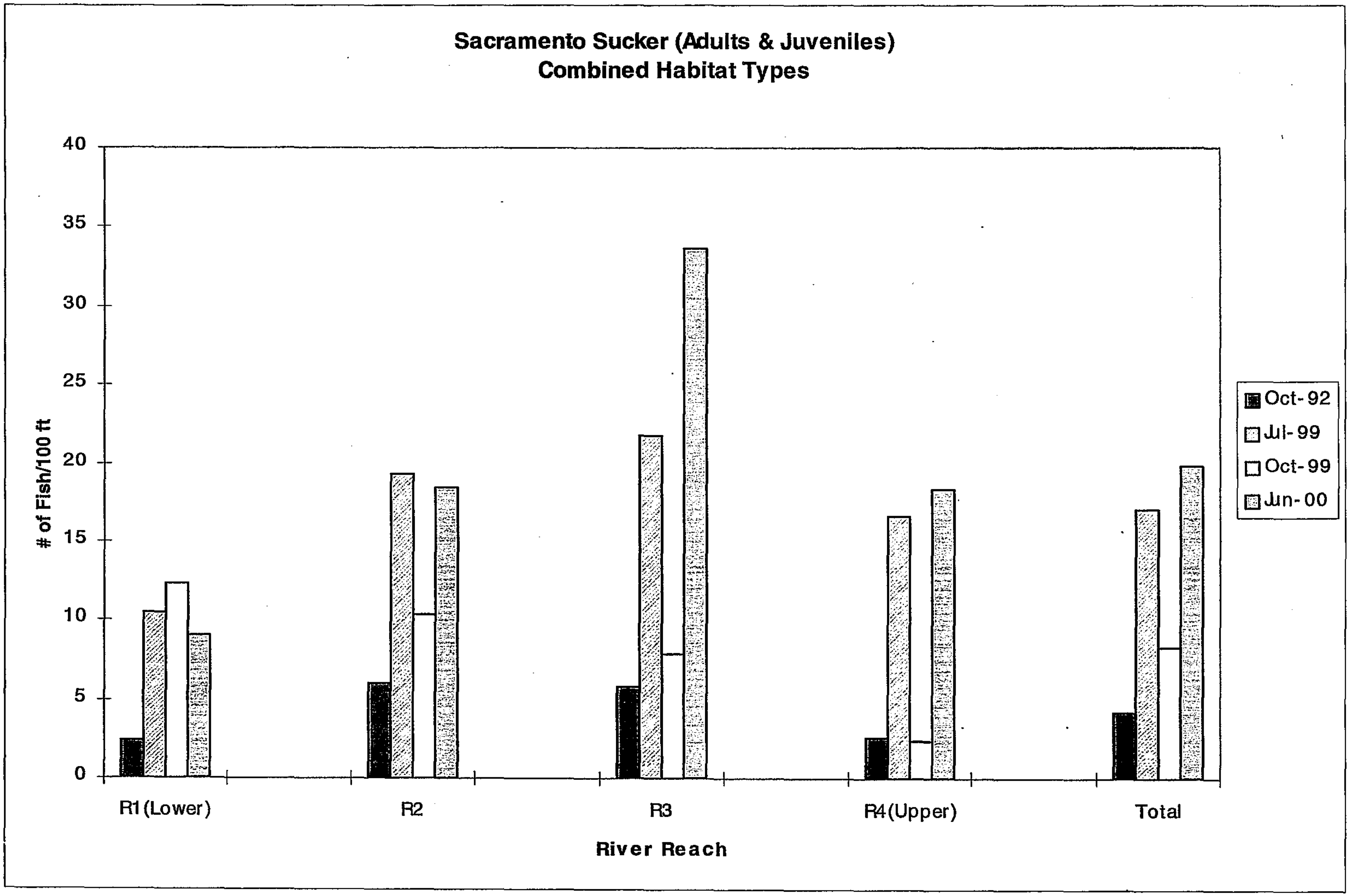



**Figure E3.1-5 Poe Snorkeling Survey - Sacramento Sucker Distribution (Adults and Juveniles)**

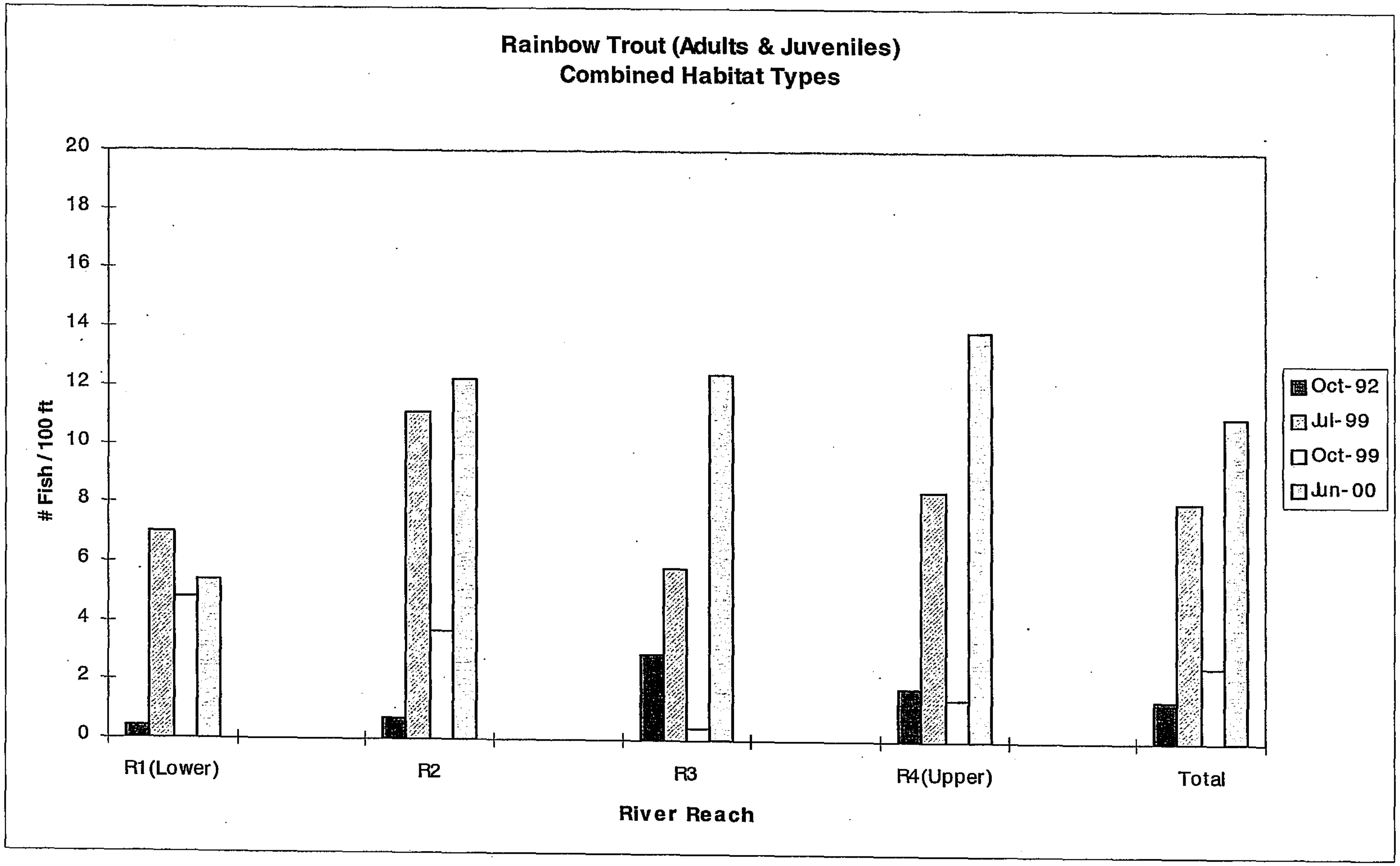



**Figure E3.1-6 Poe Snorkeling Survey - Rainbow Trout Distribution (Adults and Juveniles)**

2000 were substantially higher than the density during the intervening fall at the upper three sub-reaches and higher than, but similar to, the fall density at the lower sub-reach.

The high variability in rainbow trout densities between study sites, seasons, and years can be attributed to several factors working individually or in concert. These factors include hydrology (high flow events and dry verses wet years), water temperature, natural mortality, fishing mortality, and seasonal migrations. High flow events during the winter and spring runoff period may cause direct mortality of fish and the forced movement of fish downstream. Dry water years, particularly a series of dry years, may reduce the quantity and quality of habitat. Seasonal migrations may be occurring for several reasons including spawning migrations, dispersal of juveniles and YOY, movement of fish between the large deep pools that are scattered throughout the whole river reach and their surrounding available habitats, and movement into the stream reach from outside sources (i.e., either upriver or downriver). Movement of adult spawners into Flea Valley Creek and Mill Creek from the main river was documented in the spring of 2000, and is described in detail in a latter section. The high densities of rainbow YOY found in the upper sub-reach near the mouth of Flea Valley Creek in the spring 2000 survey reflects the successful spawning activity in the tributaries, particularly Flea Valley Creek.

Brown trout were not observed during any of the snorkeling surveys to date, so it appears that browns are scarce in the Poe Reach. Brown trout do have access to the Poe Reach from Mill Creek, where three brown trout were collected during the related tributary electrofishing survey conducted in August of 1999. Brown trout were not found in Flea Valley Creek during the 1999 electrofishing survey.

*Sacramento Pikeminnow and Hardhead* - For the fall surveys in 1992 and 1999, pikeminnow were more abundant in the lower two reaches; but in the spring of 1999 and 2000, the densities were more evenly distributed between the sub-reaches (Figure E3.1-7). The much higher density found in the 1999 fall survey in the lowest sub-reach and the differences between fall and spring efforts indicate that pikeminnow may be moving seasonally within the river reach.

Hardhead were found in low densities during all of the surveys and were distributed at these low levels throughout the reach (Figure E3.1-8). The highest density of hardhead was found during the spring 1999 survey at the upper site near Flea Valley Creek.

*Smallmouth Bass* - Smallmouth bass were observed primarily in the lower two sub-reaches during the snorkeling efforts (Figure E3.1-9). No smallmouth bass were observed at the upper study site during any of the surveys. The highest densities, by far, were found during the first fall survey in 1992. The abundance of smallmouth apparently fluctuates greatly in the Poe Reach, with the population being concentrated in the lower sub-reaches.

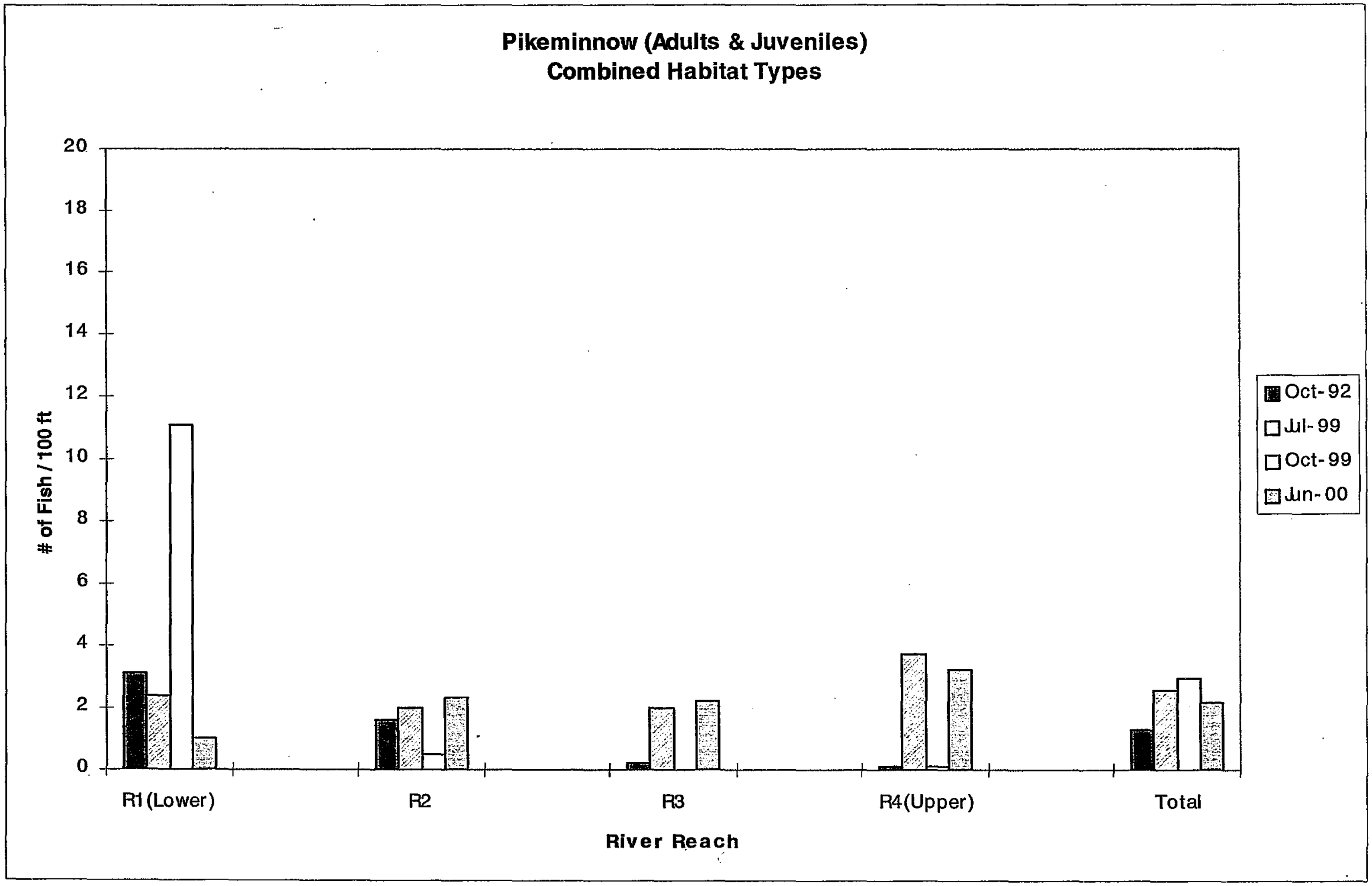



**Figure E3.1-7 Poe Snorkeling Survey - Sacramento Pikeminnow (Adults and Juveniles)**

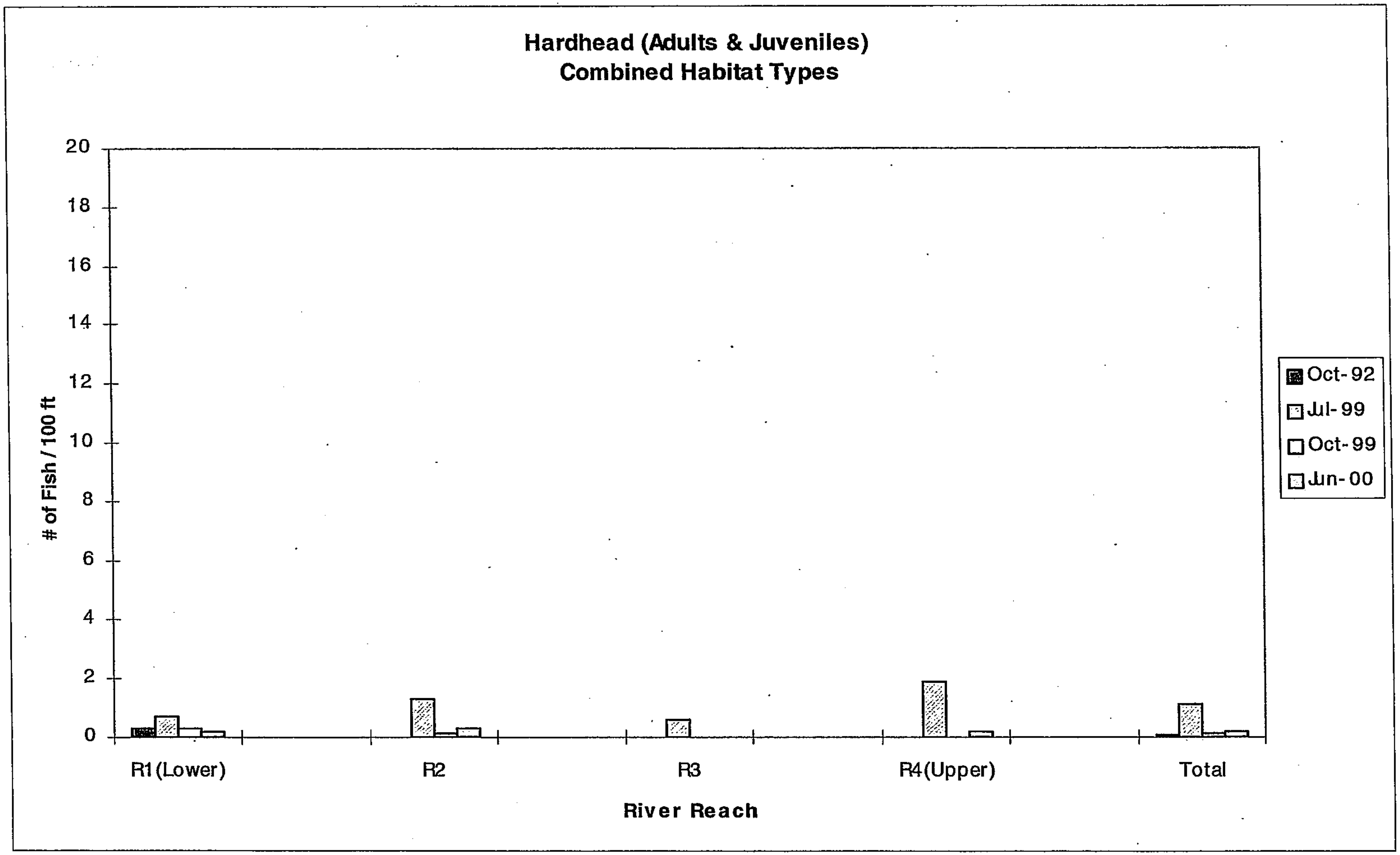



**Figure E3.1-8. Poe Snorkeling Survey - Hardhead (Adults and Juveniles).**

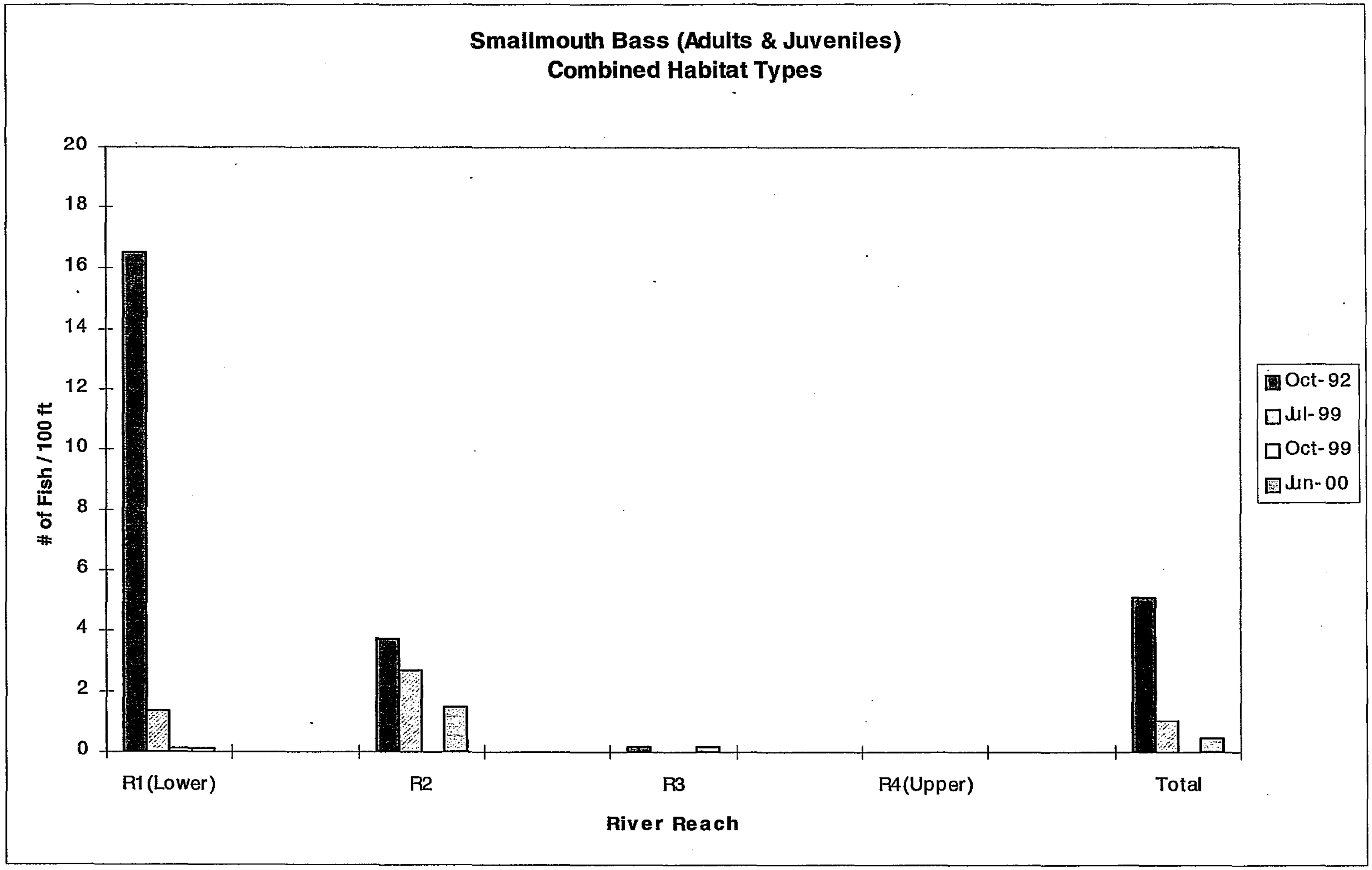



**Figure E3.1-9. Poe Snorkeling Survey - Smallmouth Bass Distribution (Adults and Juveniles).**
(HH = Hardhead, PM = Pikeminnow, RBT = Rainbow Trout, SKR = Sucker, SMB = Smallmouth Bass, CP = Carp)

**Large Pool Snorkeling Surveys - June 2000.** In association with the June 2000 snorkeling effort at the established stations, qualitative snorkeling was conducted at single large pools associated with each of the four study sites. These large pools are representative of the large pool habitat that occurs frequently throughout the Poe Reach. These types of pools are too deep and wide to snorkel effectively in a quantitative manner and were not included in the quantitative efforts.

The results of the large pool snorkeling are provided as density values corrected to 100-foot lengths of river similar to the values provided for the established stations (Figure E3.1-10). Overall, sucker, pikeminnow, and rainbow trout were the three most abundant species found in these large pools, while smallmouth bass, hardhead, and carp were observed in much lower densities. Sucker was the most abundant species at the three lower sites, while pikeminnow was the most abundant at the upper site. For the two middle sites near Bardee's Bar, rainbow trout were more abundant than pikeminnow, while pikeminnow were more abundant than rainbows at the uppermost and lowermost sites. Smallmouth were observed at all of the sites except for the upper Mill Creek site, while carp were found only at the middle site below Bardee's Bar. No hardhead were found in the two middles sites, and the numbers of hardhead at the lower and upper sites were very low.

**Large Pool Electrofishing and Gill Netting - September 2000.** To further investigate the fish population structure in the large pool habitat that occurs throughout the Poe Reach, a combination of simultaneous electrofishing and gill netting was conducted in

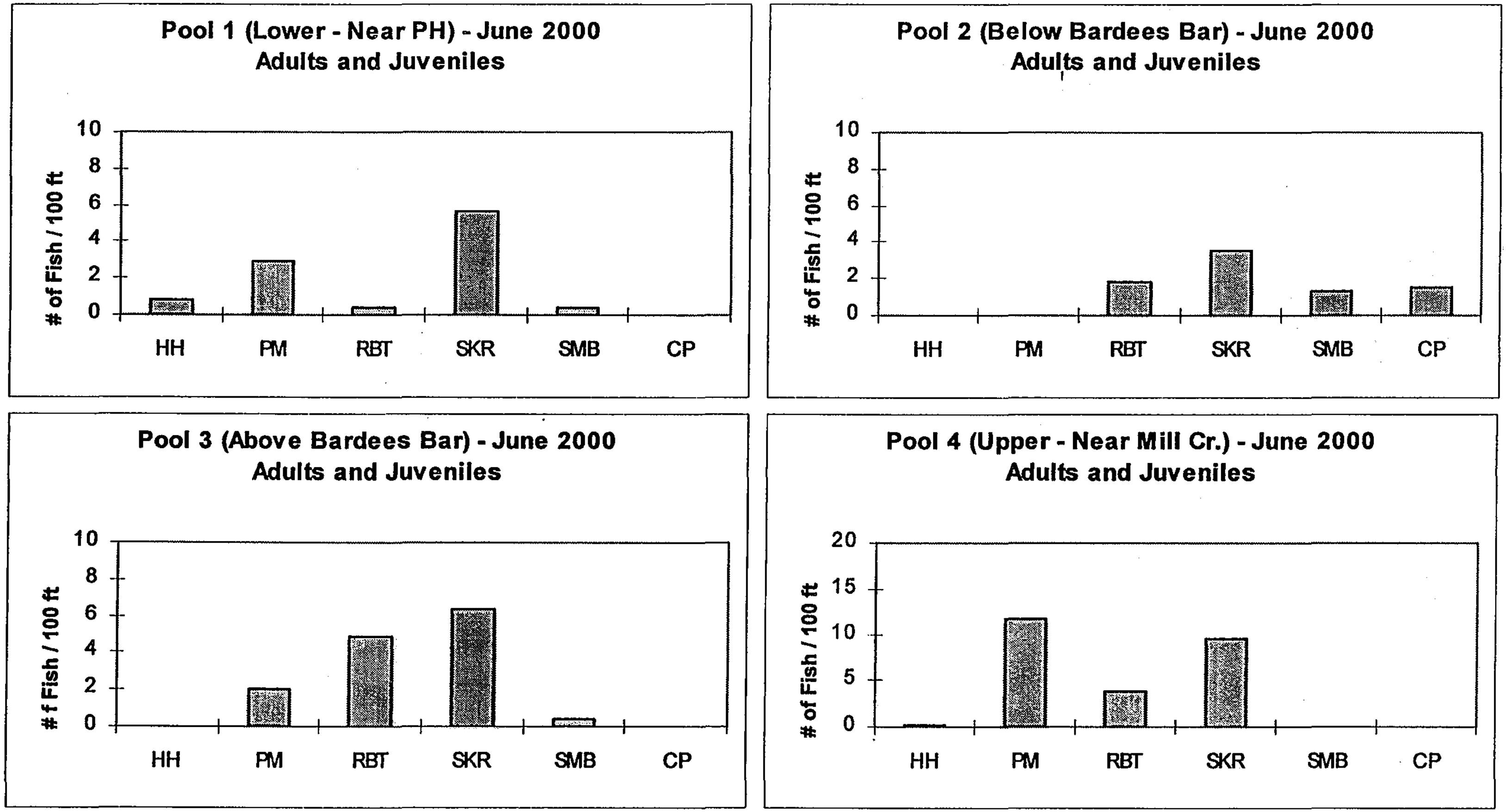



**Figure E3.1-10 Poe Large Pool Snorkeling Survey Results - June 2000**

three large pools. The original objective of this study was to obtain an estimate of population size in the pools. However, due to the large dimensions of the pools, the study was redesigned to attain a more realistic objective of collecting species composition and size data in these large pools, and comparing species distribution between the three pools. Of particular importance and one of the main reasons for the added pool sampling was to describe the abundances of hardhead and pikeminnow in this habitat type. Hardhead are listed as a Forest Sensitive Species by the Plumas National Forest, and represent the only fish species listed as such in the Project water bodies. This sampling was done in late September of 2000. A detailed report on this special study prepared by EA Engineering Science and Technology (2000) is provided Appendix E3-2.

Due to limited access to the Poe Reach and the semi-portable electrofishing barge system to be used, the sampling sites were selected at the following three fairly-accessible locations: 1) the sandy beach pool near the mouth of Mill Creek, 2) the pool below the Bardee's Bar bridge, and 3) the large pool immediately downriver from the Poe Powerhouse bridge (shown on Figure E3.1.4). At each site, the sampled pool was segmented into three or four areas of varying depth and width, and partitioned with four to five, 100-ft long variable mesh gill nets. The nets were stretched across the river with the smaller mesh sizes set in the shallower areas. A barge-mounted Coffelt model VVP electrofisher was systematically maneuvered throughout the segments between the set gill nets to thoroughly sample the area. Each pool was sampled in a one-day effort, which included daylight and twilight sampling. The timing of the daylight and twilight sampling efforts was intended to capture both daylight and twilight active species.

Fish were captured either by stunning them directly with the electric field, or by herding them into the gill nets. The gill nets were checked repeatedly throughout the day in order to minimize mortality of captured fish. Each captured fish was identified to species, measured to the nearest millimeter, weighed to the nearest tenth of a gram, and returned to the stream outside of the sampling area.

A summary of the numbers for each species and life stage collected at the three pool sites is provided in Table E3.1-7. In the consultant report, the numbers are separated out for fish collected by electrofishing or in gill nets, and during daylight or twilight hours. For all of the sites and sizes combined, sucker, smallmouth bass, and hardhead were the most abundant with 118, 83, and 86 being collected, respectively. Lower totals of 16 pikeminnow, 6 riffle sculpin, 3 carp, and 1 rainbow trout were also collected. The lack of trout in the catches was primarily a result of the sampling efforts being done in the centers of the pools rather than at the top ends where trout concentrate in the faster-flowing water.

The relative numbers of adults and juveniles for each species is shown in Figure E3.1-11 for all of the pool sites combined. At all three sites (i.e., the sandy beach pool, Bardee's Bar pool, and Poe Powerhouse pool), Sacramento sucker were the dominant adult fish collected. The most numerous juvenile-sized fish were hardhead at the upper

## Table E3.1-7

## Poe Project - Large Pool Electrofishing / Gill Netting Surveys, September 2000

| All Pool Sites Combined | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SKR | SMB | HH | PM | RSCP | CP | RBT | Total |
| All Sizes | 118 | 83 | 86 | 16 | 6 | 3 | 1 | 313 |
| Adults | 87 | 17 | 5 | 1 | 4 | 3 | 1 | 118 |
| Juveniles | 31 | 66 | 81 | 15 | 2 | 0 | 0 | 195 |
| **Sandy Beach/Mill Creek Pool** | | | | | | | | |
| | SKR | SMB | HH | PM | RSCP | CP | RBT | |
| All Sizes | 76 | 5 | 43 | 11 | 2 | 0 | 0 | 137 |
| Adults | 48 | 3 | 3 | 1 | 0 | 0 | 0 | 55 |
| Juveniles | 28 | 2 | 40 | 10 | 2 | 0 | 0 | 82 |
| **Bardee's Bar Pool** | | | | | | | | |
| | SKR | SMB | HH | PM | RSCP | CP | RBT | |
| All Sizes | 25 | 13 | 35 | 3 | 1 | 1 | 1 | 79 |
| Adults | 22 | 9 | 1 | 0 | 1 | 1 | 1 | 35 |
| Juveniles | 3 | 4 | 34 | 3 | 0 | 0 | 0 | 44 |
| **Poe Powerhouse Pool** | | | | | | | | |
| | SKR | SMB | HH | PM | RSCP | CP | RBT | |
| All Sizes | 17 | 65 | 8 | 2 | 3 | 2 | 0 | 97 |
| Adults | 17 | 5 | 1 | 0 | 3 | 2 | 0 | 28 |
| Juveniles | 0 | 60 | 7 | 2 | 0 | 0 | 0 | 69 |

1) SKR = Sucker, SMB = Smallmouth Bass, HH = Hardhead, PM = Pikeminnow, RSCP = Riffle Sculpin CP Carp, RBT = Rainbow Trout

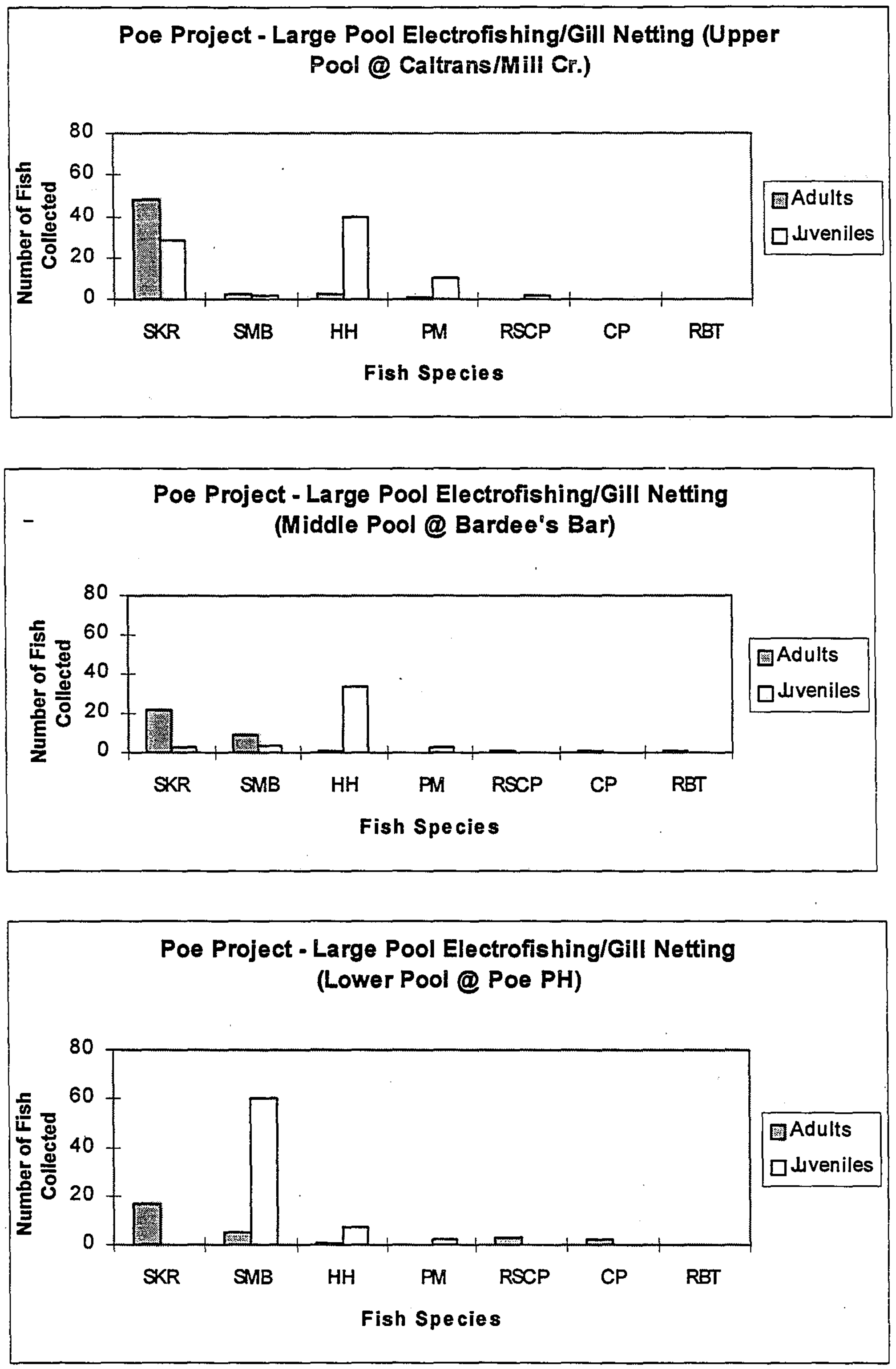



**Figure E3.1-11 Poe Large Pool Electrofishing / Gill Netting Survey Results September 2000**

(SKR=Sucker, SMB=Smallmouth Bass, HH=Hardhead, PM=Pikeminnow, RSCP=Riffle Sculpin, CP=Carp, RBT=Rainbow Trout) and middle sites and smallmouth bass at the lower site (i.e., near Poe Powerhouse). Juvenile smallmouth were more abundant than all other species and sizes at the lower site.

**Poe Reach Suitability Densities.** As an element of the Poe instream flow study, habitat suitability criteria (HSC) for selected fish species were developed for the NFFR in a separate field effort. The method estimates fish density within ranges of depth, velocity, and cover to generate the criteria curves. In addition to providing habitat suitability information, the data from this effort also has provided a measure of density for each species and area studied. The numbers of fish (for each species and for both adults and juveniles) observed within specified depth and velocity ranges across the transect were used to estimate density values. Those values are used in this section to help assess species composition within and between the study areas (i.e., Poe, Cresta, and Rock Creek).

The specific methodology used to develop the HSC curves are described in the report included in Appendix E3-8 (TRPA, 2001b).

The data collection was conducted by crews of divers working across transects placed in areas representative of the different habitat types available in the study reach. The work was completed in July and August 2000, so the resulting HSC curves would apply to mid-summer conditions. Two study sites were established in the lower portion of the Poe

Reach below Bardee's Bar, and one study site was established in the lower portions of both the Cresta and Rock Creek reaches.

In addition to focusing on two sites in the Poe Reach of the NFFR, study sites in the Cresta and Rock Creek reaches were also included in the criteria study. The analysis provides added detail on relative species abundances for the five species targeted in the instream flow study (i.e., rainbow trout, Sacramento sucker, hardhead, Sacramento pikeminnow, and smallmouth bass). The data allow species comparisons for both adults and juveniles within the Poe Reach and between the three river reaches for selected species.

In the suitability analysis, the densities are expressed as the number of individuals observed per square foot of habitat sampled. For this section, those densities have been adjusted to numbers per 10,000 square ft to provide more intuitive values. Essentially, this gives density estimates for 100-foot lengths of habitat, assuming a stream width of 100 feet. In general, the Poe Reach of the NFFR falls in the 100-ft width range.

The results for the two Poe Reach sites combined are shown in Table E3.1-8. Overall for adults, sucker and pikeminnow were equally abundant followed by smallmouth bass, rainbow trout, and hardhead. Smallmouth bass values were relatively high, due to the fact that the two Poe sites were located in the lower portion of the Poe Reach, where smallmouth have traditionally been more highly concentrated. For juveniles, rainbow trout were found in the highest concentration, followed by sucker, hardhead, smallmouth

## Table E3.1-8

## Poe Project Suitability Criteria Study – July and August, 2000
## Summary of Fish Observations (# of Fish /10,000 ft2)
## (Poe Reach- Combined Upper and Lower Sub-Reaches)

| Poe Project - Combined Upper and Lower Sub-Reaches | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | RBT Adult | RBT Juv | SKR Adult | SKR Juv | HH Adult | HH Juv | PM Adult | PM Juv | SMB Adult | SMB Juv |
| | | | | | | | | | | |
| Pool Head | 0.8 | 1.6 | 5.6 | 0.0 | 7.3 | 0.0 | 7.3 | 0.0 | 7.3 | 5.6 |
| | | | | | | | | | | |
| Pool Body | 0.4 | 0.0 | 2.2 | 0.0 | 2.7 | 0.8 | 8.8 | 0.3 | 3.2 | 1.3 |
| | | | | | | | | | | |
| Pool Tail | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 1.3 | 0.0 | 0.0 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Run | 5.6 | 0.0 | 0.6 | 3.1 | 2.6 | 0.0 | 0.0 | 0.6 | 1.3 | 3.7 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Riffle | 6.7 | 11.6 | 0.0 | 4.3 | 0.0 | 12.8 | 0.0 | 3.1 | 0.0 | 0.0 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Pocketwater | 7.9 | 3.5 | 22.7 | 3.6 | 0.0 | 0.0 | 0.5 | 1.4 | 3.1 | 1.4 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Total | 2.0 | 1.7 | 4.8 | 1.2 | 1.8 | 1.1 | 5.1 | 0.6 | 3.1 | 1.9 |
| | | | | | | | | | | |

1) RBT = Rainbow Trout, SKR = Sucker, HH = Hardhead, PM = Pikeminnow, SMB = Smallmouth Bass

bass, and pikeminnow. Table E3.1-8 also indicates how the various habitats within the Poe Reach, at least in this lower section of the Poe Reach, are utilized by the different fish species. Adult and juvenile rainbow trout were concentrated in the runs, riffles, and pocketwater areas, while the adult pikeminnow, smallmouth bass, and hardhead were found in higher abundances in the pools. Adult sucker were also found in pools, but the highest concentration was documented in pocketwater habitat.

The results from the Cresta and Rock Creek reaches are given in Table E3.1-9. The distribution of species in various habitats exhibits a similar pattern in the Cresta and Rock Creek reaches as in the Poe Reach. In general, the densities in the Rock Creek reach were much higher than the Poe reach, while the Cresta densities (excluding rainbow trout) were closer to the same levels that were found in Poe. Both adult and juvenile rainbows were significantly more abundant in Cresta than in the Poe.

**Poe Reach Fish Population Surveys - Summary.** The sampling efforts that have been conducted in the Poe Reach demonstrate that the dominant species throughout the reach has consistently been Sacramento sucker, followed by rainbow trout and Sacramento pikeminnow.

As expected, higher numbers of smallmouth bass and hardhead were found during the large pool electrofishing and gill netting surveys than during the other two sampling efforts (i.e., seasonal quantitative snorkeling and large pool qualitative snorkeling). However, the hardhead were mostly juveniles, while the smallmouth were a combination

**Table E3.1-9**

**Poe Project Suitability Criteria Study - July and August, 2000**
**Summary of Fish Observations (# of Fish /10,000 ft2)**
**(Rock Creek and Cresta Reaches)**

| **Cresta Reach** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **RBT Adult** | **RBT Juv** | **SKR Adult** | **SKR Juv** | **HH Adult** | **HH Juv** | **PM Adult** | **PM Juv** | **SMB Adult** | **SMB Juv** |
| | | | | | | | | | | |
| Pool Head | 15.7 | 0.0 | 7.9 | 0.0 | 3.9 | 3.9 | 3.9 | 0.0 | 11.8 | 0.0 |
| Pool Body | 0.0 | 0.0 | 1.3 | 0.0 | 5.7 | 0.0 | 3.2 | 0.0 | 8.9 | 0.0 |
| Pool Tail | 0.0 | 0.0 | 0.0 | 0.0 | 26.8 | 0.0 | 0.0 | 0.0 | 8.9 | 0.0 |
| | | | | | | | | | | |
| Run | 32.1 | 2.0 | 3.0 | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 | 3.0 | 0.0 |
| Riffle | 14.8 | 40.0 | 0.0 | 0.0 | 0.0 | 4.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pocketwater | 15.0 | 6.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | | | | |
| Total | 12.9 | 6.2 | 1.7 | 0.2 | 3.2 | 0.7 | 1.5 | 0.2 | 5.2 | 0.0 |
| | | | | | | | | | | |
| **Rock Creek Reach** | | | | | | | | | | |
| | **RBT Adult** | **RBT Juv** | **SKR Adult** | **SKR Juv** | **HH Adult** | **HH Juv** | **PM Adult** | **PM Juv** | **SMB Adult** | **SMB Juv** |
| | | | | | | | | | | |
| Pool Head | 0.0 | 0.0 | 8.0 | 56.0 | 48.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pool Body | 0.0 | 0.0 | 0.0 | 0.0 | 102.5 | 23.3 | 12.2 | 61.9 | 1.0 | 0.0 |
| Pool Tail | 0.0 | 0.0 | 7.2 | 0.0 | 3.6 | 32.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | | | | |
| Run | 19.0 | 7.1 | 26.2 | 11.9 | 2.4 | 4.8 | 11.9 | 4.8 | 0.0 | 0.0 |
| Riffle | 21.7 | 59.2 | 11.8 | 122.4 | 0.0 | 2.0 | 0.0 | 41.5 | 0.0 | 0.0 |
| Pocketwater | 19.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | | | | |
| Total | 9.1 | 13.1 | 7.9 | 29.4 | 43.3 | 13.9 | 6.8 | 33.4 | 0.4 | 0.0 |

1) RBT = Rainbow Trout, SKR = Sucker, HH = Hardhead, PM = Pikeminnow, SMB = Smallmouth Bass

of adults and juveniles. It is surprising that more adult hardhead were not found during the large pool sampling based on the numbers of small hardhead found. This disparity may be due to avoidance by adults during these efforts, or perhaps a downriver movement of young hardhead from Poe Reservoir into the river reach during high flow events.

Adult and juvenile sucker, rainbow trout, and pikeminnow were distributed somewhat evenly throughout the complete reach. As expected during the spring, YOY rainbows were concentrated in the upper river reach near the two tributaries where spawning is known to occur. Hardhead were also found in each area, but in much lower abundances than other species. Smallmouth bass were found throughout the reach, but were more concentrated in the lower two sub-reaches. Smallmouth are a non-native predator species that potentially can impact populations of native species by foraging on YOY and juveniles. The overall impact of smallmouth on native fish populations in the Poe Reach may be significant in the large pools where all of the species are present, and especially in the lower portion of the river reach where smallmouth are able to maintain themselves in higher concentrations.

There may be a movement of smallmouth bass between the large pools and the other habitats surrounding those large pools. High water flow during winter and spring may be moving smallmouth into these large pools out of the surrounding, less protective areas; while the converse (i.e., a lack of high flow levels) may allow smallmouth to move back into the surrounding habitats. Any movement of smallmouth back and forth between these areas potentially impacts other species in both areas. At the same time, fish species other than smallmouth are likely exhibiting this type of annual movement also, but it may be less obvious for native fish that are better adapted to high flow events in the NFFR.

#### E3.1.3.2.3 Big Bend Reservoir (Poe Afterbay) Surveys

Prior to this relicensing effort, the fish populations in Big Bend Reservoir had not been sampled or assessed. Any fish residing in Big Bend Reservoir have access to the Poe Reach of the NFFR, and are able to move into the lower section of NFFR during spawning migrations or natural upstream dispersal. Although Big Bend Dam acts as a barrier to fish movement from Lake Oroville when the lake is low, some fish may be able to move upstream through the permanent slot in the dam when the lake level is high. The assemblage of fish in Big Bend Reservoir is likely a combination of species from upriver NFFR sources and from Lake Oroville downstream.

Big Bend Reservoir was sampled with a Smith-Root electrofishing boat in September 2000. The Big Bend sites included stations in the main body of the reservoir upriver and downriver from the mid-reservoir train trestle, the shallow run of the main river entering the top end of the reservoir, the flowing water at the lower end of the Poe Powerhouse tailrace, and the tailrace area in front of and around the powerhouse building itself. Gill netting was also done during the electrofishing efforts. These nets were of variable mesh sizes (i.e., 1/2" to 2" and 2" to 4"), and were set in the main body of the reservoir. No fish were collected in the gill nets, even though the nets were set during an evening period.

The results of the 2000 electrofishing effort at Big Bend Reservoir are shown in Table E3.1-10 and in Figure E3.1-12. The same dominant species were found in Big Bend Reservoir as were found in Poe Reservoir (i.e., hardhead, sucker, smallmouth bass, and pikeminnow). In addition, a large number of adult suckers were found in the shallow run through which the main river enters the top end of the reservoir. This group of fish dominates the results from the effort for the whole reservoir. Smallmouth bass were also concentrated at this station. Finally, riffle sculpin were also collected, along with the recording of several non-netted fish (i.e., unknown cyprinids). Separate results for the Poe Powerhouse tailrace sampling are given in Figure E3.1-13. The tailrace electrofishing was conducted on the day following the sampling effort in the rest of the reservoir in the early morning hours with the Powerhouse not running. The same species were found in the tailrace area as in the reservoir itself, demonstrating that when the flow through the powerhouse is reduced, fish move into this area.

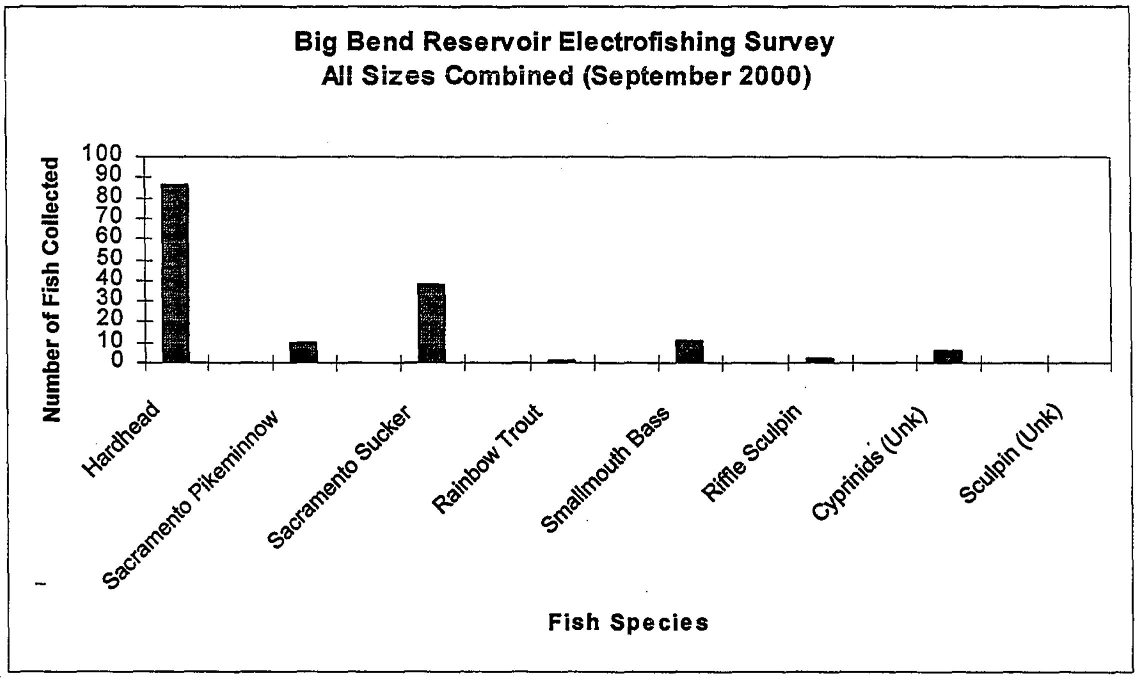
#### E3.1.3.2.4 Tributary Monitoring (Flea Valley Creek and Mill Creek)

**Backpack Electrofishing Surveys - August 1999.** Quantitative electrofishing surveys were conducted in Flea Valley Creek and Mill Creek during August of 1999. The surveys were conducted to document the species utilizing the tributaries and to quantify

## Table E3.1-10

## Big Bend Reservoir Electrofishing Results, September 2000

| Water Body (Location) | Fish Species Collected | Total Number | Number of Adults | Length Range (mm) | Number of Juveniles | Length Range (mm) | Number of YOY | Length Range (mm) |
|---|---|---|---|---|---|---|---|---|
| Big Bend Dam Afterbay | Hardhead | 86 | 0 | | 10 | 109-184 mm | 76 | 35-97 mm |
| | Sacramento Pikeminnow | 10 | 1 | 353 mm | 5 | 104-157 mm | 4 | 53-94 mm |
| | Sacramneto Sucker | 38 | 36 | 255-472 mm | 1 | 111 mm | 1 | 55 mm |
| | Rainbow Trout | 1 | 1 | 215 mm | 0 | | 0 | |
| | Smallmouth Bass | 11 | 1 | 210 mm | 9 | 109-190 mm | 1 | 78 mm |
| | Riffle Sculpin | 2 | 2 | 88-96 mm | 0 | | 0 | |
| | Cyprinds (UNK) | 6 | 2 | >200 mm | 4 | <200, >100 | 0 | |
| | Sculpin (UNK) | 0 | 0 | | 0 | | 0 | |
| | **All Species** | **154** | **43** | | **29** | | **82** | |



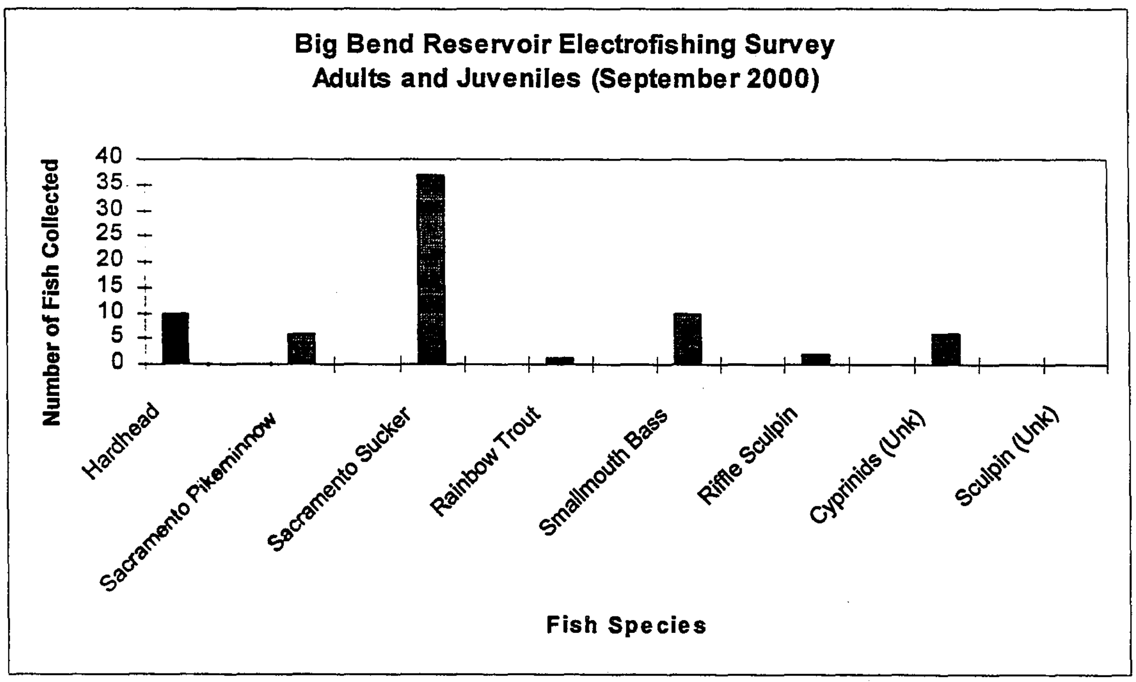
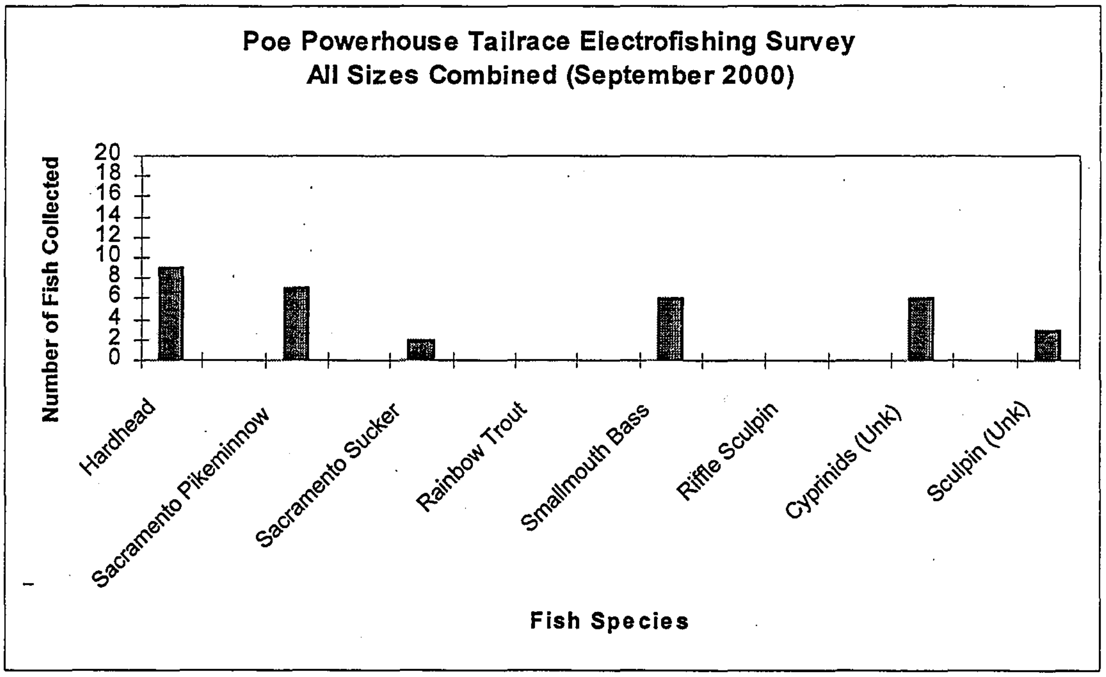




**Figure E3.1-12 Big Bend Reservoir Electrofishing Results**



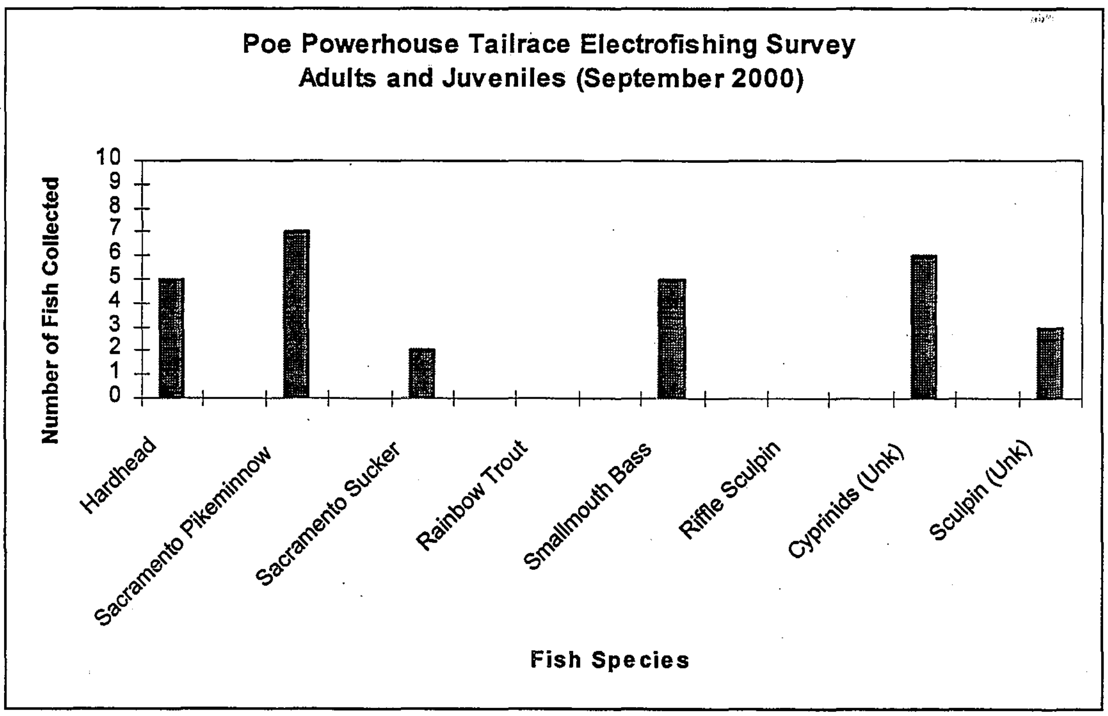



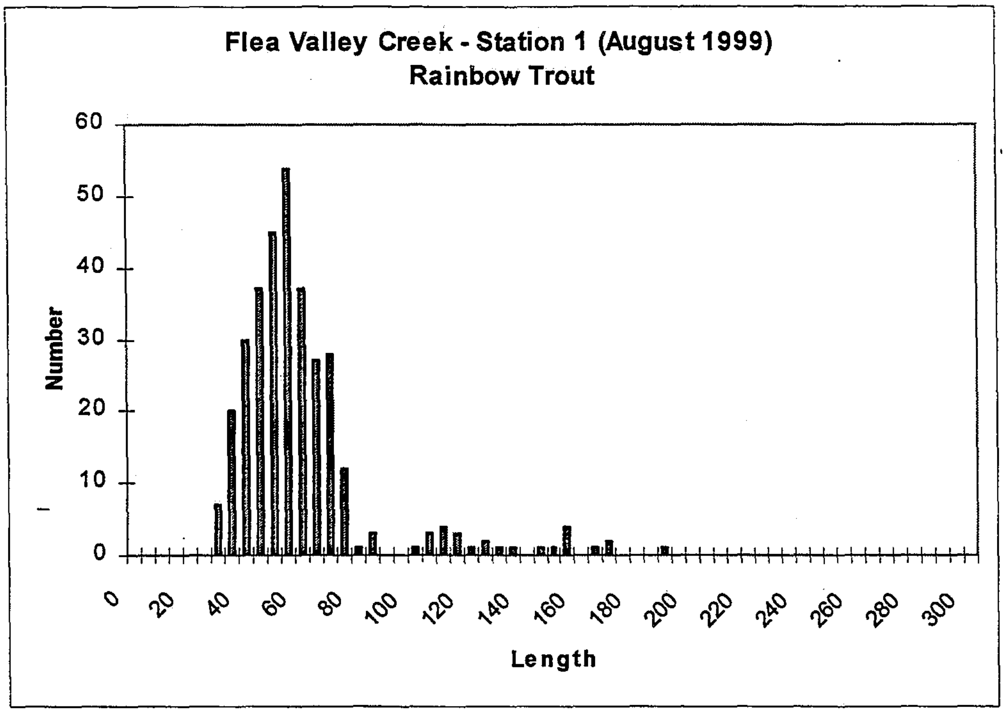

**Figure E3.1-13 Poe Powerhouse Tailrace Electrofishing Results.**

the size and character of the fish populations at sites close to the stream mouths. Two, 50-meter stations were selected in each tributary (shown on Figure E3.1-4). For Flea Valley, the lower station's downstream boundary was about 20 meters above the mouth, and the upper station's downstream boundary was about 650 meters above the mouth. For Mill Creek, the lower station's downstream boundary was about 20 meters above the Highway 70 culvert (i.e., about 110 meters above the mouth) and the upper station's downstream boundary was about 300 meters above the Highway 70 culvert. The downstream and upstream boundaries for each station were blocked off with seines, and the 50-meter section between the two seines was sampled in a series of passes with a backpack electrofisher. Fish were identified, measured, and counted from each pass. The fish collected from each pass were placed in live cars until all of the passes were completed at each station. All fish were released back to the stream after all of the processing was finished. Based on decreasing catches over a series of passes at each station, population estimates and confidence limits were generated for YOY, (1+ and older), and total trout.

The results of the stream electrofishing are given in Table E3.1-11. Only rainbow trout were found in Flea Valley, while both rainbows and browns were found in Mill Creek. No brown trout were collected at the lower Mill Creek station, while a total of three brown trout (i.e., one large, 19-inch adult and two juveniles) were collected at the upper station. For Flea Valley, YOY made up 92% of the total rainbow trout collected at the lower station and 72% at the upper station (Figure E3.1-14). The high numbers of YOY collected in Flea Valley were due to the fact that the stream is used as a spawning

**Table E3.1-11**
**Poe Project - Tributary Electrofishing Surveys**
**(Flea Valley Creek and Mill Creek - August 1999)**

| **Flea Valley Creek** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Station | Date | Species and Life Stage | Pass 1 | Pass 2 | Pass 3 | Total | Population Estimate | Confidence Limits (+/-) |
| | | | | | | | | |
| Station 1 (Lower) | 08/17/99 | Rainbow Trout (YOY) | 185 | 69 | 47 | 301 | 335 | 22.0 |
| (50 Meters) | | Rainbow Trout (1+) | 20 | 5 | 1 | 26 | 26 | 1.2 |
| | | Rainbow Trout (Total) | 205 | 74 | 48 | 327 | 359 | 20.3 |
| – | | | | | | | | |
| Station 2 (Upper) | 08/18/99 | Rainbow Trout (YOY) | 37 | 16 | 8 | 61 | 66 | 8.2 |
| (50 Meters) | | Rainbow Trout (1+) | 17 | 7 | 0 | 24 | 24 | 1.3 |
| | | Rainbow Trout (Total) | 54 | 23 | 8 | 85 | 90 | 7.2 |
| **Mill Creek** | | | | | | | | |
| Station | Date | Species and Life Stage | Pass 1 | Pass 2 | Pass 3 | Total | Population Estimate | Confidence Limits (+/-) |
| | | | | | | | | |
| Station 1 (Lower) | 08/18/99 | Rainbow Trout (YOY) | 32 | 14 | 7 | 53 | 57 | 7.4 |
| (50 Meters) | | Rainbow Trout (1+) | 28 | 7 | 9 | 44 | 48 | 7.9 |
| | | Rainbow Trout (Total) | 60 | 21 | 16 | 97 | 107 | 11.9 |
| | | | | | | | | |
| Station 2 (Upper) | 08/19/99 | Rainbow Trout (YOY) | 26 | 14 | 3 | 43 | 45 | 4.8 |
| (50 Meters) | | Rainbow Trout (1+) | 22 | 5 | 2 | 29 | 29 | 1.5 |
| | | Rainbow Trout (Total) | 48 | 19 | 5 | 72 | 74 | 4.5 |
| | | | | | | | | |
| Station 2 (Upper) | 08/19/99 | Brown Trout (YOY) | 2 | 0 | 0 | 2 | 2 | - |
| (50 Meters) | | Brown Trout (1+) | 1 | 0 | 0 | 1 | 1 | - |
| | | Brown Trout (Total) | 3 | 0 | 0 | 3 | 3 | - |



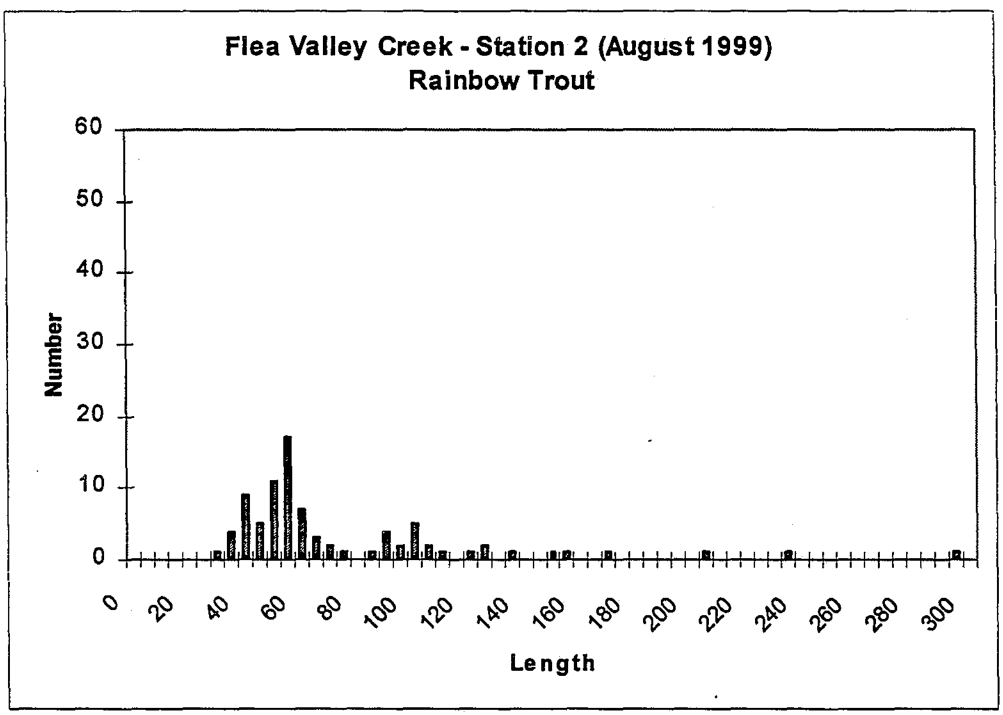
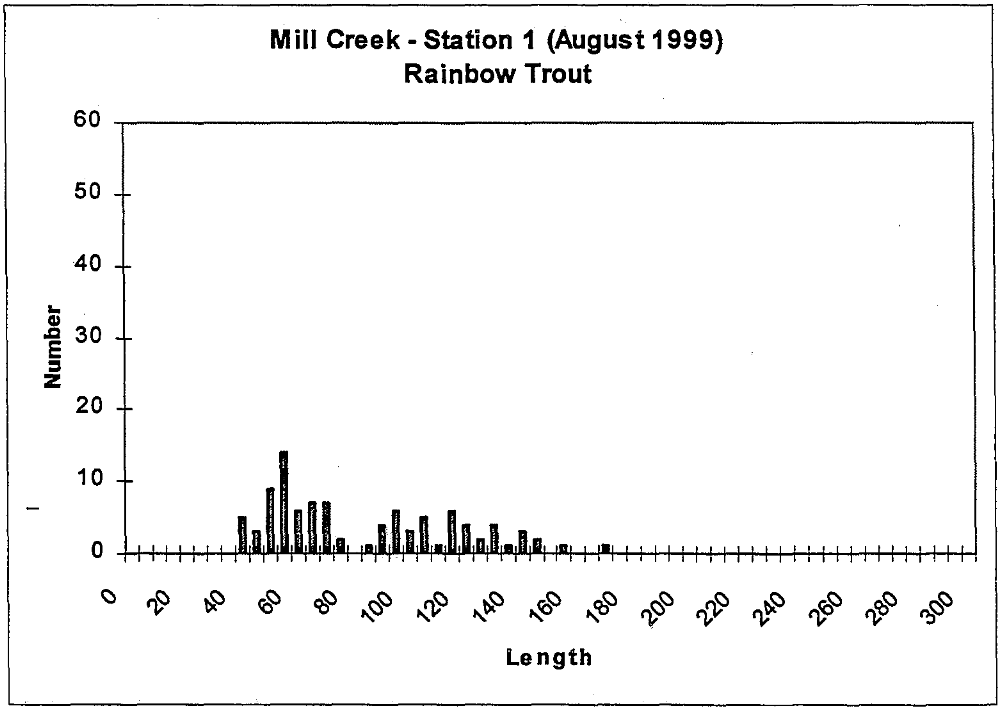




**Figure E3.1-14. Flea Valley Creek - Rainbow Trout Length Frequencies (Aug. 1999)**

tributary by adult rainbows from the main river. Adults from the main river are able to access both sampling sites, as there are no physical barriers to upstream movement in this stream section. In Mill Creek, YOY represent 55% of the total rainbow trout at the downstream station and 60% of the total at the upstream station (Figure E3.1-15). The Highway 70 box culvert and the upper end of the lower electrofishing station are, at the least, partial barriers under most flow conditions.

**Barrier Identification – September/October 1999.** To support the analysis of the tributaries, pedestrian surveys were conducted to identify barriers to fish movement. Both streams were surveyed during low flow conditions in September/October 1999. Table E3.1-12 lists the distances from the stream mouth for each potential barrier, barrier dimensions (i.e., height/length), barrier type, and the observed status of the barrier at low water levels, and the predicted status under high water levels.

At the time of the survey, the mouth of Flea Valley Creek was divided into two shallow channels that dropped off through a wide fan of cobble and rubble into the main river. The flow in the late summer and early fall can be so low that the mouth is a barrier at that time. Under most conditions during the late fall, winter and spring, the mouth is passable. During this survey, no other significant barriers were found up to the 5,092 foot mark from the mouth. It appears that this whole portion of the stream is accessible to adults from the main river. In addition, an abundant supply of gravel appropriate for trout spawning was observed throughout the section.



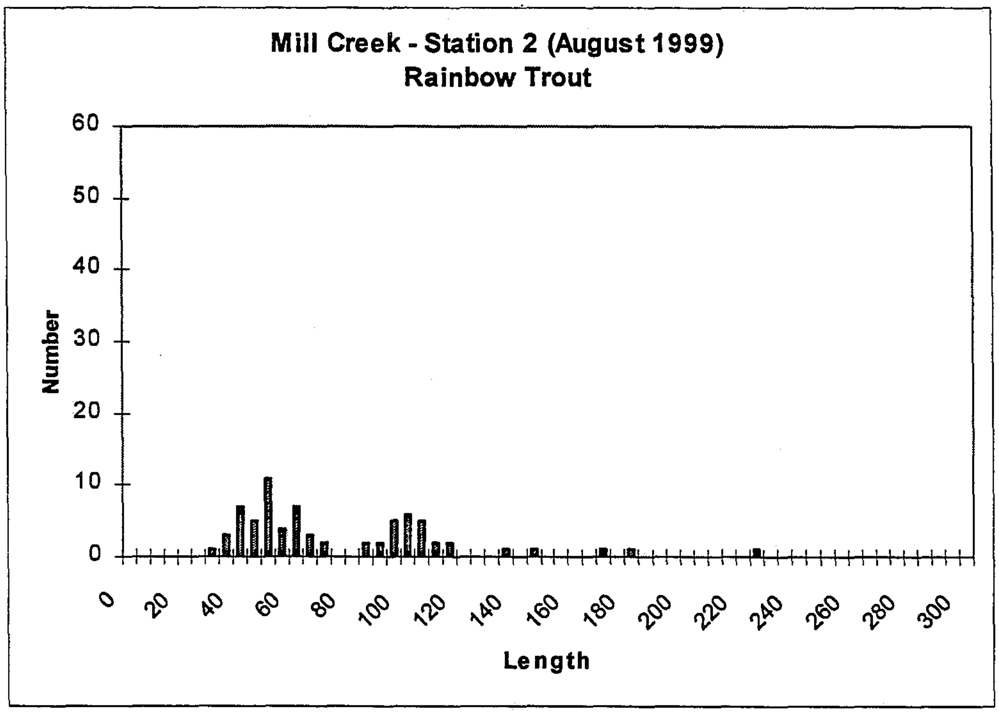




**Figure E3.1-15. Mill Creek - Rainbow Trout Length Frequencies (Aug. 1999)**

## Table 3.1-12

## Poe Project - Flea Valley Creek and Mill Creek Identification of Barriers (September 30-October 1)

| Stream | Barrier Location (Distance from Mouth) | Barrier Dimension (Height /Length) | Barrier Type | @ Low Water | @ High Water |
|---|---|---|---|---|---|
| **Flea Valley Creek** | | | | | |
| | Mouth to 30 ft Upstream | 30 ft in Length | Due to Low Water Depth @ Low Flow | Partial | No |
| – | From 1769 ft Mark to 4,840 ft Mark | 7 Partial Barriers (2-3 ft in Height) | Log Jams and Boulders | Partial | No |
| | **@ 5,092 ft Mark** | **Low Flow Barrier (4 ft in Height)** | **Log Jam** | **Yes** | **No** |
| **Mill Creek** | | | | | |
| | From Mouth to 100 ft Upstream | 20 ft - Vertical | Steep Water Flow through Boulders (Multiple Channels) | Yes | Partial |
| | **Hwy 70 Road Culvert @ 200 ft Mark** | **98 ft in Length (3% Gradient)** | **Shallow Flow in Steep Culvert** | **Yes** | **Partial** |
| | @ 515 ft Mark | 5 ft in Height | Series of Falls | Yes | Partial |
| | @ 1,325 ft Mark | 5 ft in Height | Falls | Yes | Partial |
| | **@ 1,688 ft Mark** | **10 ft in Height** | **Falls** | **Yes** | **Yes** |
| | @ 1,769 ft Mark | 5 ft in Height | Falls | Yes | Partial |
| | **@ 1,818 ft Mark** | **8 ft in Height** | **Falls** | **Yes** | **Yes** |
| | **@ 2,098 ft Mark** | **25 ft in Height** | **Falls over Bedrock** | **Yes** | **Yes** |

In Mill Creek, five partial and three complete barriers were identified between the mouth and the 2,098-foot mark. Overall, Mill Creek is larger and steeper than Flea Valley Creek. It has larger habitat features (i.e., larger, deeper pools) and larger substrate sizes (i.e., boulders and bedrock). The partial barriers include a steep cascade section of medium-sized boulders at the mouth, the Highway 70 box culvert, and three, 5-foot falls, the first of which is located about 217 feet above Highway 70. Complete barriers ranging in height from 8 to 25 feet were identified at the 1,688 , 1,818, and 2,098-foot distances from the mouth. The Highway 70 culvert was listed here as a partial barrier, because Caltrans personnel indicated that they have observed, in the recent past, large adult fish in the stream above Highway 70. However, the Highway 70 culvert appears to represent a complete blockage under most conditions. Mill Creek runs adjacent to the Caltrans property immediately above the Highway 70 crossing. A moderate amount of spawning gravel was also noted in Mill Creek during the survey.

**Observations of Adult NFFR Spawners.** Flea Valley Creek and Mill Creek were visited during the spring periods in 1999 and 2000 to observe adult rainbow trout from the main river stacking up at the mouths or moving up into the tributaries themselves for spawning. In 1999, no adults were observed, even though multiple visits to the sites were made.

However, in 2000, a number of adult rainbow trout were found in Flea Valley Creek. Sixteen adult fish were observed on March 28. These adults were observed by walking along the streambank between the railroad bridge crossing near the mouth and the upper road crossing approximately 1,300 feet upstream. In a follow-up visit site on April 7, 16 adults and 58 redds were counted between the railroad bridge and a point about 500 ft upstream from the upper road crossing.

After the initial sighting of these fish in Flea Valley Creek on March 28, visits to Mill Creek were started. No fish were observed on this first day from the streambank. Poor visibility made observations of fish from the streambank difficult at Mill Creek, so snorkeling was attempted during a subsequent visit on March 30. Snorkeling was conducted in the steep boulder section at the mouth, in the pool just below the Highway 70 box culvert, and in the stream section between the Highway 70 culvert and the first partial barrier located 217 ft upstream. No fish were observed in the boulder section at the mouth, but the falls and cascades created poor visibility. Eight large adult rainbows (definitely upstream migrants from the main river) were observed in the pool below the culvert. These fish were in addition to last year's YOY and some 1+ juveniles also found in the pool.

No large rainbows were observed in the stream section above the Highway 70 crossing. Snorkeling at these sites in Mill Creek was repeated in April, May, and June. Adult rainbows (i.e., from 5 to 10 adults) were still found in the pool on May 17, when 7 adults were observed. No adults were found during the final visit on June 27. During each of these return visits, no adults were found in the stream section above the Highway 70 crossing.

**Tributary Mouth Monitoring of YOY.** Snorkeling was conducted at the mouths of both Flea Valley Creek and Mill Creek in the early summers of 1999 and 2000. These snorkeling efforts were done to verify the recruitment of YOY trout into the main river from the two tributaries. During both years, YOY trout were observed holding in the clear water zones created by the tributary flows entering the NFFR. YOY were more abundant below Flea Valley Creek than below Mill Creek in both years (i.e., combined totals for both years of 275 at Flea Valley Creek and 63 at Mill Creek). This observation matches with the higher numbers of YOY found in Flea Valley Creek during the electrofishing surveys conducted in 1999. These relatively high numbers of YOY are a result of the adult rainbows from the NFFR successfully using Flea Valley Creek as a spawning tributary in the spring. However, the snorkeling also demonstrates that Mill Creek adds to the recruitment of YOY rainbows into the NFFR, even though the access to Mill Creek for main river adults is limited by natural and man-made barriers immediately upstream from its mouth.

### E3.1.4 Spawning Gravel / Adult Spawner Surveys– 1992, 1999, and 2003.

**Spawning Gravel Surveys.** The amount of trout spawning gravels available in various sections of the NFFR, including the Poe Reach, has been identified as one of the controlling factors that is limiting the size of trout populations within the NFFR (DWR 1986, CDFG 1988). During both of the habitat surveys along the Poe Reach conducted in 1992 and in 1999, visual estimates of the amounts and locations of suitable trout spawning gravel were made. Both surveys showed that the Poe Reach does contain some gravel in suitable locations for trout spawning, and the 1992 comparisons of gravel availability in the Poe Reach with availability in upstream reaches indicate that the Poe Reach holds more gravel. It has been postulated that this may be due to the manner in which Poe Dam is operated during spill events, which allows more sediment to move past the dam and distribute itself downstream.

A total of 151,920 square feet of suitable trout spawning gravel was documented within the Poe Reach during the 1992 habitat survey (Li and ENPLAN 1994). The gravel was more abundant in the first sub-reach below Poe Dam than in the downstream sub-reaches. About 65% of the gravel areas were either unavailable or unlikely to be used by being perched above the stream channel, located in steep cascades where water velocities are too high for successful spawning, or located in pools where water velocities are too low and water depths are too deep for spawning. During the 1999 survey, a total of 415,377 square feet of gravel was estimated proximate to the river channel. Of this total, 124,112 square feet of gravel (i.e., 30 %) was found in the water at the time of the survey. The flow in 1999 was approximately 90 cfs. A qualitative assessment of the condition of the gravel during the 1999 survey indicated that the gravel areas were not deeply embedded with fine sediment (Gast & Bremm, Pers. Comm., 1999). The gravels observed in many of the gravel sites appeared to be held loosely in place, and in suitable condition for trout.

Even though there appeared to be more available gravel for trout spawning in the Poe Reach during the 1992 and 1999 surveys than has been documented within the upper river sections, there was still a general lack of suitable spawning areas in the Poe Reach of the main river. Tributaries along the NFFR are considered very important at providing spawning habitat for adult trout from the river and for rearing and recruitment of young trout to the main river population. There are only two tributaries providing significant spawning habitat within the Poe river reach: Flea Valley Creek and Mill Creek. Both these streams enter the NFFR at the top end of the reach. Study efforts conducted in 1999 and 2000 documented the use of both streams by spawning adult rainbows from the main river and recruitment of YOY trout to the main river. Detailed results of the tributary studies are discussed in earlier sections of this document.

In a follow-up effort in 2003, detailed gravel surveys were conducted on the Poe Reach for both resident rainbow trout and for Chinook salmon and steelhead. The surveys were completed between March and June in conjunction with an adult trout spawner and redd survey. The surveys were done by accessing the complete reach by foot, and by making bankside and snorkeling observations. All gravel patches (with gravel ranging from 4-150 mm in size) greater than 1 square meter were located, measured, and marked on aerial photographs. Percent particle size was visually estimated with reference to a substrate ruler. Gravel patches within three vertical feet of the water surface were also documented and their differential elevations were noted.

As noted above, the gravel mapping was conducted on two separate trips: May 27-30, and on June 9-11. The total area of gravel measured in the Poe Reach was 12,714 $m^2$ (136,854 $ft^2$), with 9,241 $m^2$ (99,470 $ft^2$) within the wetted channel at the base flow. The flow at the time of the surveys measured at the Pulga Gage (NF 23) ranged from about 135 to 160 cfs. Gravel patches were later assessed, using the particle size information, for their potential use for spawning by chinook salmon. The criteria used in this assessment was based on the information in the California Salmonid Stream Restoration Manual, which lists the particle sizes appropriate for chinook spawning being between 0.5 to 10 inches (13 mm to 254 mm) and dominated by 1 to 3 inch (25 mm to 76 mm) gravel. This resulted in 8,879 $m^2$ (95,574 $ft^2$) of potential spawning gravel throughout the Poe Reach, with 5,906 $m^2$ (63,572 $ft^2$) currently within the wetted channel. This estimate of potential spawning area does not take into account other factors such as depth, velocity or escape cover. The amount of gravels observed in 2003 was similar in scale to what was found in earlier surveys.

**Adult Spawner Surveys.** Concurrent with the gravel mapping efforts that were conducted in 2003, multiple surveys to document adult rainbow trout spawning activity on the main river were conducted between March and into May. It is not known how much trout spawning occurs on the main river, but it is generally thought that trout do not use the main stem because the amount of gravel available is very limited. A total of five surveys were completed on approximate two-week intervals. However, the occurrence of periodic spill events in 2003 impacted when the surveys could be done effectively. The activities to be noted during the surveys included direct observations of adults exhibiting spawning behaviors (e.g., digging, chasing, grouping together, etc.) and the presence of suspected redd sites. If possible, the timing of the surveys was tied to past and on-going spawning activity that was observed in many of the main stem tributaries. The spawning period this year (2003) in tributaries to the Rock Creek and Cresta reaches of the North Fork continued through May due to the cool temperatures and precipitation in April.

Spawner surveys were not initiated until March 25, 2003 due to high flows in the Poe Reach during the spill period. Dedicated spawner surveys were conducted on the Poe Reach on March 25, 28 and 29; April 7 and 8; and April 22 and 23. Gravel mapping was combined with spawning surveys during two final field trips on May 27-30 and June 9-11. Spawning surveys consisted of two persons hiking and snorkeling the Poe Reach looking for redds and/or spawning fish. Added effort was given to two particular sites previously identified as potential spawning locations: 1) the two riffles immediately above the Mill Creek confluence where suitable gravel was abundant in the past, and 2) the riffle/run/pocket water complex immediately below the Bardee's Bar area where adult trout in reproductive condition have been caught by anglers in the past (Personal Communication, Dale Marsh).

There were no adult trout observed exhibiting spawning behavior during any of the main river 2003 surveys. Even though it can be difficult to observe trout spawning in large river systems, the survey crew indicated that the water was relatively clear and that any significant concentration of adults or redds would have been detectable. A single probable trout redd was observed on April 8 about 1.5 miles upstream of the Poe powerhouse. Six other possible redds were observed on April 7 about 200 feet upstream of the Bardee's Bar pool. The possible redd sites near Bardee's Bar were small (8") depressions with no distinct mounds, unlike typical trout redds. The steep canyon section between Bardee's Bar and the Highway 70 Bridge was surveyed only during the first and last trips due to the difficult terrain and the relative lack of suitable spawning gravel in this section. In addition to documenting adult trout, spawning activity by other fish species was noted during the surveys. On May 27, several smallmouth bass nests were observed just off the Swimmers Beach about 0.78 miles upstream of Poe Powerhouse.

Observations of trout fry on the main river were also tracked during the 2003 surveys. Almost all of the fry observed were located near the mouth of Flea Valley Creek, suggesting that they were produced by spawning adults using Flea Valley Creek. This should be no surprise, as Flea Valley Creek is known to be used heavily by main river spawners. Trout fry were first seen in 2003 at the mouth of Flea Valley Creek as early as April 7. By June 11, the numbers had steadily increased, with approximately 150 rainbow trout fry being observed around the mouth. However, a few fry were also seen at other locations on the Poe Reach. On May 28, fry were observed at three sites in the lower portion of the Poe reach located 1.3, 1.55 and 1.73 miles upstream of the Poe Powerhouse, respectively. It is possible that the fry were downriver migrants from the upper section. However, observing fry in this lower section of the reach indicates that some trout spawning may be occurring in this lower section. The single main river redd site located in this lower section noted above was within the influence of a small tributary inflow. Even though there are no major tributaries in this lower portion of the reach, smaller tributary inflows of this scale are numerous within this section, particularly in water years such as 2003 when late spring precipitation occurs.

Overall, the surveys did not document much use of the main river by rainbow trout for spawning purposes in 2003. Even though limited amounts of suitable gravel were available, trout did not appear to use it. These findings are consistent with earlier studies of the distribution of both gravel and trout fry within the river reach, indicating that the major production of YOY trout recruitment into the main river population is from the two upper tributaries (i.e., Flea Valley Creek and Mill Creek).

### E3.1.5 Entrainment Evaluation (Tailrace Monitoring)

The original proposed study plan to estimate entrainment of fish at the Poe Project included a combination of quarterly hydroacoustic sampling at the intake in Poe Reservoir and monthly fish sampling with a stationary funnel net in the Poe Powerhouse tailrace. The hydroacoustic effort was to provide estimates of the numbers and sizes of fish that entered the intake, while the tailrace effort was included to identify and verify the species and sizes of fish entrained.

In October of 1999, a test of the hydroacoustic system to be used was conducted by an outside consultant, Hydroacoustic Technology Inc. (HTI). A detailed report on the methods and results of the test prepared by (HTI 1999) is provided in Appendix E3-3. The only accessible site in the Poe tunnel to place the transducer was located near the mouth behind the stop logs. The results of the test revealed that too much entrained air exists at this site during normal operations for effective results using hydroacoustics, particularly for smaller sized fish. An alternative of mounting transducers immediately behind the trash racks was also evaluated at that time, but it was determined that the large vortex in the center of the intake bay and the structure of the intake bay itself would make it impossible to assess the final destination of fish that swim through the trash racks. The fish could enter the vortex, but they could just as easily avoid it, turn and swim back through the trash racks without being detected.

Based on the fact that hydroacoustics proved to be ineffective at the intake, the objective of the entrainment evaluation was modified from estimating entrainment numbers to a monitoring program with tailrace sampling designed to track general through-plant entrainment and to identify significant, large scale movement of fish through the powerhouse. In an effort not to miss any seasonal component of movement, the tailrace sampling was conducted monthly.

Tailrace sampling using a stationary funnel net was planned for twelve, 2-day periods between November 1999 and October 2000. The sampling was successfully completed as planned except in July; that month's effort was conducted for only 21 total hours when the attachment bolts for the net pulled out from the powerhouse wall after the first day of sampling.

During each of the monthly sampling efforts, between 10 and 20% of the cross-sectional flow were filtered with one of the two sampling gears (i.e., kodiak trawl in November and December 1999, and tailrace box net from January to October 2000). The net was positioned in the tailrace flow on the side adjacent to the land spit that separates the tailrace flow from the river flow. This allowed access to the live box from the shore when the units were brought down to minimum load. The top of the net was held at the surface with large floats, forcing the net to sample from the surface down to increase chances of catching fish that come through the powerhouse, as the water flow from the units is pushed to the surface as it enters the tailrace. The box net was designed specifically to sample the Poe tailrace. The box frame was more efficient because the sides of the net were more parallel to the flow than the Kodiak, which reduced stress on the net itself and the attachment lines and also was better at retaining smaller specimens. In addition, the rigid frame prevented the mouth of the net from closing when the powerhouse was at full load.

The results of monthly tailrace sampling efforts are shown in Table E3.1-13. A total of 238 fish was collected during the twelve months of sampling. The species breakdown included Sacramento pikeminnow (51), hardhead (37), sculpin (4), wakasagi (2), Sacramento sucker (1), and a group of unidentifiable minnows (144). None of the unidentifiable specimens were hardhead (i.e., with distinguishable frenums present). These specimens were most likely pikeminnow based on the documented abundance of pikeminnow in the NFFR upstream river reaches and reservoirs. All of the minnows collected (i.e., hardhead, pikeminnow, and unidentifiable minnows) were YOY specimens, except for three, (1+) hardhead collected in November. The 1+ hardhead were between 120 and 160 mm in length. No large adult specimens (> 200 mm) or fish parts from large specimens were found during any of the efforts.

**Table E3.1-13**

**Poe Powerhouse Monthly Tailrace Monitoring (November 1999 - October 2000)**

| Sampling Period | Net Type & Dimensions | Total Hrs Sampled | Average and (Range) of Hourly Operation | # and Species of Fish Collected | Length Range (mm) |
|---|---|---|---|---|---|
| November | Kodiak (6 X 25 ft) | 43 hours | 64% (12-100%) | Hardhead - 5 | 34-166 mm |
| December | Kodiak (6 X 25 ft) | 43 hours | 41% (0-81%) | No Fish Collected | |
| January | Box Net (8 X 10 ft) | 46 hours | 97% (0-100%) | Sculpin - 3<br>Hardhead - 3 | 62-106 mm<br>27-43 mm |
| February | Box Net (8 X 10 ft) | 45 hours | 94% (42-100%) | Sculpin - 1<br>Hardhead - 5 | 73 mm<br>25-47 mm |
| March | Box Net (8 X 10 ft) | 48 hours | 93% (20-100%) | Wakasagi - 1<br>Minnows - 134 | 101 mm<br>23-63 mm |
| April | Box Net (8 X 10 ft) | 46 hours | 75% (4-100%) | Pikeminnow - 38<br>Hardhead - 8 | 31-61 mm<br>29-53 mm |
| May | Box Net (8 X 10 ft) | 46 hours | 54% (8-100%) | Wakasagi - 1<br>Pikeminnow - 8 | 72 mm<br>31-57 mm |
| June | Box Net (8 X 10 ft) | 47 hours | 49% (16-84%) | Hardhead - 2<br>Pikeminnow - 3 | 37-80 mm<br>39-62 mm |
| July | Box Net (8 X 10 ft) | 21 hours | 63% (8-99%) | Hardhead – 5<br>Minnow – 1<br>Sucker - 1 | 31-54 mm<br>34 mm<br>22 mm |
| August | Box Net (8 X 10 ft) | 45 hours | 49% (2-100%) | Pikeminnow – 1<br>Hardhead – 3<br>Minnow - 11 | 42 mm<br>20-40 mm<br>23-45 mm |
| September | Box Net (8 X 10 ft) | 48 hours | 45% (0-98%) | Pikeminnow – 1<br>Hardhead - 4 | 39 mm<br>19-69 mm |
| October | Box Net (8 X 10 ft) | 47 hours | 49% (10-59%) | Hardhead - 2 | 44-45 mm |
| **Total** | | | | Hardhead - 37<br>Pikeminnow - 51<br>Minnows - 145<br>Sculpin - 4<br>Wakasagi – 2<br>Suckers – 1 | 19-166 mm<br>29-62 mm<br>23-63 mm<br>62-106 mm<br>72-101 mm<br>22 mm |

In general, low numbers of fish (0-15) were collected during each effort, excluding the March and April samples when 135 and 46 fish were collected, respectively. The March and April results indicate that a downstream movement of YOY fish occurred during this time period. However, it is not clear whether these fish entered the Poe intake alive or dead, as most of these specimens were dead and in poor condition when they were retrieved from the Poe tailrace live box. The fish could be dispersing voluntarily throughout the NFFR at this time of year or in response to flow increases, or there may be seasonal mortality of YOY. The March sampling followed a period of prolonged spill between February 27 and March 22 when the flows at Pulga averaged 2,036 cfs and ranged from 308 to 9,937 cfs. Prior to the April sampling effort, another period of higher flows occurred between April 13 and April 23 when the Pulga flows averaged 746 cfs. In other years, high flow levels can be more frequent and more extreme in the NFFR than during this sampling year (i.e., November 1999 through October 2000), which could result in more YOY movement and losses through the Poe Powerhouse.

A comparison of day and over-night catches shows that higher numbers of fish were collected over-night (213 fish) than during the day (20 fish). Not all of the months were included in this comparison, because the nets were sometimes not checked at the end of each day due to power generation constraints. Correcting to per hour values, the overnight catches were approximately 6 times higher than the daytime catches. These results were dominated by the March and April numbers. During both these monthly efforts, the operation of the powerhouse was constant during the sampling periods, so the observed disparity in catch rates was not a result of the powerhouse operation changes.

Overall, the monthly sampling effort does not indicate a high level of entrainment through the Poe Powerhouse. There may be a seasonal movement of YOY in the system, a portion of which may enter the intake and move through the powerhouse. Even if all of the YOY specimens are assumed to have been alive when they entered the intake, the total loss of equivalent adults would be comparatively low.

### E3.1.6 Fishing Survey

A limited fishing survey was conducted in the Poe Project area between May and November of 1999. Due to the low numbers of anglers encountered in 1999 and their limited success, a second fishing survey was not conducted in 2000. The objective of the survey was to document the current angler use of the general Poe Project area (including Poe Reservoir, the Poe Reach of the NFFR, Big Bend Reservoir, and Lake Oroville immediately below Big Bend Dam).

Eighteen census days were completed in 1999, mostly on weekends and holidays. The census focused on the early part of the trout season from May through June, but continued on a more limited basis through the rest of the fishing season in the summer and early fall. Access to most of the river reach is limited. The river reach could only be accessed from three general areas: 1) the upper end adjacent to Highway 70, 2) the middle area at Bardee's Bar, and 3) the lower end near Poe Powerhouse.

The censusing technique was a combination of interviewing fishermen and distributing census forms (with pre-addressed stamped envelopes) on parked vehicles. Information collected included: 1) the primary target species, 2) the species, number, and approximate sizes of all fish caught, 3) the start and end times for the fishing day, and 4) the angler's place of residence.

The results of the fishing survey are summarized in Table E3.1-14. On the 18 census days, 64 anglers were interviewed and a total of 27 census forms were left on parked vehicles. None of the census forms that were left on vehicles were returned. The anglers utilizing the Poe Reach were evenly spread out at the three general access areas in low numbers. No anglers were observed fishing at Poe Reservoir. However, below the formal boundaries of the Poe Project area, a relatively high number of anglers were noted fishing the NFFR arm of Lake Oroville from Big Bend Dam. Anglers accessed the dam by parking at the railroad access located adjacent to the Poe Powerhouse and walking down the railroad right-of -way. Fishing from Big Bend Dam occurred only during the spring period when Lake Oroville was high. The main target species at this site was chinook salmon, which are planted annually in Lake Oroville by CDFG to support a land-locked, trophy fishery in the lake. This is a well-known and popular fishery in the area. The NFFR arm of Lake Oroville immediately below the dam was accessed not only from both sides by foot, but also by boats from Lake Oroville which illegally cross the protective boom line located 1/8-mile below the dam.

**Table E3.1-14**

**Poe Project Sport Fishing Survey (May - November, 1999)**

| Number of Census Days | # Anglers Interviewed | # of Census Forms Left on Vehicles | # of Census Forms Returned |
|---|---|---|---|
| | | | |
| 18 | 64 | 27 | 0 |

| Census Access Points | # Anglers Interviewed | Average Fishing Effort (Hours/Day) | # and Species of Fish Caught | Catch/Hour |
|---|---|---|---|---|
| | | | | |
| **NFFR, Poe Dam to Hwy 70 Bridge** | 9 | 2 Hrs/Day | Rainbow Trout -12<br>Pikeminnow -1 | 0.7 Fish/Hr |
| | | | | |
| **NFFR, @ Bardees Bar** | 8 | 1.6 Hrs/Day | Smallmouth Bass - 1<br>Pikeminnow - 4 | 0.4 Fish/Hr |
| | | | | |
| **NFFR, Poe Powerhouse Bridge to Poe Powerhouse** | 14 | 1.2 Hrs/Day | Rainbow Trout - 3<br>Smallmouth Bass - 1<br>Pikeminnow - 1 | 0.3 Fish/Hr |
| | | | | |
| **Total for Combined Poe Reach of NFFR** | 31 | 1.5 Hrs/Day | Rainbow Trout - 15<br>Smallmouth Bass - 2<br>Pikeminnow - 6 | 0.5 Fish/Hr |
| | | | | |
| | | | | |
| **Upper End of NFFR Arm of Lake Oroville, immediately below Big Bend Dam** | 33 | 2.0 Hrs/Day | Chinook Salmon- 41<br>Rainbow Trout - 5<br>Smallmouth Bass - 1<br>Spotted/Largemouth Bass - 10<br>Pikeminnow - 2<br>Unknown -2 | 0.9 Fish/Hr |
| | | | | |

The species caught in the Poe Reach included rainbow trout, smallmouth bass, and Sacramento pikeminnow. Typically, pikeminnow were caught while fishing for the other species. In general, the fishing was marginal as reflected by the survey, but the true success rate is difficult to evaluate when the actual effort is so low. This is pointed out by the fact that 12 of the 15 rainbow trout reported were from two anglers fishing during one afternoon and evening. The fishing in the spring at the Big Bend Dam should be considered as a separate fishery. Certainly, the success rate is much higher here, with chinook salmon dominating the catch. Other species caught at the dam included, smallmouth bass, spotted bass, largemouth bass, rainbow trout, and pikeminnow.

The angler use of the Poe Reach of the NFFR is low due to multiple factors which include: 1) low to moderate abundances of sport fish (primarily rainbow trout and smallmouth bass), 2) poor access between the Highway 70 Bridge and the Poe Powerhouse, and 3) more accessible fishing locations farther up the NFFR canyon with higher abundances of trout and better chances for success. However, the Poe Reach does provide some opportunities for anglers during the late fall and winter when the upper areas are closed to fishing.

### E3.1.7 Macroinvertebrate Surveys

The macroinverterate studies that have been conducted to date in the Poe Reach include a 1992 benthic and drift survey related to the proposed SPT project, a two-phased sampling effort in 1999 and 2000, and repeated sampling efforts in 2001 and 2002 at the sampling sites established in 2000. The 1999-2002 sampling was done to characterize the macroinvertebrates currently utilizing the Poe Reach, and to evaluate applicability of the California Stream Bioassessment Procedure for assessing flow impacts on the macroinvertebrate community.

**1992 Macroinvertebrate Invertebrate Survey - Benthic and Drift Sampling.**

Invertebrate fauna were characterized in the Poe Reach by benthic sampling and by drift sampling, as part of the background data collection for the proposed SPT project (Fields 1993). In conjunction, gamefish were collected from the river reach and their stomach contents were analyzed.

The number of species collected from the Poe Reach (benthos and drift combined) was 102, and was similar to the diversity found in the Rock Creek and Cresta reaches. The benthic samples from Poe averaged 177 organisms per sample, similar in density to Cresta but lower than Rock Creek. Both rainbow trout (7 adults, 1 juvenile, and 2 YOY) and smallmouth bass (4 juveniles and 6 YOY) were collected in the Poe Reach for stomach content analysis. At least 25 species of aquatic organisms were consumed by the rainbow trout, and 9 species were found in the smallmouth stomachs. Drifting organisms were more important to both groups, and included mayflies, caddisflies, blackflies, and water boatmen.

**1999 and 2000 Macroinvertebrate Baseline Surveys.** In support of the project relicensing, macroinvertebrate sampling was conducted in a two-phased approach over two years (i.e., 1999 and 2000). The purposes of the surveys were to describe the general macroinvertebrate community within the Poe Reach, and to evaluate the applicability of the California Stream Bioassessment Procedure (CSBP) to assess impacts of flow changes on the macroinvertebrate community. The first year's effort in the Poe Reach was associated with similar sampling in the Rock Creek, Cresta, and Belden river reaches, and was limited to a single sampling site near Pulga in the Poe Reach. This site was located between the Highway 70 Bridge and Flea Valley Creek. The second year was an expansion of the first sampling program and included multiple sites throughout the Poe Reach.

**2001 and 2002 Macroinvertebrate Baseline Surveys.** The third and fourth year surveys were continued efforts at the same sampling sites established in 2000. The main purpose of these continued efforts was to further describe the macroinvertebrate community with an emphasis on documenting the variation observed in the metric values over multiple baseline years. The observed variation will be one of the factors that will be used to evaluate the application of the CSBP method to assess impacts of future flow changes.

The specifics of the sampling methodology are provided in the consultant reports (Hydrozoology, 2000a), (Hydrozoology, 2000b), (Hydrozoology, 2001), and (Ganda, 2003) provided in Appendices E3-4-E3-7. In general, the methods outlined in the California Stream Bioassessment Procedues (CSBP) were followed (CDFG 1999). For every sample reach, the CSBP Physical Habitat Quality and California Bioassessment Worksheet forms were filled out. Copies of the original forms are included with the summary reports. In the laboratory, all organisms were identified to the species level, if possible, using available keys. Species lists and counts for each sample are presented within the technical reports. The data from the species lists were used to calculate the suite of metrics, which includes measures of richness, composition, tolerance/intolerance, and functional feeding groups. The following discussion of results is a summary of the information provided in the technical reports.

The metrics generated from the species data are in four general categories: 1) species richness and diversity measures, 2) EPT composition measures, 3) tolerance/intolerance measures, and 4) functional feeding group measures.

Species richness and diversity measures are viewed as ways of describing the number of ecological niches present in the river ecosystem and the overall health of the macroinvertebrate community. The EPT composition measures and the tolerance/intolerance values are two ways to group macroinvertebrates that are sensitive or intolerant to disturbance. The fourth measure is a percentage value that reflects relative abundances by functional feeding group (e.g., percentage of collector/gatherers, filterers, shredders, etc.).

To place these metrics in perspective, evaluating what the values mean relative to other non-project sites and how to deal with observed variation in values needs to be developed.

An attempt to proceed in this direction for the two main metrics (richness and diversity) is provided within the 2001 technical report (Hydrozoology, 2001), where a categorization scheme (see Table E3.1-15) is proposed to assess species richness and diversity values for the Feather River system. The categorization scheme is based on samples that have been taken from a combination of regulated and unregulated river reaches including the Middle Fork Feather, the East Branch, Upper Butt Valley Creek, Yellow Creek, the upper North Fork between Canyon Dam and the North Fork, and the Rock Creek and Cresta reaches. This scheme provides a range of values by which current samples can be judged. As an example, for the 2002 samples, mean richness (37) and diversity (3.46) rated as "moderate" overall.

**Table E3.1-15**

**Suggested Benthic Invertebrate Community Conditions Classification Scheme for the Feather River (Hydrozoology 2001)**

| Mean Species Richness | Mean Brillouin Diversity | Benthic Community Condition |
|---|---|---|
| < 25 | < 1.25 | extremely poor |
| 25 - 30 | 1.25 - 2.50 | poor |
| 31 - 35 | 2.51 - 3.00 | fair |
| 36 - 40 | 3.01 - 3.50 | moderate |
| 41 - 45 | 3.51 - 4.00 | good |
| 46 - 50 | 4.01 - 4.25 | very good |
| > 50 | > 4.25 | excellent |

**1999 Results.** The results of the 1999 effort in the Poe Reach (near Pulga) are shown in Table E3.1-16 (Hydrozoology 2000 (a)). Only the results from the Poe Reach are shown here, while the results from the other reaches of the NFFR and a reference site on the East Branch of the NFFR are provided in the report provided in Appendix E 3-4.

In the 1999 survey, the single Poe station at Pulga showed a relatively low species richness value when compared to the other sites (i.e., Cresta, Rock Creek, and Belden reaches), while the species diversity indices showed moderate values. The tolerance/intolerance measures were generally low throughout the North Fork. However, species from the families Hydropsychidae and Baetidae (i.e., two tolerant groups that are expected to be more common with increased habitat degradation) were the most dominant taxa in all reaches including the Poe Reach. The functional feeding group data for Poe, when compared to the other NFFR sites, show that collectors/gatherers were found at substantial levels, filterers were common, and shredders were in low abundance.

## Table E3.1-16

### Macroinvertebrate Survey (Phase 1) - October 1999

| Month and Year | Station Location | # of Sites Sampled |
|---|---|---|
| | | |
| October 1999 | From 0.1 Mile above Hwy 70 Bridge to 0.5 Mile Upriver (Pulga) | 3 |
| | | |

| | Poe River Section | | | |
|---|---|---|---|---|
| | | | | |
| **RICHNESS MEASURES** | Site 1 | Site 2 | Site 3 | Total |
| | | | | |
| Species Richness | 38 | 33 | 36 | 52 |
| EPT Species | 17 | 15 | 16 | 21 |
| Ephemeroptera Species | 5 | 5 | 5 | 6 |
| Plecoptera Species | 3 | 4 | 4 | 5 |
| Trichoptera Species | 9 | 6 | 7 | 10 |
| | | | | |
| **COMPOSITION MEASURES** | Site 1 | Site 2 | Site 3 | Mean |
| | | | | |
| EPT Index | 79.1 | 79.7 | 68.9 | 75.9 |
| Sensitive EPT Index | 5.8 | 4.6 | 5.0 | 5.1 |
| Brillouin Diversity Index, H | 3.60 | 3.36 | 3.80 | 3.59 |
| Shannon Diversity Index, H' | 3.86 | 3.55 | 4.06 | 3.82 |
| | | | | |
| **TOLERANCE / INTOLERANCE MEASURES** | Site 1 | Site 2 | Site 3 | Mean |
| | | | | |
| % Intolerant Species | 8.5 | 4.6 | 5.0 | 6.0 |
| % Tolerant Species | 1.6 | 1.9 | 5.0 | 2.5 |
| % Hydropsychidae | 51.3 | 53.5 | 34.1 | 46.3 |
| % Baetidae | 8.5 | 13.0 | 10.3 | 10.6 |
| % Dominant Taxon | 24.2 | 27.8 | 17.5 | 23.2 |
| | | | | |
| **FUNCTIONAL FEEDING GROUP MEASURES** | Site 1 | Site 2 | Site 3 | Mean |
| | | | | |
| % Collectors | 18.6 | 20.2 | 27.4 | 22.1 |
| % Filterers | 61.6 | 65.9 | 59.3 | 62.3 |
| % Shredders | 3.3 | 5.1 | 4.6 | 4.3 |
| | | | | |

In the 1999 report, Fields points out that the characteristics of the macroinvertebrate community in the Rock Creek, Cresta, and Poe reaches are impacted to varying degrees by the boulder-dominated streambed, the lack of riffle habitat, the lack of riparian vegetation, side-casting from construction/maintenance of Highway 70 and the railroad, and poor land use practices in the East Branch watershed.

2000 Results - The results of the sampling in 2000 in the Poe Reach are shown in Table E3.1-17 and Table E3.1-18 (Hydrozoology 2000 (b)). The sampling sites in 2000 included the Pulga location from 1999, a Bardee's Bar site in the middle of the river reach, and a site near the Poe Powerhouse bridge at the lower end of the reach (Figure E3.1-16). Sampling was also conducted at a potential reference location on the Middle Fork of the Feather River. However, the results are not included here, because it was determined, at a later date that the Middle Fork site was too much higher in elevation than the Poe Reach, and therefore would not be an appropriate reference.

In 2000, the upper Pulga site showed the highest species richness. However, the diversity values (i.e., a blend of species number and their evenness) were more similar between the three sites. The comparison between the two years (1999 and 2000) showed increases in species richness and species diversity values in the 2000 samples. The EPT species found in the Poe Reach were actually of moderate sensitivity, and were consistent during both year's efforts. However, the overall EPT index dropped in the second year, while the sensitive EPT index remained close to the same level.

## Table E3.1-17

## Poe Project - Macroinvertebrate Survey (Phase 2) - September 2000 (Species Richness and Species Composition Measures)

| | Poe River Reach | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Poe Powerhouse | | | Bardee's Bar | | | Pulga | | |
| | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 |
| **RICHNESS MEASURES** | | | | | | | | | |
| | | | | | | | | | |
| Species Richness | 38 | 25 | 41 | 28 | 39 | 31 | 40 | 38 | 58 |
| **Total (Mean)** | **51 (35)** | | | **49 (33)** | | | **69 (45)** | | |
| | | | | | | | | | |
| Species Diversity (H) | 4.1 | 3.59 | 3.94 | 3.26 | 3.60 | 3.34 | 4.12 | 3.93 | 4.50 |
| **(Mean)** | **(3.88)** | | | **(3.40)** | | | **(4.18)** | | |
| | | | | | | | | | |
| | | | | | | | | | |
| **COMPOSITION MEASURES** | Poe Powerhouse | | | Bardee's Bar | | | Pulga | | |
| | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 |
| | | | | | | | | | |
| EPT Species | 20 | 13 | 19 | 16 | 18 | 15 | 17 | 17 | 22 |
| **Total (Mean)** | **21 (17)** | | | **21 (16)** | | | **27 (19)** | | |
| | | | | | | | | | |
| Ephemeroptera Species | 7 | 6 | 7 | 6 | 6 | 5 | 5 | 6 | 7 |
| **Total (Mean)** | **7 (7)** | | | **6 (6)** | | | **9 (6)** | | |
| | | | | | | | | | |
| Plecoptera Species | 3 | 2 | 2 | 5 | 4 | 3 | 2 | 4 | 5 |
| **Total (Mean)** | **4 (2)** | | | **6 (4)** | | | **6 (4)** | | |
| | | | | | | | | | |
| Trichoptera Species | 10 | 5 | 10 | 5 | 8 | 7 | 10 | 7 | 10 |
| **Total (Mean)** | **10 (8)** | | | **9 (7)** | | | **12 (9)** | | |
| | | | | | | | | | |
| EPT Index | 61.6 | 50.0 | 70.5 | 83.4 | 75.6 | 77.3 | 55.6 | 66.2 | 63.6 |
| **(Mean)** | **(60.7)** | | | **(78.8)** | | | **(61.8)** | | |
| | | | | | | | | | |
| Sensitive EPT Index | 2.0 | 1.4 | 2.5 | 3.9 | 2.7 | 4.8 | 2.2 | 7.2 | 4.6 |
| **(Mean)** | **(2.0)** | | | **(3.8)** | | | **(4.6)** | | |
| | | | | | | | | | |
| | | | | | | | | | |

# Table E3.1-18

## Poe Project - Macroinvertebrate Survey (Phase 2) - September 2000
## (Tolerance/Intolerance Measures and Functional Feeding Groups)

| | Poe River Reach | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Poe Powerhouse | | | Bardee's Bar | | | Pulga | | |
| | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 |
| **TOLERANCE / INTOLERANCE MEASURES** | | | | | | | | | |
| | | | | | | | | | |
| % Intolerant Species | 2.4 | 1.4 | 2.5 | 3.9 | 2.7 | 4.8 | 1.9 | 7.2 | 4.6 |
| **(Mean)** | | **(2.1)** | | | **(3.8)** | | | **(4.6)** | |
| – | | | | | | | | | |
| % Tolerant Species | 2.0 | 1.0 | 1.8 | 0.0 | 2.0 | 0.0 | 1.9 | 0.6 | 4.3 |
| **(Mean)** | | **(1.6)** | | | **(0.6)** | | | **(2.3)** | |
| | | | | | | | | | |
| % Hydropsychidae | 25.0 | 7.0 | 29.9 | 19.3 | 13.0 | 39.2 | 16.2 | 27.2 | 29.5 |
| **(Mean)** | | **(20.6)** | | | **(23.8)** | | | **(24.3)** | |
| | | | | | | | | | |
| % Baetidae | 20.2 | 23.1 | 24.5 | 29.8 | 38.8 | 17.8 | 17.2 | 11.8 | 10.2 |
| **(Mean)** | | **(22.6)** | | | **(28.8)** | | | **(13.1)** | |
| | | | | | | | | | |
| % Dominant Taxon | 13.4 | 18.2 | 17.4 | 25.9 | 28.1 | 17.5 | 14.1 | 16.6 | 11.8 |
| **(Mean)** | | **(16.3)** | | | **(23.8)** | | | **(14.2)** | |
| | | | | | | | | | |
| **FUNCTIONAL FEEDING GROUP MEASURES** | | | | | | | | | |
| | | | | | | | | | |
| % Collectors | 39.0 | 49.6 | 38.8 | 35.2 | 50.5 | 28.1 | 36.5 | 31.4 | 33.1 |
| **(Mean)** | | **(43.8)** | | | **(37.8)** | | | **(33.7)** | |
| | | | | | | | | | |
| % Filterers | 36.6 | 40.9 | 35.2 | 52.1 | 35.8 | 61.2 | 43.4 | 50.8 | 46.9 |
| **(Mean)** | | **(37.6)** | | | **(46.8)** | | | **(47.0)** | |
| | | | | | | | | | |
| % Shredders | 2.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.6 | 2.5 | 1.5 | 1.3 |
| **(Mean)** | | **(0.6)** | | | **(0.3)** | | | **(1.8)** | |
| | | | | | | | | | |

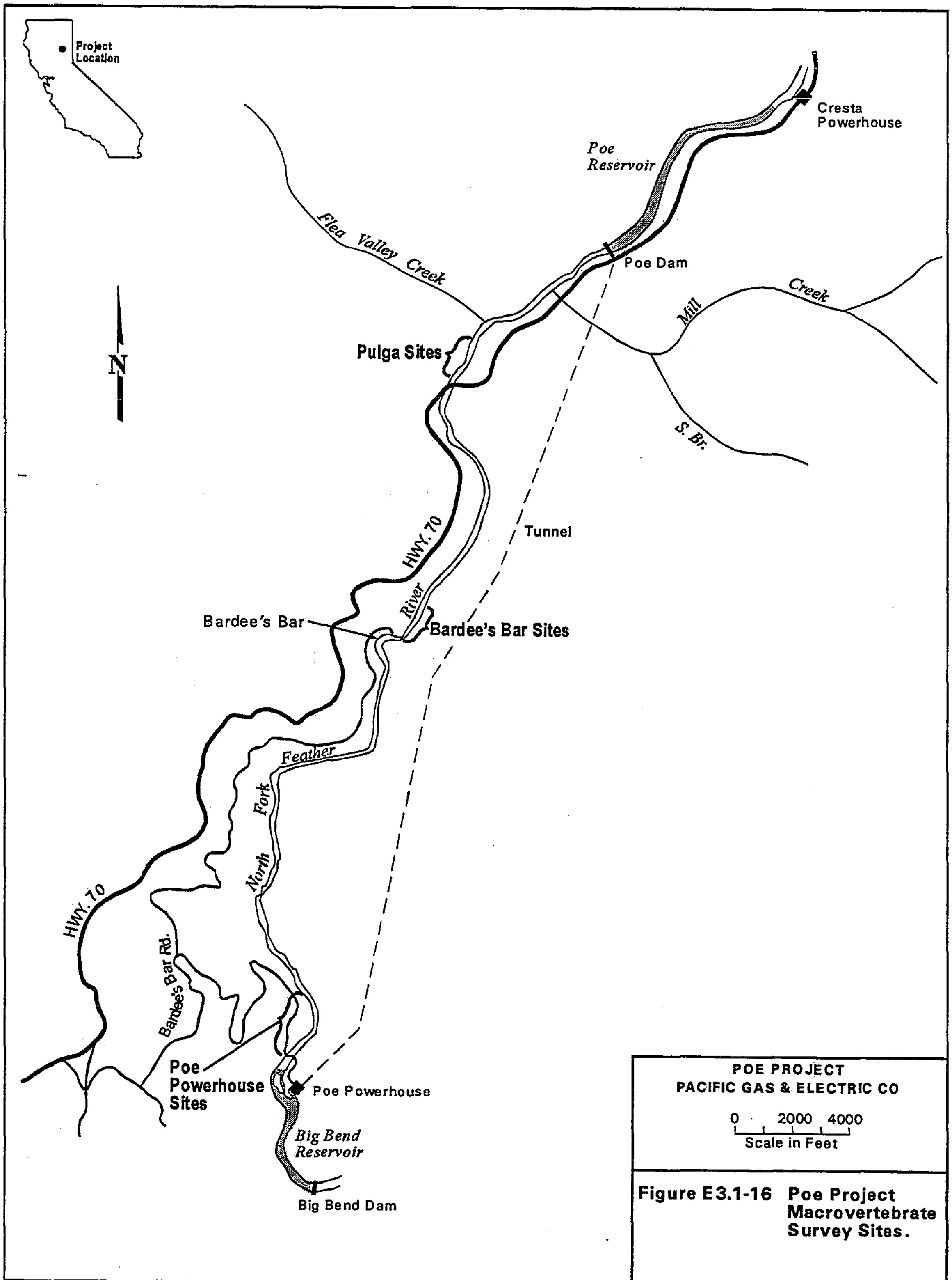



Figure E3.1-16 Poe Project Macrovertebrate Survey Sites.

980780/Poe invertebrate

In the Poe Reach, two fairly tolerant species from the families Baetidae and Hydropsychidae dominated the samples in both years. The only significant change between 1999 and 2000 occurred in the category % Hydropsychidae, where a decline from 46.3% to 24.3% was observed. If conditions improve for macroinvertebrates, one should expect increases in the abundances of the more sensitive and intolerant species.

The collectors/gatherers in 2000 were distributed in slightly increasing levels from the upper to the lower end of the Poe Reach, while the filterers were more highly concentrated in the upper two reaches than in the lower reach. The within-site variability with both these groupings was high in 2000. Comparing the Pulga site in 1999, some shifts did occur in 2000, with the collector/gatherer group increasing by 52% and the filterers decreasing by 25%. The sizes of the shredder population were consistently low during both years, most likely a reflection of the lack of existing riparian growth along the NFFR.

**2001 and 2002 Macroinvertebrate Repeat Surveys.**

2001 Results - The results of the sampling in 2001 in the Poe Reach are shown in Table E3.1-19 and Table E3.1-20 (Hydrozoology 2001), while the 2002 results are shown in Table E3.1-21 and Table E3.1-22 (Ganda 2003). The sites established in 2000 were repeated in the 2001 and 2002 efforts.

## Table E3.1-19

## Poe Project - Macroinvertebrate Survey - October 2001
## (Species Richness and Species Composition Measures)

| | Poe River Reach | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Poe Powerhouse | | | Bardee's Bar | | | Pulga | | |
| | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 |
| **RICHNESS MEASURES** | | | | | | | | | |
| | | | | | | | | | |
| Species Richness | 34 | 29 | 20 | 25 | 31 | 26 | 41 | 39 | 34 |
| **Total (Mean)** | | **42 (28)** | | | **38 (27)** | | | **54 (38)** | |
| – | | | | | | | | | |
| Species Diversity (H) | 3.34 | 3.23 | 2.73 | 3.17 | 3.03 | 2.74 | 4.00 | 3.81 | 3.81 |
| **(Mean)** | | **(3.10)** | | | **(2.98)** | | | **(3.87)** | |
| | | | | | | | | | |
| | | | | | | | | | |
| **COMPOSITION MEASURES** | Poe Powerhouse | | | Bardee's Bar | | | Pulga | | |
| | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 |
| | | | | | | | | | |
| EPT Species | 8 | 8 | 7 | 11 | 12 | 13 | 12 | 12 | 11 |
| **Total (Mean)** | | **10 (8)** | | | **16 (12)** | | | **16 (12)** | |
| | | | | | | | | | |
| Ephemeroptera Species | 4 | 4 | 3 | 3 | 3 | 4 | 4 | 3 | 3 |
| **Total (Mean)** | | **5 (4)** | | | **4 (3)** | | | **4 (3)** | |
| | | | | | | | | | |
| Plecoptera Species | 0 | 0 | 0 | 1 | 2 | 3 | 0 | 2 | 2 |
| **Total (Mean)** | | **0 (0)** | | | **3 (2)** | | | **2 (1)** | |
| | | | | | | | | | |
| Trichoptera Species | 4 | 4 | 4 | 7 | 7 | 6 | 8 | 7 | 7 |
| **Total (Mean)** | | **5 (4)** | | | **9 (7)** | | | **10 (7)** | |
| | | | | | | | | | |
| EPT Index | 56.8 | 52.5 | 56.2 | 60.5 | 73.8 | 50.8 | 53.3 | 52.9 | 54.3 |
| **(Mean)** | | **(55.2)** | | | **(61.7)** | | | **(52.5)** | |
| | | | | | | | | | |
| Sensitive EPT Index | 1.1 | 0.3 | 1.8 | 1.5 | 1.7 | 1.5 | 0.7 | 1.4 | 3.0 |
| **(Mean)** | | **(1.1)** | | | **(1.6)** | | | **(1.7)** | |
| | | | | | | | | | |

## Table E3.1-20

**Poe Project - Macroinvertebrate Survey – October 2001**
**(Tolerance/Intolerance Measures and Functional Feeding Groups)**

| | Poe River Reach | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Poe Powerhouse | | | Bardee's Bar | | | Pulga | | |
| | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 |
| **TOLERANCE / INTOLERANCE MEASURES** | | | | | | | | | |
| | | | | | | | | | |
| % Intolerant Species | 1.4 | 0.3 | 1.8 | 1.5 | 2.0 | 1.5 | 1.0 | 1.4 | 3.0 |
| **(Mean)** | | **(1.2)** | | | **(1.7)** | | | **(1.8)** | |
| | | | | | | | | | |
| % Tolerant Species | 1.1 | 3.2 | 0.3 | 1.2 | 0.3 | 1.2 | 1.8 | 0.7 | 0.6 |
| **(Mean)** | | **(1.5)** | | | **(0.9)** | | | **(1.0)** | |
| | | | | | | | | | |
| % Hydropsychidae | 18.0 | 5.0 | 10.6 | 14.2 | 19.1 | 14.5 | 29.5 | 29.5 | 29.8 |
| **(Mean)** | | **(11.2)** | | | **(15.6)** | | | **29.6** | |
| | | | | | | | | | |
| % Baetidae | 35.6 | 42.8 | 27.7 | 36.5 | 46.4 | 31.1 | 16.8 | 15.6 | 11.6 |
| **(Mean)** | | **(35.4)** | | | **(38.0)** | | | **(14.7)** | |
| | | | | | | | | | |
| % Dominant Taxon | 35.2 | 39.8 | 27.6 | 34.4 | 41.1 | 33.8 | 15.1 | 21.0 | 16.4 |
| **(Mean)** | | **(34.2)** | | | **(36.4)** | | | **(17.5)** | |
| | | | | | | | | | |
| **FUNCTIONAL FEEDING GROUP MEASURES** | | | | | | | | | |
| | | | | | | | | | |
| % Collectors | 60.4 | 68.1 | 39.8 | 55.6 | 54.2 | 40.6 | 50.9 | 37.3 | 29.0 |
| **(Mean)** | | **(56.1)** | | | **(50.1)** | | | **(39.1)** | |
| | | | | | | | | | |
| % Filterers | 29.8 | 18.9 | 59.3 | 35.0 | 44.2 | 56.3 | 32.6 | 48.8 | 54.9 |
| **(Mean)** | | **(36.2)** | | | **(44.2)** | | | **(45.4)** | |
| | | | | | | | | | |
| % Shredders | 1.1 | 1.5 | 0 | 0.3 | 0.3 | 0.0 | 2.8 | 3.4 | 1.2 |
| **(Mean)** | | **(0.9)** | | | **(0.2)** | | | **(2.5)** | |
| | | | | | | | | | |

## Table E3.1-21

## Poe Project - Macroinvertebrate Survey - October 2002
## (Species Richness and Species Composition Measures)

| | Poe River Reach | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Poe Powerhouse | | | Bardee's Bar | | | Pulga | | |
| | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 |
| **RICHNESS MEASURES** | | | | | | | | | |
| | | | | | | | | | |
| Species Richness | 45 | 42 | 33 | 34 | 33 | 34 | 40 | 34 | 35 |
| **Total (Mean)** | | **62 (40)** | | | **54 (34)** | | | **53 (36)** | |
| – | | | | | | | | | |
| Species Diversity (H) | 3.61 | 3.73 | 3.53 | 3.37 | 3.25 | 3.14 | 3.69 | 3.56 | 3.30 |
| **(Mean)** | | **(3.62)** | | | **(3.25)** | | | **(3.52)** | |
| | | | | | | | | | |
| | | | | | | | | | |
| **COMPOSITION MEASURES** | Poe Powerhouse | | | Bardee's Bar | | | Pulga | | |
| | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 |
| | | | | | | | | | |
| EPT Species | 17 | 14 | 12 | 16 | 11 | 14 | 14 | 11 | 12 |
| **Total (Mean)** | | **20 (14)** | | | **20 (14)** | | | **17 (12)** | |
| | | | | | | | | | |
| Ephemeroptera Species | 7 | 5 | 5 | 5 | 4 | 5 | 3 | 3 | 4 |
| **Total (Mean)** | | **7 (6)** | | | **6 (5)** | | | **4 (3)** | |
| | | | | | | | | | |
| Plecoptera Species | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 |
| **Total (Mean)** | | **3 (1)** | | | **3 (1)** | | | **2 (2)** | |
| | | | | | | | | | |
| Trichoptera Species | 8 | 8 | 6 | 10 | 5 | 8 | 10 | 6 | 6 |
| **Total (Mean)** | | **10 (7)** | | | **11 (8)** | | | **11 (7)** | |
| | | | | | | | | | |
| EPT Index | 69.2 | 63.1 | 45.2 | 81.3 | 74.3 | 71.5 | 41.1 | 43.8 | 74.2 |
| **(Mean)** | | **(59.1)** | | | **(75.7)** | | | **(53.0)** | |
| | | | | | | | | | |
| Sensitive EPT Index | 2.9 | 2.5 | 2.2 | 2.1 | 2.3 | 1.8 | 2.6 | 1.8 | 2.6 |
| **(Mean)** | | **(2.5)** | | | **(2.1)** | | | **(2.4)** | |
| | | | | | | | | | |

## Table E3.1-22

### Poe Project - Macroinvertebrate Survey - October 2002
### (Tolerance/Intolerance Measures and Functional Feeding Groups)

| | Poe River Reach | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Poe Powerhouse | | | Bardee's Bar | | | Pulga | | |
| | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 |
| **TOLERANCE / INTOLERANCE MEASURES** | | | | | | | | | |
| | | | | | | | | | |
| % Intolerant Species | 4.1 | 3.2 | 3.1 | 3.0 | 2.6 | 2.1 | 2.6 | 2.6 | 2.6 |
| **(Mean)** | | **(3.5)** | | | **(2.6)** | | | **(2.6)** | |
| | | | | | | | | | |
| % Tolerant Species | 8.3 | 7.0 | 6.5 | 3.6 | 3.0 | 2.7 | 13.5 | 4.4 | 2.0 |
| **(Mean)** | | **(7.3)** | | | **(3.1)** | | | **(6.6)** | |
| | | | | | | | | | |
| % Hydropsychidae | 19.4 | 21.7 | 7.5 | 37.4 | 27.6 | 22.3 | 12.5 | 23.2 | 55.2 |
| **(Mean)** | | **(16.2)** | | | **(29.1)** | | | **(30.3)** | |
| | | | | | | | | | |
| % Baetidae | 35.9 | 27.7 | 20.9 | 31.8 | 34.2 | 40.7 | 9.2 | 12.9 | 10.8 |
| **(Mean)** | | **(28.2)** | | | **(35.5)** | | | **(11.0)** | |
| | | | | | | | | | |
| % Dominant Taxon | 34.0 | 26.8 | 20.2 | 27.6 | 32.6 | 38.9 | 25.3 | 28.3 | 33.0 |
| **(Mean)** | | **(27.0)** | | | **(33.0)** | | | **(28.9)** | |
| | | | | | | | | | |
| **FUNCTIONAL FEEDING GROUP MEASURES** | | | | | | | | | |
| | | | | | | | | | |
| % Collectors | 43.8 | 33.4 | 22.4 | 37.1 | 39.8 | 43.6 | 17.4 | 18.8 | 16.3 |
| **(Mean)** | | **(33.2)** | | | **(40.2)** | | | **(17.5)** | |
| | | | | | | | | | |
| % Filterers | 37.5 | 50.0 | 62.3 | 49.3 | 45.7 | 40.9 | 36.5 | 67.6 | 65.0 |
| **(Mean)** | | **(49.9)** | | | **(45.3)** | | | **(56.4)** | |
| | | | | | | | | | |
| % Shredders | 0.6 | 0.6 | 0.3 | 0.3 | 0.3 | 1.5 | 0.0 | 0.0 | 1.0 |
| **(Mean)** | | **(0.5)** | | | **(0.7)** | | | **(0.3)** | |
| | | | | | | | | | |

Species richness and diversity in 2001 followed the same pattern observed in 2000 with higher numbers of species and greater diversity at the Pulga site than the other two sites, while the richness and diversity values in 2002 were highest at the lower-most Poe Powerhouse site. The EPT measures in 2001 and 2002 were more inconsistent between years, with the fewest EPT species at Poe Powerhouse in 2001 and the fewest at Pulga in 2002. The percentage index values for tolerant and intolerant species were low in both 2001 and 2002, even though the values in 2002 were higher than in the past for both categories. In general, most of the organisms in the Poe Reach are of moderate sensitivity. The percentages of collector/gatherers and filterers dominate the functional feeding group results for all of the years, even though the variation between years is high. The percentage of shredders has been low for each year, and is a direct reflection of the lack of woody debris and heavy riparian systems in the NFFR canyon.

**Metric Comparisons (1999-2002).** Data metrics for the 1999-2002 period are provided for annual comparison purposes in Tables E3.1-23 through E3.1-28. For the Pulga station over the four-year period, species richness by replicate site ranged from 33 to 41 species, and the species diversity values ranged from 3.30 to 4.50. Based on the proposed categorization of richness and diversity values for the Feather River system referenced previously (Hydrozoology 2001), species richness ranged from fair to good while the diversity values ranged from moderate to excellent. For the Bardee's Bar station over a three-year period, species richness ranged from 25 species (poor) to 39 species (fair), and the species diversity values ranged from 2.74 (fair) to 3.60 (good).

# Table E3.1-23

## Poe Project - Macroinvertebrate Surveys (Species Richness and Composition)
## Pulga (1999 - 2002)

| Poe River Reach – Pulga Station | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | October 1999 | | | September 2000 | | | October 2001 | | | October 2002 | | |
| | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 |
| **RICHNESS MEASURES** | | | | | | | | | | | | |
| Species Richness | 38 | 33 | 36 | 40 | 38 | 58 | 41 | 39 | 34 | 40 | 34 | 35 |
| **Total (Mean)** | | **52 (35)** | | | **69 (45)** | | | **54 (38)** | | | **53 (36)** | |
| Species Diversity(H) | 3.60 | 3.36 | 3.80 | 4.12 | 3.93 | 4.50 | 4.00 | 3.81 | 3.81 | 3.69 | 3.56 | 3.30 |
| **(Mean)** | | **(3.59)** | | | **(4.18)** | | | **(3.87)** | | | **(3.52)** | |
| **COMPOSITION MEASURES** | | | | | | | | | | | | |
| EPT Species | 17 | 15 | 16 | 17 | 17 | 22 | 12 | 12 | 11 | 14 | 11 | 12 |
| **Total (Mean)** | | **21 (16)** | | | **27 (19)** | | | **16 (12)** | | | **17 (12)** | |
| Ephemeroptera Species | 5 | 5 | 5 | 5 | 6 | 7 | 4 | 3 | 3 | 3 | 3 | 4 |
| **Total (Mean)** | | **6 (5)** | | | **9 (6)** | | | **4 (3)** | | | **4 (3)** | |
| Plecoptera Species | 3 | 4 | 4 | 2 | 4 | 5 | 0 | 2 | 2 | 1 | 2 | 2 |
| **Total (Mean)** | | **5 (4)** | | | **6 (4)** | | | **2 (1)** | | | **2 (2)** | |
| Trichoptera Species | 9 | 6 | 7 | 10 | 7 | 10 | 8 | 7 | 7 | 10 | 6 | 6 |
| **Total (Mean)** | | **10 (7)** | | | **12 (9)** | | | **10 (7)** | | | **11 (7)** | |
| EPT Index | 79.1 | 79.7 | 68.9 | 55.6 | 66.2 | 63.6 | 53.3 | 52.9 | 54.3 | 41.1 | 43.8 | 74.2 |
| **(Mean)** | | **(75.9)** | | | **(61.8)** | | | **(52.5)** | | | **(53.0)** | |
| Sensitive EPT Index | 5.8 | 4.6 | 5.0 | 2.2 | 7.2 | 4.6 | 0.7 | 1.4 | 3.0 | 2.6 | 1.8 | 2.6 |
| **(Mean)** | | **(5.1)** | | | **(4.6)** | | | **(1.7)** | | | **(2.4)** | |

## Table E3.1-24

**Poe Project - Macroinvertebrate Surveys (Tolerance/Intolerance and Functional Feeding)**
**Pulga (1999 - 2002)**

| Poe River Reach – Pulga Station | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | October 1999 | | | September 2000 | | | October 2001 | | | October 2002 | | |
| | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 |
| **TOLERANCE / INTOLERANCE MEASURES** | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| % Intolerant Species | 8.5 | 4.6 | 5.0 | 1.9 | 7.2 | 4.6 | 1.0 | 1.4 | 3.0 | 2.6 | 2.6 | 2.6 |
| **(Mean)** | | **(6.0)** | | | **(4.6)** | | | **(1.8)** | | | **(2.6)** | |
| | | | | | | | | | | | | |
| % Tolerant Species | 1.6 | 1.9 | 5.0 | 1.9 | 0.6 | 4.3 | 1.8 | 0.7 | 0.6 | 13.5 | 4.4 | 2.0 |
| **(Mean)** | | **(2.5)** | | | **(2.3)** | | | **(1.0)** | | | **(6.6)** | |
| | | | | | | | | | | | | |
| % Hydropsychidae | 51.3 | 53.5 | 34.1 | 16.2 | 27.2 | 29.5 | 29.5 | 29.5 | 29.8 | 12.5 | 23.2 | 55.2 |
| **(Mean)** | | **(46.3)** | | | **(24.3)** | | | **(29.6)** | | | **(30.3)** | |
| | | | | | | | | | | | | |
| % Baetidae | 8.5 | 13.0 | 10.3 | 17.2 | 11.8 | 10.2 | 16.8 | 15.6 | 11.6 | 9.2 | 12.9 | 10.8 |
| **(Mean)** | | **(10.6)** | | | **(13.1)** | | | **(14.7)** | | | **(11.0)** | |
| | | | | | | | | | | | | |
| % Dominant Taxon | 24.2 | 27.8 | 17.5 | 14.1 | 16.6 | 11.8 | 15.1 | 21.0 | 16.4 | 25.3 | 28.3 | 33.0 |
| **(Mean)** | | **(23.2)** | | | **(14.2)** | | | **(17.5)** | | | **(28.9)** | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| **FUNCTIONAL FEEDING GROUP MEASURES** | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| % Collectors | 18.6 | 20.2 | 27.4 | 36.5 | 31.4 | 33.1 | 50.9 | 37.3 | 29.0 | 17.4 | 18.8 | 16.3 |
| **(Mean)** | | **(22.1)** | | | **(33.7)** | | | **(39.1)** | | | **(17.5)** | |
| | | | | | | | | | | | | |
| % Filterers | 61.6 | 65.9 | 59.3 | 43.4 | 50.8 | 46.9 | 32.6 | 48.8 | 54.9 | 36.5 | 67.6 | 65.0 |
| **(Mean)** | | **(62.3)** | | | **(47.0)** | | | **(45.4)** | | | **(56.4)** | |
| | | | | | | | | | | | | |
| % Shredders | 3.3 | 5.1 | 4.6 | 2.5 | 1.5 | 1.3 | 2.8 | 3.4 | 1.2 | 0.0 | 0.0 | 1.0 |
| **(Mean)** | | **(4.3)** | | | **(1.8)** | | | **(2.5)** | | | **(0.3)** | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

## Table E3.1-25

**Poe Project - Macroinvertebrate Surveys (Species Richness and Composition)**
**Bardee's Bar (2000 - 2002)**

| Poe River Reach – Bardee's Bar Station | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | September 2000 | | | October 2001 | | | October 2002 | | |
| | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 |
| **RICHNESS MEASURES** | | | | | | | | | |
| | | | | | | | | | |
| Species Richness | 28 | 39 | 31 | 25 | 31 | 26 | 34 | 33 | 34 |
| **Total (Mean)** | **49 (33)** | | | **38 (27)** | | | **54 (34)** | | |
| | | | | | | | | | |
| Species Diversity (H) | 3.26 | 3.60 | 3.34 | 3.17 | 3.03 | 2.74 | 3.37 | 3.25 | 3.14 |
| **(Mean)** | **(3.40)** | | | **(2.98)** | | | **(3.25)** | | |
| | | | | | | | | | |
| | | | | | | | | | |
| **COMPOSITION MEASURES** | | | | | | | | | |
| | | | | | | | | | |
| EPT Species | 16 | 18 | 15 | 11 | 12 | 13 | 16 | 11 | 14 |
| **Total (Mean)** | **21 (16)** | | | **16 (12)** | | | **20 (14)** | | |
| | | | | | | | | | |
| Ephemeroptera Species | 6 | 6 | 5 | 3 | 3 | 4 | 5 | 4 | 5 |
| **Total (Mean)** | **6 (6)** | | | **4 (3)** | | | **6 (5)** | | |
| | | | | | | | | | |
| Plecoptera Species | 5 | 4 | 3 | 1 | 2 | 3 | 1 | 2 | 1 |
| **Total (Mean)** | **6 (4)** | | | **3 (2)** | | | **3 (1)** | | |
| | | | | | | | | | |
| Trichoptera Species | 5 | 8 | 7 | 7 | 7 | 6 | 10 | 5 | 8 |
| **Total (Mean)** | **9 (7)** | | | **9 (7)** | | | **11 (8)** | | |
| | | | | | | | | | |
| EPT Index | 83.4 | 75.6 | 77.3 | 60.5 | 73.8 | 50.8 | 81.3 | 74.3 | 71.5 |
| **(Mean)** | **(78.8)** | | | **(61.7)** | | | **(75.7)** | | |
| | | | | | | | | | |
| Sensitive EPT Index | 3.9 | 2.7 | 4.8 | 1.5 | 1.7 | 1.5 | 2.1 | 2.3 | 1.8 |
| **(Mean)** | **(3.8)** | | | **(1.6)** | | | **(2.1)** | | |
| | | | | | | | | | |

## Table E3.1-26

**Poe Project - Macroinvertebrate Surveys (Tolerance/Intolerance and Functional Feeding) Bardee's Bar (2000 - 2002)**

| Poe River Reach – Bardee's Bar Station | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | September 2000 | | | October 2001 | | | October 2002 | | |
| | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 |
| **TOLERANCE / INTOLERANCE MEASURES** | | | | | | | | | |
| | | | | | | | | | |
| % Intolerant Species | 3.9 | 2.7 | 4.8 | 1.5 | 2.0 | 1.5 | 3.0 | 2.6 | 2.1 |
| **(Mean)** | | **(3.8)** | | | **(1.7)** | | | **(2.6)** | |
| | | | | | | | | | |
| % Tolerant Species | 0.0 | 2.0 | 0.0 | 1.2 | 0.3 | 1.2 | 3.6 | 3.0 | 2.7 |
| **(Mean)** | | **(0.6)** | | | **(0.9)** | | | **(3.1)** | |
| | | | | | | | | | |
| % Hydropsychidae | 19.3 | 13.0 | 39.2 | 14.2 | 19.1 | 14.5 | 37.4 | 27.6 | 22.3 |
| **(Mean)** | | **(23.8)** | | | **(15.6)** | | | **(29.1)** | |
| | | | | | | | | | |
| % Baetidae | 29.8 | 38.8 | 17.8 | 36.5 | 46.4 | 31.1 | 31.8 | 34.2 | 40.7 |
| **(Mean)** | | **(28.8)** | | | **(38.0)** | | | **(35.5)** | |
| | | | | | | | | | |
| % Dominant Taxon | 25.9 | 28.1 | 17.5 | 34.4 | 41.1 | 33.8 | 27.6 | 32.6 | 38.9 |
| **(Mean)** | | **(23.8)** | | | **(36.4)** | | | **(33.0)** | |
| | | | | | | | | | |
| | | | | | | | | | |
| **FUNCTIONAL FEEDING GROUP MEASURES** | | | | | | | | | |
| | | | | | | | | | |
| % Collectors | 35.2 | 50.5 | 28.1 | 55.6 | 54.2 | 40.6 | 37.1 | 39.8 | 43.6 |
| **(Mean)** | | **(37.8)** | | | **(50.1)** | | | **(40.2)** | |
| | | | | | | | | | |
| % Filterers | 52.1 | 35.8 | 61.2 | 35.0 | 44.2 | 56.3 | 49.3 | 45.7 | 40.9 |
| **(Mean)** | | **(46.8)** | | | **(44.2)** | | | **(45.3)** | |
| | | | | | | | | | |
| % Shredders | 0.0 | 0.3 | 0.6 | 0.3 | 0.3 | 0.0 | 0.3 | 0.3 | 1.5 |
| **(Mean)** | | **(0.3)** | | | **(0.2)** | | | **(0.7)** | |
| | | | | | | | | | |
| | | | | | | | | | |

## Table E3.1-27

**Poe Project - Macroinvertebrate Surveys (Species Richness and Composition)**
**Poe Powerhouse (2000 - 2002)**

| Poe River Reach – Poe Powerhouse Station | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | September 2000 | | | October 2001 | | | October 2002 | | |
| | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 |
| **RICHNESS MEASURES** | | | | | | | | | |
| Species Richness | 38 | 25 | 41 | 34 | 29 | 20 | 45 | 42 | 33 |
| **Total (Mean)** | **51 (35)** | | | **42 (28)** | | | **62 (40)** | | |
| Species Diversity (H) | 4.1 | 3.59 | 3.94 | 3.34 | 3.23 | 2.73 | 3.61 | 3.73 | 3.53 |
| **(Mean)** | **(3.88)** | | | **(3.10)** | | | **(3.62)** | | |
| **COMPOSITION MEASURES** | | | | | | | | | |
| EPT Species | 20 | 13 | 19 | 8 | 8 | 7 | 17 | 14 | 12 |
| **Total (Mean)** | **21 (17)** | | | **10 (8)** | | | **20 (14)** | | |
| Ephemeroptera Species | 7 | 6 | 7 | 4 | 4 | 3 | 7 | 5 | 5 |
| **Total (Mean)** | **7 (7)** | | | **5 (4)** | | | **7 (6)** | | |
| Plecoptera Species | 3 | 2 | 2 | 0 | 0 | 0 | 2 | 1 | 1 |
| **Total (Mean)** | **4 (2)** | | | **0 (0)** | | | **3 (1)** | | |
| Trichoptera Species | 10 | 5 | 10 | 4 | 4 | 4 | 8 | 8 | 6 |
| **Total (Mean)** | **10 (8)** | | | **5 (4)** | | | **10 (7)** | | |
| EPT Index | 61.6 | 50.0 | 70.5 | 56.8 | 52.5 | 56.2 | 69.2 | 63.1 | 45.2 |
| **(Mean)** | **(60.7)** | | | **(55.2)** | | | **(59.1)** | | |
| Sensitive EPT Index | 2.0 | 1.4 | 2.5 | 1.1 | 0.3 | 1.8 | 2.9 | 2.5 | 2.2 |
| **(Mean)** | **(2.0)** | | | **(1.1)** | | | **(2.5)** | | |

## Table E3.1-28

### Poe Project - Macroinvertebrate Surveys (Tolerance/Intolerance and Functional Feeding) Poe Powerhouse (2000 - 2002)

| Poe River Reach – Poe Powerhouse Station | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | September 2000 | | | October 2001 | | | October 2002 | | |
| | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 | Site 1 | Site 2 | Site 3 |
| **TOLERANCE / INTOLERANCE MEASURES** | | | | | | | | | |
| % Intolerant Species | 2.4 | 1.4 | 2.5 | 1.4 | 0.3 | 1.8 | 4.1 | 3.2 | 3.1 |
| **(Mean)** | | **(2.1)** | | | **(1.2)** | | | **(3.5)** | |
| % Tolerant Species | 2.0 | 1.0 | 1.8 | 1.1 | 3.2 | 0.3 | 8.3 | 7.0 | 6.5 |
| **(Mean)** | | **(1.6)** | | | **(1.5)** | | | **(7.3)** | |
| % Hydropsychidae | 25.0 | 7.0 | 29.9 | 18.0 | 5.0 | 10.6 | 19.4 | 21.7 | 7.5 |
| **(Mean)** | | **(20.6)** | | | **(11.2)** | | | **(16.2)** | |
| % Baetidae | 20.2 | 23.1 | 24.5 | 35.6 | 42.8 | 27.7 | 35.9 | 27.7 | 20.9 |
| **(Mean)** | | **(22.6)** | | | **(35.4)** | | | **(28.2)** | |
| % Dominant Taxon | 13.4 | 18.2 | 17.4 | 35.2 | 39.8 | 27.6 | 34.0 | 26.8 | 20.2 |
| **(Mean)** | | **(16.3)** | | | **(34.2)** | | | **(27.0)** | |
| **FUNCTIONAL FEEDING GROUP MEASURES** | | | | | | | | | |
| % Collectors | 39.0 | 49.6 | 38.8 | 60.4 | 68.1 | 39.8 | 43.8 | 33.4 | 22.4 |
| **(Mean)** | | **(43.8)** | | | **(56.1)** | | | **(33.2)** | |
| % Filterers | 36.6 | 40.9 | 35.2 | 29.8 | 18.9 | 59.3 | 37.5 | 50.0 | 62.3 |
| **(Mean)** | | **(37.6)** | | | **(36.2)** | | | **(49.9)** | |
| % Shredders | 2.0 | 0.0 | 0.0 | 1.1 | 1.5 | 0 | 0.6 | 0.6 | 0.3 |
| **(Mean)** | | **(0.6)** | | | **(0.9)** | | | **(0.5)** | |

For the Poe Powerhouse station, species richness ranged from 20 species (extremely poor) to 45 species (good), and the species diversity values ranged from 2.73 (fair) to 4.10 (very good). Based on average species richness and diversity, the Pulga station is in moderate to good shape, Bardee's Bar is in fair condition, and Poe Powerhouse is intermediate in fair to good condition.

Overall, the between year, between station, and between site replicate variability observed at the Poe sampling locations is high for many of the metrics, including the two most dependable metrics, species richness and diversity. Base flows, on the other hand, have been fairly consistent over the baseline period. Even though it is possible to evaluate these sites in relation to others in a qualitative sense based on the monitoring to date, attempting to tie the observed variation quantitatively to a single or multiple causative factors will be difficult.

### E3.1.8 Sensitive Aquatic Species

The following sections summarize information on sensitive fish, amphibians, and reptiles within the Project area. The initial step taken to assess sensitive species in the project area was to collect all known data on listed species through CDFG's California Natural Diversity Data Base (CNDDB) system.

#### E3.1.8.1 Sensitive Fish Species

There are no fish species within the Poe Project area currently listed or proposed for listing under either the Federal Endangered Species Act (FESA) or the California

Endangered Species Act (CESA). However, there are two fish species of special concern that could be found in the Poe Project area: 1) hardhead (*Mylopharadon conocephalus*), a California Special Concern Species and a Forest Sensitive Species, and 2) Sacramento perch (*Archoplithys interruptus*), a California Special Concern Species.

Hardhead - The hardhead is a large native minnow endemic to the Sacramento River and San Joaquin River watersheds. It is the only fish species with special status known to reside in the Poe Project area. During the 1992 fish surveys, hardhead were abundant in Poe Reservoir, but only a few were found in the Poe Reach of the NFFR, concentrated in the lower sub-reach near the Poe Powerhouse. Hardhead were also abundant in Rock Creek and Cresta reservoirs during the 1992 sampling.

The fish population studies in 1999 and 2000 confirmed that hardhead are found in large numbers relative to other species within both Poe Reservoir and Big Bend Reservoir, but in low abundance throughout the Poe Reach. Tables E3.1-2 and Table E3.1-10 (i.e., results from boat electrofishing surveys) show the relative abundances of hardhead in the reservoir areas, while Table E3.1-4 and Figure E3.1-8 (i.e., results from the quantitative snorkeling surveys in 1992, 1999, and 2000) illustrate the lower numbers within the river reach. The results from the additional fish population surveys conducted in the river reach (i.e., large pool qualitative snorkeling, large pool electrofishing and gill netting, and density estimates from the instream flow study species suitability data analysis) support the conclusion that hardhead abundance is relatively low in the Poe Reach. As expected, more hardhead were found in pools than in other habitat types, but their distribution was more spread out over the complete reach than was suggested by the 1992 snorkeling data.

In general, hardhead appear to do well in the small regulating reservoirs associated with the NFFR projects. However, they are not very abundant within the Poe river reach, which may be a function of periodic high winter and spring flows, competition with other species during juvenile and adult life stages, or direct predation by other species on YOY and juvenile hardhead. This is surprising considering that they are very common in the Rock Creek and Cresta river reaches immediately upstream.

Sacramento Perch - The Sacramento perch is the only species of the sunfish and bass family (Centrarchidae) native to California waters. Even though Sacramento perch has not been documented in the Poe Project area, populations do exist in reservoirs in the upper NFFR drainage (e.g., Lake Almanor and Butt Valley Reservoir). Individuals could be transported downstream into the Poe Project area during high flow periods or through other natural or unnatural dispersal mechanisms (e.g., entrainment at upstream projects). This species has been out-competed throughout most of its original habitat in the Central Valley by introduced centrarchids (i.e., bluegill, crappie, and black bass), but it has been introduced into several reservoirs, including Lake Almanor. However, Sacramento perch would not be expected to do well in small reservoirs like Poe and Big Bend with short residence times, large fluctuations in flow and water level, and existing populations of smallmouth bass. Its current distribution is limited to isolated reservoirs or farm ponds in the state, or highly alkaline reservoirs where they seem to do well. In addition, populations have been established in out-of-state reservoirs to support localized sport fisheries, particularly in Nevada, Colorado, and Utah (CDFG 1989).

### E3.1.8.2 Sensitive Amphibians and Aquatic Reptiles

The following sensitive amphibians and aquatic reptiles were considered to have potential for occurring in the Poe Project area and, thus, were addressed within this relicensing effort: the California red-legged frog (*Rana aurora draytonii*), the foothill yellow-legged frog (*Rana boylii*), and the western pond turtle (*Clemmys marmorata*). A summary of the status, range, life history, and preferred habitat for these species is provided below. In addition, an overview of general and species-specific surveys conducted in the Poe Project area for sensitive amphibians and aquatic reptiles is included.

**California Red-Legged Frog (CRLF).** The CRLF is listed as a threatened species under the Federal Endangered Species Act (FESA) and is designated as a California Special Concern Species by the California Department of Fish and Game (CDFG). On March 13, 2001, the United States Fish and Wildlife Service (USFWS) formally announced a final determination of critical habitat for the CRLF (Federal Register Volume 66, Number 49). The final determination of 4.1 million acres of land included a core recovery unit (Unit 1, North Fork Feather Unit in Plumas and/or Butte counties) along the NFFR and selected tributary drainages. However, in November 2002, the USFWS eliminated all but 200,000 acres of critical habitat for the CRLF in a settlement of a suit brought by the Home Builders Association of Northern California. This settlement removed the critical habitat

Unit 1 along the NFFR. The USFWS plans to publish a proposed Revised Rule by March 2004 and a Final Revised Rule by November 2005.

CRLF occur in isolated ponds or pools of intermittent or perennial stream courses where water remains long enough for breeding and development of young. The highest densities of frogs are found in dense emergent or shoreline vegetation closely associated with deep (> 2.3 ft), still or slow-moving water (Jennings and Hayes 1994). Historically, CRLF populations were found from Shasta County to Baja California, along both the coast range and the west slope of the Sierra Nevada Mountains at elevations below 4,500 ft (Jennings and Hayes 1994). The current range is greatly reduced, with a few, highly restricted populations in the Sierra Nevada Mountains. In general, the decline of CRLF has been attributed to habitat exploitation, competition with bullfrogs and fish, and predation by bullfrogs and fish. The nearest known occurrence of CRLF to the Project area is in the headwaters of a small creek, approximately 6 km east of Poe Powerhouse (CDFG 2003).

**California Red-Legged Frog Surveys**

As part of relicensing the Rock Creek-Cresta Project (FERC 1962), field surveys for CRLF habitat were conducted in 1998 along the NFFR (including the Poe Project area) (EA Engineering and Ibis 1998a). Potential breeding habitat was identified at one site in the immediate vicinity of the Poe Project, and potential dispersal habitat was identified at seven other sites. To determine if CRLF were present, protocol-level surveys (USFWS

1997) were conducted at the potential breeding habitat site. No CRLF were found during this effort (EA Engineering and Ibis 1998b).

Additional amphibian surveys, including informal surveys for CRLF, were conducted in June 2000 by Garcia and Associates (GANDA). Riparian and stream habitats in the Project area were searched utilizing the basic techniques described by Fellers and Freel (1995). No CRLF were found during these surveys. However, two other amphibian species were found. Pacific treefrogs (*Hyla regilla)*, both adults and tadpoles, were common in backwater and stagnant pools throughout the Poe Reach. Foothill yellow-legged frogs were also documented in several locations within the reach, and are discussed in more detail in the subsequent sections. In addition, no incidental sightings of CRLF were documented during other relicensing studies conducted in the Poe Project area during the 1999-2000 study period.

In general, the steep topography and rocky substrate in this portion of the NFFR canyon does not provide suitable habitat for CRLF. The only suitable habitat along the NFFR occurs at off-channel sites where ponds or pools have formed as a result of ground disturbances caused by mining, road building, and other activities.

**Foothill Yellow-Legged Frog (FYLF).** The FYLF is designated as a Federal Special Concern species under the FESA, a Forest Service Sensitive species, and a California Special Concern species by CDFG. FYLF occur in the Coast Ranges from the Oregon border south to the Transverse Mountains in Los Angeles County, in most of northern

California west of the Sierra Cascade crest, and along the Coast Ranges north of Monterey. Its elevation range extends from sea level to 6,000 ft (1,830 m) in the Sierra (Stebbins 2003). The FYLF is found in or near rocky streams or rivers in a variety of habitats, including valley-foothill hardwood, valley-foothill hardwood-conifer, valley-foothill riparian, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadow types. Streams and rivers with riffles and at least cobble-sized substrates, and partial shade are its preferred habitat (Hayes and Jennings 1998, Van Wagner 1996).

Adult frogs are primarily diurnal and occupy home ranges with a mean diameter of 14 m (Van Wagner 1996). In the spring adult frogs move longer distances to breeding sites, including a mean linear distance of 54 m and maximum distances of over 400 m recorded by Van Wagner (1996) for both males and females. The FYLF is characterized by breeding sites that are often separated by large distances of hundreds or thousands of meters (Ashton et al. 2003). Tadpoles generally remain around remnant egg masses for several days before dispersing into interstices in the gravel or moving downstream to areas of moderate flow. In the fall Van Wagner (1996) found that recently metamorphosed frogs dispersed both up and downstream in the river channel from their tadpole habitats. A maximum dispersal distance of 555 m over 95 days was recorded for a dispersing juvenile.

Habitat use by FYLF is complex as different life stages and sexes uses different habitats. Breeding most often occurs in depositional areas such as point bars and cobble/boulder bars at pool outlets (Yarnell 2000, Van Wagner 1996). After breeding, adults disperse with adult females using deep pools, possibly to avoid predation (Van Wagner 1996). By fall and winter both adult males and females were found primarily near pools while juveniles were found at riffles on main stem rivers. Tributaries may be used by both juveniles and adults as refuges from summer heat and from high water flows in winter and spring (Ashton et al. 2003).

On the Poe Reach, surveys have documented seasonal movements of adult frogs from tributaries to the main stem of the NFFR during April (in 2003). During surveys conducted in May 2003 on Flea Valley Creek, numbers of adult frogs observed increased from 2 on May 15 to 11 adult frogs May 22. During fall 2003 surveys on the Poe Reach and associated tributaries, adult frogs were observed in tributaries up to 1,000 m above the main stem NFFR, while most juveniles remained on the river.

Egg laying usually follows the period of high flow discharge associated with winter rainfall and snowmelt, mostly in May and early June, but sometimes beginning as early as March or as late as July (Storer 1925, Grinnell et al. 1930, Wright and Wright 1949, PG&E unpubl. data, pers. comm., S. Kupferberg 2001). Eggs hatch in 5-36 days (Zweifel, 1955, Kupferberg, 1996, Lind, pers. observ.), and tadpoles metamorphose in three to four months. Breeding may occur the spring following metamorphosis for males but probably begins for females and most males in the second year after metamorphosis. The oldest documented FYLF was a three year old female (Van Wagner 1996).

**Foothill Yellow-Legged Frog Occurrence in the Project Area**

In the Poe Project area, FYLF were initially observed on both Mill Creek and Flea Valley Creek during electrofishing surveys in August 1999 (Pacific Gas and Electric Company 1999). FYLF were also documented during the spring and summer of 2000 at multiple locations along the NFFR within the Poe Project area. These locations are: 1) at the mouth of Mill Creek, and downstream of the mouth of Mill Creek; 2) in the vicinity of the mouth of Flea Valley Creek, and downstream of the of Flea Valley Creek; 3) Bardee's Bar; 4) approximately ½ mile upstream of Poe Powerhouse (Swimmer's Beach); and 5) adjacent to the Poe Powerhouse. Sightings at these locations included tadpoles, metamorphs (transforming tadpoles), juveniles/subadults, and adults.

A series of surveys and special studies related to amphibians, particularly FYLF, were conducted in the Poe Reach in 2000, 2001, 2002, and 2003. The efforts in 2000 included general and targeted surveys to document presence and distribution of amphibians, and focused surveys before, during, and after high flows associated with whitewater rafting and IFIM studies. Those efforts have been expanded each year to include added monitoring (frequency and area), and targeted special studies designed to address specific issues (e.g., a 2002 evaluation of FYLF habitat availability at five flow levels [GANDA 2003a] and tadpole attrition studies in 2003 [GANDA 2003b]).

**2000 Amphibian Surveys**

In the spring of 2000, general amphibian surveys were conducted along the NFFR to determine presence of amphibians and western pond turtle (see Aquatic Reptile section for western pond turtle results). These surveys followed the basic techniques described in Fellers and Freel (1995) and were focused on FYLF, CRLF, and western pond turtle. The surveys were conducted along the NFFR from Poe Powerhouse to Bardee's Bar and from Pulga (Flea Valley Creek area) to Poe Dam. During these surveys, adult, juvenile, and larval FYLF were found at scattered locations throughout the Poe Reach. Sightings of adult and juvenile FYLFs on the NFFR were primarily at or near small stream or spring confluences. FYLF tadpoles were found in slow-moving side channels with cobble and sedges (*Carex* sp.). In April 2000, an incidental sighting of an adult FYLF was documented along the Bardee's Bar Road at an intermittent stream crossing. During the general amphibian surveys in 2000, no CRLF were observed.

**2000 Foothill Yellow-Legged Frog Survey**

Targeted surveys for the FYLF were conducted throughout the Poe Reach in August, September, October, and December 2000 at locations where FYLFs were previously documented in the Poe Reach (Figure E3.1-17) including: 1) NFFR in the vicinity of Flea Valley Creek, 2) NFFR at Bardee's Bar, 3) NFFR approximately ½-mile upstream of Poe Powerhouse, 4) NFFR at Poe Powerhouse, 5) Flea Valley Creek, 6) Mill Creek, and 7) a perennial tributary (unnamed) to NFFR located approximately 1/3-mile downstream of Bardee's Bar. The purpose of the surveys was to determine presence, general distribution, and relative abundance (including life stage) of FYLF at selected locations along the NFFR between Poe Dam and Poe Powerhouse, and in several perennial tributaries (Figure E3.1-17).

During the late August and early September surveys, the highest concentration of FYLF on the NFFR was found in the upper section of the Poe Reach near Flea Valley Creek and Mill Creek. A moderate number were observed in the lower section of the reach near the Poe Powerhouse, and the fewest were found in the vicinity of Bardee's Bar (Table E3.1-29). For the tributary locations, the highest number of FYLF were found in Flea Valley Creek, followed by Mill Creek, and the small, unnamed tributary located downriver from Bardee's Bar (Table E3.1-30 and Table E3.1-31).

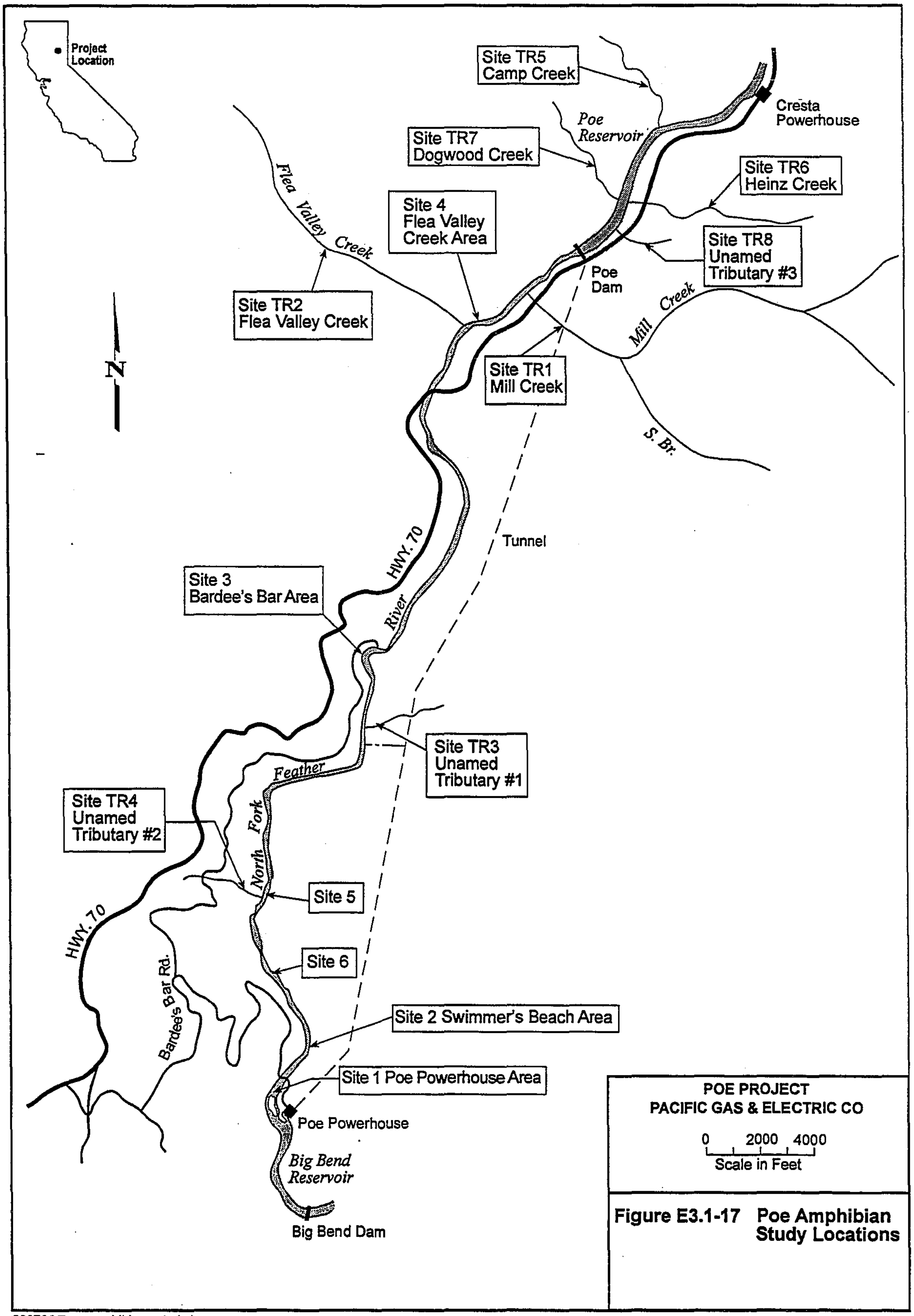



**Figure E3.1-17 Poe Amphibian Study Locations**

980780/Poe amphibians study locs

**Other Studies Performed in 2000**

**Whitewater Test Flow Monitoring.** Recreational whitewater tests were conducted on the Poe Reach in late May 2000. Flows of 500, 800, and 1400 cfs were provided in the reach over three consecutive days (May 19, 20, and 21). A team of kayakers evaluated the reach from the whitewater recreation perspective by running the reach from Mill Creek to the Poe Powerhouse each day. During these test days, various sites within the reach were visited to monitor potential displacement of aquatic organisms (primarily fish and amphibians) from shoreline habitats at the elevated flow levels. Potential stranding during the following flow decreases each afternoon and the overall change in abundance of aquatic organisms in shoreline habitats following the three-day series of flow changes also was monitored.

## Table E 3.1-29
## Location and Microhabitat Observations of Foothill Yellow-Legged Frogs – Main Stem Locations, Poe Reach, August and September 2000

| Site | Date | FYLF Observations[2] | Location[1] |
|---|---|---|---|
| Near Flea Valley Cr. | | | |
| 1A | 8/30/00 | 46 Juveniles (21-25 mm SVL) | In willow side-channel habitat and along high gradient riffle (HGR) |
| 1A | 8/30/00 | 4 Metamorphs (hind legs only) | RB NFFR in stranded pools, and along low gradient riffle |
| 1B | 8/31/00 | 17 Juveniles (21-25 mm SVL) | Found under cobble along wetted bank of NFFR. |
| 1B | 8/31/00 | 8 Metamorphs (hind legs only) | Found under cobble along wetted bank of NFFR. |
| 1C | 8/31/00 | 6 Juveniles (23-25 mm SVL) | Elevated spring-fed pool ~80 ft downstream of gravel bar |
| 1C | 8/31/00 | 2 Metamorphs | Elevated spring-fed pool ~80 ft downstream of gravel bar |
| 1C | 8/31/00 | 88 Juveniles (23-25 mm SVL) | Boulder sedge habitat downstream of elevated pool |
| 1C | 8/31/00 | 6 Metamorphs | Boulder sedge habitat downstream of elevated pool |
| **Total Juveniles/subadults: 157** | | **Total Metamorphs: 20** | **Total Adults: 0** |
| | | | |
| At Bardee's Bar | | | |
| 2A | 9/07/00 | 8 Juveniles (~23 mm SVL) | Along water's edge on wet rocks |
| 2B | 9/07/00 | 1 Juvenile | Found near tail-out of pond in boulder/pool habitat |
| 2B | 9/07/00 | 1 Adult | Found near tail-out of pond in boulder/pool habitat |
| **Total Juveniles/subadults: 9** | | **Total Metamorphs: 0** | **Total Adults: 1** |
| | | | |
| Above Poe Powerhouse Bridge (1/4 mile) | | | |
| 3A | 9/01/00 | 9 Juveniles (23-25 mm SVL) | Frogs on sandy bank in backwater area and on cobble along shoreline |
| 3B | 9/01/00 | 34 Juveniles (23-28 mm SVL) | Frogs on wet gravel/cobble concentrated at tail-out of pool adjacent to fast water |
| 3A | 9/07/00 | 5 Juveniles (20-30 mm SVL) | Frogs on cobble and rocks along shoreline |
| 3B | 9/07/00 | 6 Juveniles | Frogs on wet rocks, gravel, and sand along shoreline, and small backwater area along LB bedrock wall |
| **Total Juveniles/subadults: 54** | | **Total Metamorphs: 0** | **Total Adults: 0** |
| | | | |
| Adjacent to Poe Powerhouse | | | |
| 4A | 9/01/00 | 5 Juveniles (20-25 mm SVL) | All found in side pool adjacent to LGR at top |
| 4B | 9/01/00 | 6 Juveniles (20-25 mm SVL) | On gravel, rocks, and wet soil associated with sedge clumps |
| 4B | 9/01/00 | 2 Adults (~ 50 mm SVL) | On rocks along shore – dove into water and took cover in algae |
| **Total Juveniles/subadults: 11** | | **Total Metamorphs: 0** | **Total Adults: 2** |

1) SVL= Snout to Vent Length, RB = Right Bank, LB = Left Bank, HGR = High Gradient Riffle, LGR = Low Gradient Riffle.
2) Approximate FYLF Life Stage Length Categories: Adults ≥40mm, Juvenile/subadult <40mm, Metamorphs = Larvae w/legs.

## Table E3.1-30

### Location and Microhabitat Observations of Foothill Yellow-Legged Frogs
### Tributary Locations – Mill Creek and Flea Valley Creek, Poe Reach, August 2000

| Mill Creek (TR1) | .FYLF Observations[1] | Location and Microhabitat |
|---|---|---|
| From confluence with NFFR to Highway 70 culvert (approximately 200 ft) | 3 Juveniles (23, 25, 25 mm SVL)<br>1 Adult (65 mm SVL) | One juvenile observed on bank of NFFR associated with a trickle of water from spring, and two juveniles were observed adjacent to main flow of creek near a small pool.<br>Adult on cobble bank about 1ft from the water, at the base of a boulder/cobble cascade/pool. |
| From the Highway 70 culvert upstream approximately 2,000 ft | 1 Adult (no SVL)<br>1 Adult (68 mm SVL)<br>1 Adult (40-50mm SVL) | Adult on dry boulder along riffle/cascade.<br>Adult on boulder next to cascade in cascade/pool area.<br>Subadult on dry boulder next to deep pool (4 ft). |
| **Total Juveniles/subadults: 3** | **Total Metamorphs: 0** | **Total Adults: 4** |

| Flea Valley Creek (TR2)[1] | FYLF Observations[2] | Location and Microhabitat |
|---|---|---|
| Along Flea Valley Creek within 50 ft of NFFR | 6 Juveniles<br>(23 to 25 mm SVL) | All frogs observed on wet rocks (cobble and boulder) in area with open banks with little riparian cover. |
| Approx. 30 ft downstream of railroad crossing | 1 Adult (60 mm SVL) | Frog on wet gravel bank with willow cover. |
| Immediately u/s of railroad culvert. | 1 Adult<br>(~50 mm SVL) | Frog observed on wet boulder in middle of channel. |
| Approx. 60 ft u/s of railroad culvert | 1 Juvenile | Juvenile along stream bank. |
| Upper portion of main Pulga housing area | 1 Adult (~50 mm SVL)<br>1 Juvenile | Adult on dry boulder adjacent to pool about 30 inches deep. Juvenile observed on wet gravel on stream bank. |
| About 30 ft u/s of PVC water pipe crossing | 1 Adult<br>(60 mm SVL) | Adult observed on rock in middle of channel. |
| Immediately u/s of power line crossing | 1 Adult<br>(~50 mm SVL) | Frog seen along small riffle. |
| About 80 ft downstream of uppermost house in Pulga (on LB) | 1 Juvenile<br>(~25 mm SVL) | Frog observed in shallow riffle area along side of channel. |
| Adjacent to uppermost house in Pulga (RB) | 1 Adult<br>(~60 mm SVL) | Frog found on wet, shady rock next to pool. |
| About 15 ft downstream of foot bridge | 1 Juvenile<br>(~23 mm SVL) | Juvenile on wet gravel basking in sun. |
| Adjacent to last RB house in Pulga; just u/s of footbridge | 3 Adults<br>(58, 60, & 60 mm SVL) | Adult on dry boulder in sun adjacent to small pool, and a second adult on dry boulder in middle of channel in riffle area just downstream of small pool. The other adult was observed on dry rock along the bank. |
| 500 ft Length of Stream above uppermost house in Pulga | No Frogs Observed | |
| About 925 ft upstream of footbridge | 1 Adult<br>(~ 60 mm SVL) | Adult frog observed diving into pool. |
| **Total Juveniles/subadults: 10** | **Total Metamorphs: 0** | **Total Adults: 10** |

[1] SVL = Snout to Vent Length, RB = Right Bank, LB = Left Bank

[2] Approximate FYLF Life Stage Length Categories: Adults ≥40mm, Juvenile/subadult <40mm, Metamorphs = Larvae w/legs.

## Table E3.1-31

## Location and Microhabitat Observations of Foothill Yellow-Legged Frogs
## Unnamed Tributary Location - TR3, Poe Reach
## September 2000

| Unnamed Tributary (TR3) | FYLF Observations[1] | Location and Microhabitat |
|---|---|---|
| At upstream base of railroad culvert | 2 adults (~40 – 50 mm SVL) | Both frogs on wet rocks within 15 feet of each other. |
| Approximately 250 to 300 ft u/s of railroad culvert | 1 adult (~50 mm SVL) | Frog seen on wet rock adjacent to cascade/pool. |
| **Total Juveniles/subadults: 0** | **Total Metamorphs: 0** | **Total Adults: 3** |

[1] SVL = Snout to Vent Length.

Both adult and juvenile/subadult FYLF and unidentified tadpoles were observed at various locations throughout the Poe Reach on the day prior to the first test flow. Many of these frogs and tadpoles were not found in the same shoreline areas during the test flow period, but reappeared at a reduced level following the 3-day test flow period. These observations indicate that amphibians in the Poe Reach, at least FYLF and treefrogs, appeared to have some ability to deal with the short-term fluctuations in flow. These results are qualitative, as there was no attempt to conduct more intensive, quantitative surveys due to time constraints. Samples of tadpoles were collected from the various sites for identification. All of the tadpoles collected from the sites, excluding one FYLF tadpole from the Bardee's Bar area, were identified as Pacific treefrogs.

**IFIM Flow Monitoring.** A special amphibian monitoring study also was conducted during the instream flow study (IFIM; September 8-10, 2000) to further evaluate the response of FYLF to short-term flow fluctuations. A separate detailed report of both these efforts is provided in Appendix E3-8 (Pacific Gas and Electric Company and EA Engineering 2001a).

Surveys for FYLF were conducted before, during, and after IFIM flows at the following amphibian monitoring locations: 1) Site 1 – the area around the mouth of Flea Valley Creek, 2) Site 2 - Bardee's Bar area, 3) Site 3 - Swimmer's Beach area approximately ½ -mile upstream of Poe Powerhouse, and 4) Site 4 - side channel area adjacent to the Poe Powerhouse. Visual encounter surveys utilizing basic search techniques described in Lind (1997) (including numbers of frogs observed and descriptions of macro- and microhabitat conditions) were conducted. Information obtained at each site included: the linear distance and shoreline location of each site; a description of the key habitat features at each site; and survey counts including life stage, numbers observed, and distribution within microhabitat of FYLF observed.

Prior to the IFIM study, flows in the Poe Reach were approximately 115 cfs. Flows were increased to 500 cfs on the first two days (September 8 and 9) of the IFIM study, and reduced to 250 cfs on the third day (September 10). Photographs were taken at each site to document pre-high flow (existing) conditions, high flow conditions (maximum 500 cfs), and post-high flow conditions associated with instream and side channel amphibian habitat. Changes in FYLF habitat conditions and in the numbers of frogs observed were documented at each site. The results of the IFIM monitoring study are shown in Table E3.1-32.

## Table E3.1-32

**Numbers of FYLF[1] Observed Prior, During, and After IFIM Test Flows, 2000 (Pacific Gas and Electric Company and EA Engineering, 2001a)**

| Near Flea Valley Cr. | | | |
|---|---|---|---|
| **Subsite** | **Prior to High Flow** | **During High Flow** | **After High Flow** |
| 1A | 46 Juveniles<br>4 Metamorphs | 22 Juveniles<br>0 Metamorphs | 113 Juveniles<br>0 Metamorphs |
| 1B | 17 Juveniles<br>8 Metamorphs | 8 Juveniles<br>0 Metamorphs | 12 Juveniles<br>8 Metamorphs |
| 1C | 94 Juveniles<br>8 Metamorphs | 47 Juveniles<br>1 Metamorph | 98 Juveniles<br>9 Metamorphs |
| **Total** | 157 Juveniles<br>20 Metamorphs | 77 Juveniles<br>1 Metamorph | 223 Juveniles<br>17 Metamorphs |

| At Bardee's Bar | | | |
|---|---|---|---|
| **Subsite** | **Prior to High Flow** | **During High Flow** | **After High Flow** |
| 2A | 8 Juveniles | 1 Juvenile | 8 Juveniles |
| 2B | 1 Juvenile<br>1 Adult | 0 Juveniles | 1 Juvenile<br>1 Adult |
| **Total** | 9 Juveniles<br>1 Adult | 1 Juvenile | 9 Juveniles<br>1Adult |

| Above Poe Powerhouse Bridge (1/4 –mile) | | | |
|---|---|---|---|
| **Subsite** | **Prior to High Flow** | **During High Flow** | **After High Flow** |
| 3A | 9 Juveniles<br>0 Adult<br>0 Metamorphs | 2 Juveniles<br>1 Adult<br>1 Metamorph | 8 Juveniles<br>0 Adult<br>0 Metamorphs |
| 3B | 34 Juveniles<br>0 Adults | 6 Juveniles<br>0 Adults | 29 Juveniles<br>1 Adult |
| **Total** | 43 Juveniles | 8 Juveniles<br>1 Adult<br>1 Metamorph | 37 Juveniles<br>1 Adult |

| Adjacent to Poe Powerhouse | | | |
|---|---|---|---|
| **Subsite** | **Prior to High Flow** | **During High Flow** | **After High Flow** |
| 4A | 5 Juveniles<br>0 Adults | 3 Juveniles<br>1 Adult | 1 Juveniles<br>2 Adults |
| 4B | 6 Juveniles<br>2 Adults | 3 Juveniles<br>0 Adults | 4 Juvenile<br>3 Adults |
| **Total** | 11 Juveniles<br>2 Adults | 6 Juveniles<br>1 Adult | 5 Juveniles<br>5 Adults |

[1] Approximate FYLF Life Stage Length Categories: Adults ≥40mm, Juvenile/subadult <40mm, Metamorphs = Larvae w/legs.

In general, the numbers of FYLF observed at each site decreased during the high flow period, but returned to approximately the same numbers following the high flow event. In addition, the three-day high flow event (500 cfs for two days, and 250 cfs for one day) did not appear to have an overall negative effect on metamorphs or juveniles/subadults. For FYLF habitat, in areas with moderately to steeply sloping cobble/gravel bars or boulder/cobble shorelines, the frogs appeared to migrate up the shoreline to similar micro-habitats as flows increased. Where habitat was comprised of low-relief cobble/gravel bars or areas of mixed boulders and sedges, habitat was either reduced or eliminated during the high flow period.

The longer-term impact on the movement of frogs or on habitat availability and quality of flow changes during the spring and summer was difficult to assess. More extensive surveys were needed to better define habitat suitability and seasonal use patterns, and to assess effects of short-term and long-term flow changes not only for adults and juveniles/subadults and their habitat, but more critically for the earlier life stages (i.e., egg mass development, tadpoles, and metamorphs). Therefore, extensive visual encounter surveys (VES) by company biologists were continued and expanded in 2001, 2002, and 2003 for FYLF in the Poe Reach. In addition to the VES, special studies were conducted to address flow-level effects on FYLF habitat (2002) and to address persistence of tadpoles groups (2003).

## 2001 and 2002 Foothill Yellow-Legged Frog Surveys

A total of four main stem NFFR river sites were included in the expanded 2001 and 2002 FYLF surveys, including the Poe Powerhouse area, Swimmer's Beach area, Bardee's Bar area, and Flea Valley Creek area (Figure E3.1-18). Within these sites, there were a total of eleven separate subsites, delineated by distinct habitat units or characteristics. River sites and sub-sites were renumbered from 2000 to 2001/2002/2003 values (Table E3.1-33); tributary sites were not renumbered. The locations of eight tributary sites (TR1 – TR8) surveyed for FYLF in 2001 and 2002 are shown on Figure E3.1-18.

To provide a baseline on FYLF habitat preferences in the NFFR, detailed habitat assessments were conducted at each river and tributary site in 2001 according to "Survey Protocols, Standard Operating Procedures, and Data Sheets for Amphibian Surveys and Habitat Assessments" (Pacific Gas and Electric Company 2001). Subsequent surveys in 2002 and 2003 followed a revised protocol (Seltenrich and Pool 2002). These survey protocols were prepared by Company biologists to standardize FYLF surveys across hydroelectric projects in California. In addition to the habitat assessments, up to four VES were typically conducted at each of the river subsites by company biologists per year to document all FYLF life stages (egg masses, tadpoles, and juvenile and adult frogs) and to evaluate juvenile recruitment.

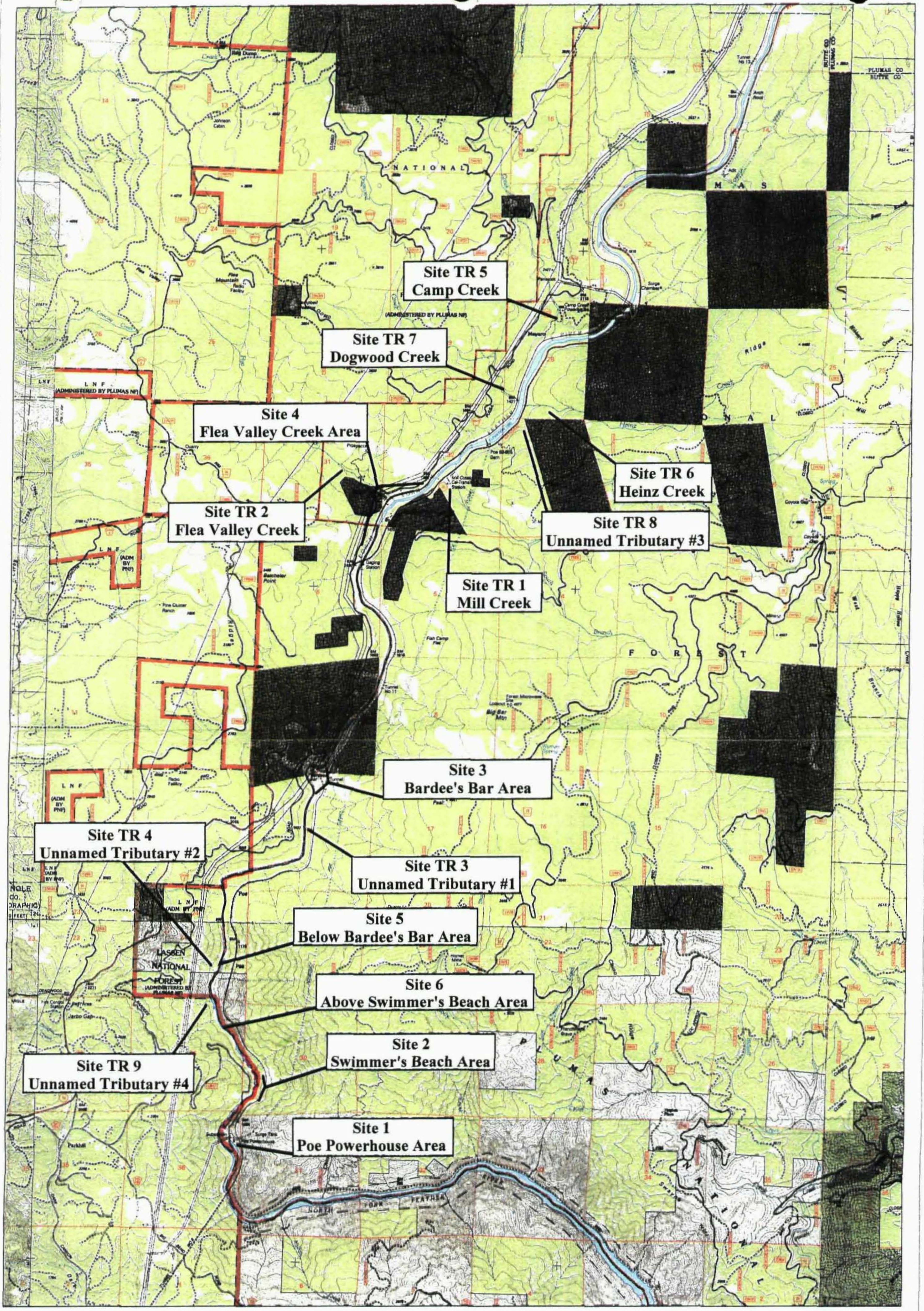



**Figure E3.1-18**
Poe Amphibian
Study Locations
(2001/ 2002/ 2003)

Basemap: USGS 7.5' Quadrangles
Paradise East, Cherokee, Berry Creek, Pulga, Brush Creek, Soapstone Hill, Kimshew Point, Bucks Lake, Storrie

**Table E3.1-33**

**Study Site Numbers for 2000 and 2001/2002/2003 on the Poe Reach, NFFR.**

| General Area | 2000 | 2001/2002/2003 |
|---|---|---|
| Flea Valley Creek | 1a | 4a |
| | 1b | 4b |
| | 1c | 4c |
| | | 4d |
| Bardee's Bar | 2a | 3a |
| | 2b | 3b |
| Swimmer's Beach | 3a | 2a |
| | 3b | 2b |
| | | 2c |
| Poe Powerhouse | 4a | 1a |
| | 4b | 1b |
| Below Bardee's Bar | n/a | 5* |
| Above Swimmer's Beach | n/a | 6* |

*These sites were added in 2003

Tables E3.1-34 and E3.1-35 show the results of visual encounter surveys at the eleven main stem NFFR subsites during 2001 and 2002, respectively. In general, FYLF reproduction in sampled portions of the Poe Project in 2001 and 2002 appeared successful, with adequate egg laying and hatching success and some juvenile recruitment evident in most subsites.

The most successful reproduction occurred at Site 4 where one large tributary enters the NFFR in the middle of the site (Flea Valley Creek), and another enters approximately 800 m upstream of the survey area (Mill Creek). Close proximity to tributaries is thought to be an important habitat component for river-breeding FYLF (Kupferberg 1996).

## Table E3.1-34 (Page 1 of 2)

## Number of FYLF Egg Masses, Tadpoles, Juveniles/Subadults and Adults Observed During the 2001 Visual Encounter Surveys – Main Stem Locations, Poe Reach (GANDA 2003a)

| Subsite | Date | Search Area ($m^2$) | Average Discharge (cfs) | Egg Masses | Tadpole Groups | Juvenile/ Subadult Observed | Adults Observed |
|---|---|---|---|---|---|---|---|
| **Poe Powerhouse Area, Site 1** | | | | | | | |
| 1a | 5-12-01 | 495 | 132 | 0 | 1s | 0 | 2 |
| 1a | 7-27-01 | 1,005 | 122 | 0 | 0 | 0 | 0 |
| 1a | 9-27-01 | 495 | 116 | 0 | 0 | 2 | 0 |
| 1b | 5-12-01 | 404 | 132 | 2 | hatching | 1 | 0 |
| 1b | 7-27-01 | 404 | 122 | hatched | 0 | 1 | 0 |
| 1b | 9-27-01 | 404 | 116 | hatched | 0 | 2 | 0 |
| **Total Egg Masses: 2 Total Tadpole Groups: 1 Total Juvenile/subadult: 6 Total Adults: 2** | | | | | | | |
| **Swimmer's Beach Area, Site 2** | | | | | | | |
| 2a | 5-11-01 | 352 | 132 | 3 | hatching | 1 SA | 1 |
| 2a | 7-27-01 | 352 | 122 | hatched | 1M | 0 | 2 |
| 2a | 9-28-01 | 352 | 113 | hatched | 0 | 2 | 1 |
| 2b | 5-11-01 | 288 | 132 | 0 | 0 | 0 | 0 |
| 2b | 7-27-01 | 288 | 122 | 0 | 0 | 1 | 1 |
| 2b | 9-28-01 | 288 | 113 | 0 | 0 | 1 J, 2 SA | 0 |
| 2c | 5-11-01 | 488 | 132 | 2 | hatching | 0 | 1 |
| 2c | 7-27-01 | 488 | 122 | hatched | 3s | 5 | 0 |
| 2c | 9-28-01 | 488 | 113 | hatched | 0 | 2 | 0 |
| **Total Egg Masses: 5 Total Tadpole Groups: 4 Total Juvenile/subadult: 14 Total Adults: 6** | | | | | | | |
| **Bardee's Bar Area, Site 3** | | | | | | | |
| 3a | 5-31-01 | 412 | 116 | 0 | 0 | 0 | 3 |
| 3a | 7-27-01 | 412 | 122 | 0 | 0 | 0 | 0 |
| 3a | 9-28-01 | 412 | 113 | 0 | 0 | 0 | 0 |
| 3b | 5-31-01 | 234 | 116 | 8 | 4S, 3M | 0 | 4 |
| 3b | 7-27-01 | 234 | 122 | hatched | 0 | 1 | 0 |
| 3b | 9-28-01 | 304 | 113 | hatched | 0 | 1 | 0 |
| **Total Egg Masses: 8 Total Tadpole Groups: 7 Total Juvenile/subadult: 2 Total Adults: 7** | | | | | | | |

[a]Tadpole group numbers: L = >100 tadpoles/ $m^2$, M = 11-100, S = 5-10, s = <5

## Table E3.1-34 (Page 2 of 2)

## Number of FYLF Egg Masses, Tadpoles, Juveniles/Subadults and Adults Observed During the 2001 Visual Encounter Surveys – Main Stem Locations, Poe Reach (GANDA 2003a)

| Subsite | Date | Search Area ($m^2$) | Average Discharge (cfs) | Egg Masses | Tadpole Groups | Juvenile/ Subadult Observed | Adults Observed |
|---|---|---|---|---|---|---|---|
| **Flea Valley Creek Area, Site 4** | | | | | | | |
| 4a | 5-10-01 | 432 | 130 | 3 | 0 | 0 | 0 |
| 4a | 5-30-01 | 432 | 115 | hatched | 3L | 0 | 0 |
| 4a | 7-26-01 | 432 | 123 | hatched | 2S | 0 | 0 |
| 4a | 9-26-01 | 432 | 111 | hatched | 0 | 5 J, 1SA | 0 |
| 4b | 5-10-01 | 150 | 130 | 1 | 0 | 4 SA | 3 |
| 4b | 5-30-01 | 150 | 115 | 1 | 1M | 0 | 0 |
| 4b | 7-26-01 | 18 | 123 | hatched | 3s | 0 | 0 |
| 4b | 9-26-01 | 96 | 111 | hatched | 0 | 10 J | 0 |
| 4c | 5-10-01 | 882 | 130 | 4 | 0 | 1 SA | 3 |
| 4c | 5-30-01 | 378 | 115 | hatched | 2L, 1M | 0 | 1 |
| 4c | 7-27-01 | 504 | 122 | hatched | 2s | 3 J, 1 SA | 0 |
| 4c | 9-27-01 | 504 | 116 | hatched | 0 | 7 J | 0 |
| 4d | 5-10-01 | 685 | 130 | 0 | 0 | 0 | 0 |
| 4d | 5-30-01 | 685 | 115 | 3 | hatching | 0 | 0 |
| 4d | 7-26-01 | 685 | 123 | hatched | 6s | 5 J | 0 |
| 4d | 9-27-01 | 685 | 116 | hatched | 0 | 11 J | 0 |
| **Total Egg Masses: 11 Total Tadpole Groups: 20 Total Juvenile/subadult: 48 Total Adults: 7** | | | | | | | |
| [a]Tadpole group numbers: L = >100 tadpoles/ $m^2$, M = 11-100, S = 5-10, s = <5 | | | | | | | |

## Table E3.1-35 (Page 1 of 2)

## Number of FYLF Egg Masses, Tadpoles, Juveniles/Subadults and Adults Observed During the 2002 Visual Encounter Surveys – Main Stem Locations, Poe Reach (GANDA 2003a)

| Subsite | Date | Search Area ($m^2$) | Average Discharge (cfs) | Egg Masses | Tadpole Groups[a] | Juvenile/ Subadult Observed | Adults Observed |
|---|---|---|---|---|---|---|---|
| **Poe Powerhouse Area, Site 1** | | | | | | | |
| 1a | 4/12/02 | 495 | 115 | 0 | 0 | 0 | 2 |
| 1b | 4/12/02 | 455 | 115 | 0 | 0 | 0 | 1 |
| 1b | 5/9/02 | 404 | 115 | 6 | 0 | 0 | 1 |
| 1b | 6/6/02 | 404 | 115 | 0 | 1M | 0 | 0 |
| 1b | 8/15/02 | 404 | 115 | 0 | 0 | 0 | 0 |
| 1b | 9/9/02 | 404 | 115 | 0 | 0 | 0 | 0 |
| **Total Egg Masses: 6 Total Tadpole groups: 1 Total Juvenile/Subadults: 0 Total Adults: 4** | | | | | | | |
| **Swimmer's Beach Area, Site 2** | | | | | | | |
| 2a | 4/12/02 | 308 | 115 | 1 | 0 | 0 | 1 |
| 2a | 5/10/02 | 308 | 115 | 2 | 2L | 1 SA | 1 |
| 2a | 6/6/02 | 308 | 115 | 0 | 6L | 0 | 1 |
| 2a | 8/14/02 | 440 | 115 | 0 | 0 | 15 J | 0 |
| 2a | 9/9/02 | 352 | 115 | 0 | 0 | 18 J | 0 |
| 2b | 8/14/02 | 336 | 115 | 0 | 0 | 2 J | 0 |
| 2b | 9/9/02 | 288 | 115 | 0 | 0 | 4 J | 1 |
| 2c | 4/12/02 | 732 | 115 | 0 | 0 | 1 SA | 1 |
| 2c | 5/17/02 | 549 | 115 | 2 | 2L | 0 | 1 |
| 2c | 8/14/02 | 732 | 115 | 0 | 1s | 0 | 0 |
| **Total Egg Masses: 5 Total Tadpole Groups: 11 Total Juvenile/Subadults: 41 Total Adults: 6** | | | | | | | |
| **Bardee's Bar Area, Site 3** | | | | | | | |
| 3a | 8/17/02 | 412 | 115 | 0 | 0 | 0 | 0 |
| 3a | 9/11/02 | 206 | 115 | 0 | 0 | 0 | 0 |
| 3b | 5/16/02 | 195 | 115 | 6 | 0 | 0 | 4 |
| 3b | 8/17/02 | 117 | 115 | 0 | 0 | 0 | 0 |
| 3b | 9/11/02 | 117 | 115 | 0 | 0 | 0 | 0 |
| **Total Egg Masses: 6 Total Tadpole Groups: 0 Total Juvenile/Subadults: 0 Total Adults: 4** | | | | | | | |

[a]Tadpole group numbers: L = >100 tadpoles/ $m^2$, M = 11-100, S = 5-10, s = <5

### Table E3.1-35 (Page 2 of 2)

### Number of FYLF Egg Masses, Tadpoles, Juveniles/Subadults and Adults Observed During the 2002 Visual Encounter Surveys – Main Stem Locations, Poe Reach (GANDA 2003a)

| Subsite | Date | Search Area ($m^2$) | Average Discharge (cfs) | Egg Masses | Tadpole Groups[a] | Juvenile/ Subadult Observed | Adults Observed |
|---|---|---|---|---|---|---|---|
| Flea Valley Creek Area, Site 4 | | | | | | | |
| 4a | 5/22/02 | 288 | 115 | 6 | 1M | 0 | 4 |
| 4a | 6/06/02 | 216 | 115 | 0 | 4L | 0 | 1 |
| 4a | 8/16/02 | 216 | 115 | 0 | 3S | 0 | 0 |
| 4a | 9/27/02 | 315 | 115 | 0 | 0 | 5 J | 0 |
| 4b | 5/22/02 | 100 | 115 | 2 | 0 | 0 | 2 |
| 4b | 6/06/02 | 125 | 115 | 2 | 1M | 0 | 5 |
| 4b | 8/16/02 | 120 | 115 | 0 | 3S | 0 | 0 |
| 4b | 9/27/02 | 90 | 115 | 0 | 0 | 10 J | 0 |
| 4c | 5/22/02 | 567 | 115 | 1 | 0 | 0 | 1 |
| 4c | 6/06/02 | 480 | 115 | 0 | 4L | 1 J | 0 |
| 4c | 8/16/02 | 508 | 115 | 0 | 1s | 0 | 0 |
| 4c | 9/27/02 | 635 | 115 | 0 | 0 | 3 J | 0 |
| 4d | 5/22/02 | 411 | 115 | 2 | 0 | 1 J | 1 |
| 4d | 6/06/02 | 548 | 115 | 0 | 2L | 0 | 1 |
| 4d | 8/16/02 | 532 | 115 | 0 | 0 | 1 J | 0 |
| 4d | 9/27/02 | 399 | 115 | 0 | 0 | 3 J | 0 |
| **Total Egg Masses: 13 Total Tadpole Groups: 19 Total Juvenile/Subadults: 24 Total Adults: 15** | | | | | | | |

[a]Tadpole group numbers: L = >100 tadpoles/ $m^2$, M = 11-100, S = 5-10, s = <5

The poorest reproductive results occurred at Subsite 3b, where eight egg masses were found in 2001 and six in 2002. Later season surveys at this subsite found few tadpoles or juveniles. Subsite 3b may have poor recruitment due to presence of an abundance of predatory fish and relatively high levels of human disturbance, including mining and recreational activities.

Most egg masses and tadpole groups found in the Project area were in relatively shallow water close to shore. The mean depth to the bottom at egg mass oviposition sites was 25 cm both years; mean distance to shore for egg masses was 166 cm in 2001 and 156 cm in 2002. The mean depth to the bottom at tadpole group locations was 19 cm and 21 cm in 2001 and 2002, respectively. Mean distance to shore for tadpole groups was 94 cm in 2001 and 158 cm in 2002. Mean flow velocities at egg mass attachment sites were low, 1.4 and 2.2 cm/sec in 2001 and 2002, respectively. Mean flow velocities at tadpole group locations were low, 0.6 cm/sec. for both years.

In addition to the three tributary sites surveyed in 2000 (see also tables E3.1-29 and E3.1-30), five other tributary sites were searched in 2001, along with two revisits to TR-2 (Table E.1-36). At least five of the eight tributaries surveyed in the Poe Project area provided suitable habitat for FYLF. Flea Valley Creek (TR2) was the most utilized by frogs of all the tributaries. Since several juveniles were observed there in late summer and early fall, Flea Valley Creek may provide off-river breeding habitat, although no egg masses or tadpoles have been found.

## Table E3.1-36

**Number of FYLF Juveniles/Subadults and Adults Observed during the 2001 Visual Encounter Surveys in the Tributaries of the Poe Reach (GANDA 2003a)**

| Tributary | Date | Location | Search Length (m) | Juvenile/ subadults Observed | Adults Observed |
|---|---|---|---|---|---|
| TR2 | 7/26/2001 | Flea Valley Creek, NFFR | ~1000 | 1 | 2 |
| TR2 | 9/26/2001 | Flea Valley Creek, NFFR | ~1000 | 13 | 3 |
| TR3 | 9/7/2001 | Unnamed tributary #1, NFFR | ~100 | 0 | 3 |
| TR4 | 9/14/2001 | Unnamed tributary #2, Bardee's Bar Rd. | 305 | 0 | 10 |
| TR5 | 8/6/2001 | Camp Creek, NFFR | nd | 0 | 1 |
| TR6 | 8/17/2001 | Heinz Creek, Poe Reservoir | 305 | 0 | 0 |
| TR7 | 8/17/2001 | Dogwood Creek, Poe Reservoir | 200 | 0 | 0 |
| TR8 | 8/16/2001 | Unnamed tributary #3, NFFR | 230 | 0 | 0 |
| **Total Juvenile/Subadults: 14** | | | **Total Adults: 19** | | |

**Other Studies Performed in 2001 and 2002**

**2002 FYLF Habitat Flow Evaluation Study.** In September 2002, an extensive study was conducted to quantitatively and qualitatively evaluate changes in the availability, quality, and extent of breeding, tadpole rearing, and juvenile FYLF habitats from the current flow regime (110 cfs) to four higher flow levels (150, 200, 250, and 310 cfs) within the Poe Reach of the NFFR. The purpose of the study was to assess whether altering the base flow would be detrimental to FYLF populations by decreasing usable habitat.

The microhabitat data on FYLF egg mass and tadpole locations from the Poe Reach (i.e., depths, distance to shore, flow velocities), along with similar data collected by Company biologists from other Sierran streams, were used to formulate the parameters that defined preferred, marginal, and total FYLF habitat criteria for this study. *Preferred* habitat was edgewater habitat <30 cm deep with flow velocity ≤5 cm/s. *Marginal* habitat was edgewater areas between 30 and 50 cm deep with flow velocity between 5 and 20 cm/s, within a maximum distance from shore of 5 m. *Preferred* and *marginal* habitats combined are referred to as *total* habitat within the analysis. Changes to the *total* habitat area at the various flows were evaluated at 10 of the original subsites where visual encounter surveys were conducted in 2001 and 2002, along with two additional sites: Site 5 and Site 6.

The results of the flow evaluation show that the amounts of preferred and marginal FYLF habitat varied across flow levels (Table E3.1-37). This data analysis pooled the data for each site at the outset of analysis. None of the changes in preferred or marginal habitat area were statistically significant under this pooled analysis. A statistically significant result was one in which the $p$ value was less than or equal to 0.05.

**Table E3.1-37**
**Preferred and Marginal FYLF Habitat Area (Pooled by Site)**
**(GANDA 2003b)**

| Habitat Area Measurements | Discharge Levels (cfs) | | | | |
|---|---|---|---|---|---|
| | **110** | **150** | **200** | **250** | **310** |
| Preferred Habitat Area ($m^2$) | 2469.3 | 2550.5 | 2098.2 | 1961.8 | 2038.3 |
| Marginal Habitat Area ($m^2$) | 1773.5 | 1820.2 | 1964.6 | 2190.5 | 1769.3 |
| Total Habitat Area ($m^2$) | 4242.7 | 4370.6 | 4062.8 | 4152.3 | 3807.6 |

The data on FYLF habitat area were reanalyzed to assess changes in total habitat using area at subsites as replicates rather than pooling the data at the beginning of analysis. This analysis showed that at 310 cfs significantly less habitat area was available for FYLF than at 110 cfs (Table E3.1-38).

**Table E3.1-38**

**P-values from Pair-wise Tests Showing Statistically Significant Difference ($p \leq 0.05$) in Mean FYLF Habitat Area Available between 110 and 310 cfs Discharge. Statistically Significant Results are Shown in Bold Text. (GANDA 2003b)**

| Flow level | 110 cfs | 150 cfs | 200 cfs | 250 cfs | 310 cfs |
|---|---|---|---|---|---|
| **110 cfs** | | | | | |
| **150 cfs** | 0.8835 | | | | |
| **200 cfs** | 0.5452 | 0.9767 | | | |
| **250 cfs** | 0.8996 | 1.0000 | 0.9701 | | |
| **310 cfs** | **0.0199** | 0.2205 | 0.5560 | 0.2028 | |

This reduction in available habitat, while statistically significant, did not represent loss of all or most habitat; rather, it showed a loss of a mean of 4.4 $m^2$ habitat, from 25.4 $m^2$ to 21.0 $m^2$ per site (Table E3.1-39). No significant differences exist in amount of available habitat for FYLF among any other pair-wise comparisons of flow levels.

**Table E3.1-39**

**Mean FYLF Habitat Area ($m^2$) at each Discharge Level. (GANDA 2003b)**

| Discharge Level (cfs) | Mean Habitat Area ($m^2$) | S.E. Mean |
|---|---|---|
| | | |
| 110 cfs | 25.4 | 1.527 |
| 150 cfs | 24.6 | 1.519 |
| 200 cfs | 23.3 | 1.505 |
| 250 cfs | 24.7 | 1.519 |
| 310 cfs | 21.0 | 1.470 |

Site, how it varied by flow (discharge) level, and the interaction of these two factors all produced statistically significant ($p \leq 0.05$) changes in mean area of habitat available for FYLF (Table E3.1-40). The effect of site was not surprising, as this result simply shows that habitat area available for FYLF varies by site location on the river. The significant effect of flow comes from the reduction in available habitat from 110 cfs to 310 cfs. The significant interaction effect of site and flow level is driven primarily by the geomorphologic complexities of the river. Flatter areas with wide gravel bars will be less effected by increasing discharge than areas with narrower river channels.

**Table E3.1-40**

**Results of ANOVA Showing Effects of Site, Discharge Level, and the Interaction of the Two on Mean Area of Available FYLF Habitat. Statistically Significant Effects ($p \leq 0.05$) are Shown in Bold Text.**

| **Source** | **DF** | **F** | **P** |
|---|---|---|---|
| Site | 5 | 18.77 | **0.000** |
| Discharge | 4 | 2.56 | **0.038** |
| Site*Discharge | 20 | 1.69 | **0.030** |
| Error | 775 | | |
| Total | 804 | | |

**2002 Recreation and Pulse Flow Biological Evaluation.** While no study has been conducted in the Poe Reach to monitor the effects of recreational flows (for whitewater boating) or pulse flows on FYLF egg mass survival, a study for the Rock Creek-Cresta Project (FERC 1962), located just upstream along the NFFR, is applicable to the Poe Reach (GANDA 2002).

During the 2002 Recreation and Pulse Flow Biological Evaluation study on the Cresta Reach just upstream of Poe Reservoir, a recreation flow release of 1,600 cfs apparently was responsible for the loss of two egg masses and half of a third egg mass. Of five egg masses found before the release in June, only two and a half were found following the release. While this sample size was small, it demonstrated the potential of these early-season high flow events to negatively affect FYLF reproduction in the NFFR. The effects of high water flow on very small tadpoles present before the recreation release were not conclusive. Tadpole numbers were lower after the flow event, but this decrease could be from predation, dispersal or natural mortality (see 2003 Tadpole Attrition Study, below). The effects of later-season recreation flow releases did not appear to impact numbers of larger FYLF tadpoles or juveniles, although one tadpole stranding mortality was documented during fish stranding studies (T. Payne and Associates, personal communication, 2002).

**2003 Foothill Yellow-Legged Frog Surveys**

Visual encounter surveys for FYLF were continued in 2003 throughout the Poe Reach following the survey methodology developed in 2001 (Seltenrich and Pool 2002). Targeted surveys for all life stages of FYLF were conducted in a coordinated effort by the Licensee and GANDA biologists. Preliminary findings for 2003 are shown in Table E3.1-41. As in 2001 and 2002, FYLF were observed breeding at nearly all main stem sites within the Poe Reach. A total of 49 egg masses were observed at 6 sites (16 subsites) in 2003. Once again, the largest number (31) of FYLF egg masses was found near Flea Valley Creek (Site 4). Adult or juvenile FYLFs, were present at all but two subsites. Two new sites (Site 5 and Site 6) were added in 2003, following the discovery of these potential breeding sites during the 2002 Habitat Flow Evaluation Study (see below).

## Table E3.1-41 (Page 1 of 2)

## Number of FYLF Egg Masses (EM), Tadpoles, Juveniles/subadults and Adults Observed During the 2003 Visual Encounter Surveys – Main Stem Locations, Poe Reach, (GANDA 2003c)

| Site/ Subsite | Date | Average Discharge (cfs) | Egg Masses Present | Tadpoles | Juveniles/ Subadults Observed | Adults observed | Comments |
|---|---|---|---|---|---|---|---|
| **Poe Powerhouse Area, Site 1** | | | | | | | |
| 1a | 5/15/03 | ~900 | 0 | 0 | 0 | 0 | |
| 1a | 5/22/03 | ~110 | 0 | 0 | 0 | 0 | |
| 1a | 5/29/03 | ~460 | 0 | 0 | 0 | 0 | |
| 1a | 6/18/03 | ~150 | 0 | 0 | 0 | 0 | |
| 1a | 7/22/03 | ~110 | 0 | 0 | 0 | 0 | |
| 1a | 9/8/03 | ~110 | 0 | 0 | 0 | 0 | |
| 1b | 5/1/03 | ~1,500 | 0 | 0 | 0 | 0 | |
| 1b | 5/15/03 | ~900 | 0 | 0 | 0 | **2** | 1 female gravid |
| 1b | 5/22/03 | ~110 | **1** | 0 | 0 | **7** | |
| 1b | 5/27/03 | ~230 | **3** | 0 | **2** | **1** | |
| 1b | 7/22/03 | ~110 | 0 | **6** | 0 | 0 | |
| 1b | 9/8/03 | ~110 | 0 | 0 | **1** | 0 | |
| Total Egg Masses (non-duplicate): 3 | | Total Tadpoles: 6 | | Total Juveniles/Subadults: 3 | | Total Adults: 10 | |
| **Swimmer's Beach Area, Site 2** | | | | | | | |
| 2a | 5/22/03 | ~110 | **1** | 0 | 0 | **2** | |
| 2a | 5/29/03 | ~400 | **1** | 0 | 0 | **2** | adults in amplexus |
| 2a | 6/10/03 | ~135 | **2** | 0 | **1** | **2** | |
| 2a | 7/22/03 | ~110 | 0 | **20** | 0 | 0 | |
| 2a | 9/8/03 | ~110 | 0 | 0 | **11** | **1** | |
| 2b | 5/15/03 | ~900 | 0 | 0 | 0 | 0 | |
| 2b | 5/22/03 | ~110 | 0 | 0 | 0 | 0 | |
| 2b | 5/29/03 | ~400 | 0 | 0 | 0 | 0 | |
| 2b | 6/10/03 | ~135 | 0 | 0 | 0 | 0 | |
| 2b | 7/22/03 | ~110 | 0 | 0 | 0 | 0 | |
| 2b | 9/8/03 | ~110 | 0 | 0 | **3** | 0 | |
| 2c | 5/29/03 | ~400 | **1** | 0 | 0 | **3** | females gravid |
| 2c | 6/10/03 | ~135 | 0 | 0 | 0 | 0 | |
| 2c | 9/8/03 | ~110 | 0 | 0 | 13 | 0 | |
| Total Egg Masses (non-duplicate): 3 | | Total Tadpoles: 20 | | Total Juveniles/Subadults: 28 | | Total Adults: 10 | |
| **Bardee's Bar Area, Site 3** | | | | | | | |
| 3a | 5/28/03 | ~200 | 0 | 0 | 0 | 0 | bass nests abundant |
| 3a | 6/18/03 | ~150 | 0 | 0 | 0 | 0 | bass larvae abundant |
| 3a | 7/23/03 | ~110 | 0 | 0 | 0 | 0 | |
| 3a | 9/10/03 | ~110 | 0 | 0 | 0 | 0 | |
| 3b | 5/28/03 | ~200 | **2** | 0 | 0 | **1** | 1 EM hatching |
| 3b | 7/23/03 | ~110 | 0 | 0 | 0 | 0 | |
| 3b | 9/10/03 | ~110 | 0 | 0 | 0 | 0 | |
| Total Egg Masses (non-duplicate): 2 | | Total Tadpoles: 0 | | Total Juveniles/Subadults: 0 | | Total Adults: 1 | |

**Number of FYLF Egg Masses (EM), Tadpoles, Juveniles/subadults and Adults Observed During the 2003 Visual Encounter Surveys – Main Stem Locations, Poe Reach. (GANDA 2003c)**

| Site/ Subsite | Date | Average Discharge (cfs) | Egg Masses Present | Tadpoles | Juveniles/ Subadults Observed | Adults observed | Comments |
|---|---|---|---|---|---|---|---|
| **Flea Valley Creek Area, Site 4** | | | | | | | |
| 4a | 5/15/03 | ~900 | 0 | 0 | 2 | 2 | |
| 4a | 5/22/03 | -110 | 5 | 0 | 0 | 3 | |
| 4a | 5/27/03 | ~250 | 3 | 0 | 0 | 5 | 3 EM gone; 1 EM new; female spent |
| 4a | 6/3/03 | ~200 | 11 | 0 | 0 | 2 | Female appeared gravid some EMs just hatching |
| 4a | 7/23/03 | -110 | 0 | 42 | 0 | 0 | |
| 4a | 9/10/03 | -110 | 0 | 0 | 6 | 0 | |
| 4b | 5/15/03 | ~900 | 0 | 0 | 0 | 2 | |
| 4b | 5/27/03 | ~250 | 5 | 0 | 0 | 5 | |
| 4b | 6/3/03 | ~200 | 6 | 0 | 0 | 6 | some EMs just hatching |
| 4b | 7/23/03 | -110 | 0 | 61 | 0 | 0 | |
| 4b | 9/10/03 | -110 | 0 | 14 | 10 | 0 | |
| 4c | 5/27/03 | ~250 | 4 | 0 | 0 | 4 | |
| 4c | 6/5/03 | ~200 | 3 | 0 | 0 | 3 | 2 EM missing, 1 new |
| 4c | 7/23/03 | -110 | 0 | 55 | 0 | 1 | |
| 4c | 9/10/03 | -110 | 0 | 1 | 14 | 0 | |
| 4d | 5/27/03 | ~250 | 3 | 0 | 0 | 0 | 1 EM detached |
| 4d | 6/5/03 | ~200 | 5 | 0 | 0 | 3 | 1 EM missing, 3 new |
| 4d | 7/23/03 | -110 | 0 | 36 | 0 | 0 | |
| 4d | 9/10/03 | -110 | 0 | 1 | 22 | 0 | |
| Total Egg Masses (non-duplicate): 31* Total Tadpoles: 210 Total Juveniles/Subadults: 50 Total Adults: 36 | | | | | | | |
| **Below Bardee's Bar Area, Site 5** | | | | | | | |
| 5a | 5/28/03 | ~400 | 0 | 0 | 0 | 0 | |
| 5a | 6/18/03 | ~150 | 0 | 0 | 1 | 0 | 1 subadult female |
| 5a | 7/22/03 | ~110 | 0 | 4 | 0 | 0 | |
| 5a | 9/8/03 | ~110 | 0 | 0 | 6 | 0 | |
| 5b-d | 5/29/03 | ~400 | 2 | 0 | 0 | 1 | EMs 18 m, 19 m from shore |
| 5b-d | 7/22/03 | ~110 | 0 | 2 | 0 | 0 | |
| 5b-d | 9/8/03 | ~110 | 0 | 0 | 1 | 0 | |
| Total Egg Masses (non-duplicate): 2 Total Tadpoles: 6 Total Juveniles/Subadults: 8 Total Adults: 1 | | | | | | | |
| **Above Swimmer's Beach Area, Site 6** | | | | | | | |
| 6a | 5/29/03 | ~400 | 0 | 0 | 0 | 1 | male calling |
| 6a | 6/3/03 | ~200 | 1 | 0 | 0 | 2 | EM partially scoured |
| 6a | 7/23/03 | -110 | 0 | 3 | 0 | 0 | |
| 6a | 9/8/03 | -110 | 0 | 0 | 3 | 0 | |
| 6b | 6/3/03 | ~200 | 1 | 0 | 1 | 2 | EM detached |
| 6b | 7/22/03 | ~110 | 0 | 0 | 0 | 0 | |
| 6b | 9/8/03 | ~110 | 0 | 0 | 7 | 0 | |
| 6c | 6/5/03 | ~200 | 6 | 0 | 0 | 4 | most hatching, 1 new |
| 6c | 7/22/03 | ~110 | 0 | 82 | 0 | 0 | |
| 6c | 9/8/03 | ~110 | 0 | 0 | 7 | 0 | |
| Total Egg Masses (non-duplicate): 8 Total Tadpoles: 85 Total Juveniles/Subadults: 18 Total Adults: 9 | | | | | | | |

*Total includes egg masses lost during high flows

### Other FYLF Studies Performed on the NFFR in 2003

**Recreation and Pulse Flow Biological Evaluation.** These studies were not conducted on the Poe Reach, but they were conducted just upstream on the Cresta Reach of the NFFR for PG&E's Rock Creek-Cresta Project (FERC 1962). During 2003 none of the recreational or pulse flows were released on the Cresta Reach within three weeks of the observation of egg masses, so it was not possible to assess flow impacts on egg masses. Recreational flows in July and August on the Cresta Reach occurred while GANDA biologists were monitoring tadpole groups. The results from monitoring show that no additional tadpole disappearance was found due to recreational flows, compared to natural disappearance measured in the Tadpole Attrition Study (below).

**Snorkel Surveys.** In addition to walking along shore and wading during visual encounter surveys, biologists also snorkeled, as described in the FYLF survey protocol (Pacific Gas and Electric Company 2002), to locate egg masses on the Cresta Reach in 2003. While results are preliminary, the addition of snorkeling to the survey technique successfully located eleven egg masses in habitats swifter, deeper, and further from shore than wading surveys revealed.

**Tadpole Attrition Study.** A tadpole attrition study was implemented in 2003 on the Poe and Cresta Reaches to better understand natural tadpole disappearance due to predation, dispersal, and other factors. Preliminary results of the tadpole attrition study (five groups on the Poe Reach and 20 on the Cresta Reach) show that numbers of tadpoles in groups substantially declined over the survey period of about a week (e.g., from hundreds to dozens or less) as tadpoles dispersed; found hiding places in the algae, detritus, and cobble/boulders; fell prey to predators; or succumbed to other sources of mortality under normal (non-spill) flow conditions.

**Underwater Camera Monitoring.** A pilot project using an underwater camera to record sources of embryo and tadpole mortality was implemented in 2003 on the Cresta Reach. This technique may be used in the future on the Poe Reach, as preliminary results showed its value in documenting predation. These results showed nocturnal activity of large fish, diurnal activity of Sierra garter snakes (*Thamnophis couchii*), and nocturnal and diurnal activity of crayfish at egg masses and tadpole groups. This activity appeared to be predation and attempted predation of FYLF embryos and tadpoles. The results from the underwater camera monitoring were corroborated during a visual encounter survey when a Sierra garter snake was observed vigorously feeding on a group of small tadpoles.

### Aquatic Reptiles

**Western Pond Turtle (WPT).** The western pond turtle (WPT) is designated as a Federal Special Concern Species under the FESA, a Forest Service Sensitive Species, and a California Special Concern Species by CDFG. The WPT is the only freshwater turtle native to most of the west coast of temperate North America. They occur from sea level to 6,000 ft (1,829 m) from British Columbia south to northwestern Baja California, principally west of the Sierra-Cascade Crest. Preferred aquatic habitats for WPT include low-flow regions of rivers, and side channels and backwater areas with access to deep slow water with underwater refugia (Reese and Welsh 1998). Habitat quality seems to be correlated with the abundance of aerial and aquatic basking sites. They are uncommon in high-gradient streams probably because water temperatures, current velocity, lack of food resources, or combinations of these factors may limit their distribution (Holland 1991). Low fecundity, low hatchling and juvenile survival, high adult survival and potentially long life spans characterize this species (Jennings and Hayes 1994). WPT require upland oviposition sites in the vicinity of aquatic habitats with the majority of nesting sites within 200 m of water (Storer 1930, Jennings and Hayes 1994).

**2000 Western Pond Turtle Surveys**

Presence/absence surveys for pond turtles were completed in conjunction with the general amphibian surveys conducted by GANDA in June 2000. Binoculars were used to scan for basking turtles in all aquatic habitats associated with the NFFR riparian corridor, including riverine pools, side channels, backwaters, and tributary confluences. Searches were conducted along the NFFR from Poe Reservoir to Pulga and from Bardee's Bar to Poe Powerhouse.

A single adult western pond turtle was observed during the GANDA survey along the NFFR from Poe Reservoir to Poe Powerhouse. This individual was basking on a rock in the large pool just upstream of Poe Powerhouse and less than 1,000 ft above Big Bend Reservoir. Other areas of apparent habitat for this species were Poe Reservoir and Big Bend Reservoir, although no turtles were sighted at either location during this survey. The Poe Reach contains many deep, wide pools in areas of relatively low gradient;

however, scouring by high spring flows in the steep and constricted NFFR canyon may degrade habitat conditions for pond turtles.

The Licensee and EA conducted an additional survey targeted for western pond turtles at Big Bend Reservoir on October 12, 2000. A detailed report of the survey is provided in Appendix E3-12 (Pacific Gas and Electric Company and EA Engineering, 2001b). The survey followed field sampling techniques recommended by established western pond turtle experts (Reese, undated, and Holland 1991).

The banks of Big Bend Reservoir were surveyed on October 12, 2000. A canoe equipped with an electric trolling motor was used to allow the observers to move quietly along the shoreline with minimal disturbance to either bank. Both shorelines were scanned for basking turtles and for areas of potential habitat (i.e., logs or other woody debris, sand or mud banks, exposed rocks). Aquatic and shoreline habitat features, as well as upland habitat types, and other important habitat parameters were documented. Suitable habitat features were described, photographed, and recorded on an aerial photograph.

No western pond turtles were observed during the survey. Most of the shoreline consists of bedrock or steep rocky slopes, providing little suitable turtle habitat. Suitable upland habitat for nesting was scarce. However, several small isolated sand beaches occur along the shoreline, providing some of the best basking sites on the reservoir. The fluctuations in water surface elevation and water velocities due to changes in powerhouse operations may make it difficult for rearing of young turtles or for sustaining a population of adults in the reservoir.

Finally, no incidental observations of turtles were made during extensive FYLF surveys, fish population sampling and other on-river surveys conducted for the relicensing, supporting the conclusion that western pond turtles are generally not utilizing the Poe Reservoir or the Poe Reach.

### E3.1.9 Instream Flow Study

#### E.3.1.9.1 Introduction

In the First Stage Consultation Package for Poe Project relicensing (Pacific Gas and Electric Company 1999), the Licensee proposed to conduct an instream flow study in the Poe Reach of the NFFR following the Instream Flow Incremental Methodology (IFIM) (Milhous et al., 1984 and 1989). In general, there are two main components of an IFIM evaluation: 1) a field component that includes habitat mapping of the study reach, measurements of selected transect hydraulic data at various study flows, and species suitability curve development, and 2) an in-office modeling component where the field data from the transects and habitat mapping are overlaid with the species suitability information. The major products are estimates of available fish habitat within a target stream or river reach over a range of simulated release flows. Available fish habitat is predicted in the output of the Physical Habitat Simulation (PHABSIM) model as weighted usable area (WUA), expressed in units of square feet per thousand feet of stream. WUA is a combination of physical parameters (water velocity, depth, and substrate) at selected locations (cells) along transects that represent the different macrohabitat types (pools, runs, riffles, and pocket water) within the river reach. The model predicts velocities and depths at various flows at those cells, and overlays preferred velocity, depth, and substrate criteria for particular fish species and life stages to estimate WUA values at various flows.

**Agency Negotiations.** Following the submittal of the First Stage Consultation Package, the Licensee selected an outside IFIM specialist, Thomas R. Payne and Associates (TRPA), to conduct the IFIM study. TRPA developed a study plan that was submitted to the agencies for comment, with the intent of incorporating agency comments and conducting the study in the summer/fall of 1999. Over the same time period, the resource agencies (i.e., the USFWS, USFS, CDFG, and SWRCB) responded to the First Stage Consultation Package, including the proposed IFIM study. Within this set of agency responses, the USFWS recommended using a 2-D modeling approach instead of the standard 1-D methodology to develop the hydraulic data base for the model. After a series of phone conversations and meetings over the summer of 1999, the USFWS and the Licensee were not able to agree on which method to use in time to conduct the study in the fall of 1999 as planned. Thus, the study was postponed until 2000.

The Licensee's preference for the standard 1-D method was based on the fact that this method has been used and tested extensively in river systems like the NFFR and that the results using this method have been accepted by the resource agencies, including FERC. In contrast, the 2-D approach has received limited use, has not been used in a river system like the NFFR, and has not gained general acceptance by the agencies. USFWS's position was that the 2-D methodology represents state-of-the-art technology, that the 2-D is a better predictor of hydraulic information (i.e., velocities and depths) particularly in complex systems, and that the final WUA values are more accurate than when the 1-D method is used.

Even though more talks occurred over the spring and summer of 2000, the Licensee and the agencies could still not come to agreement on which method to use. As a compromise, the Licensee and TRPA proposed to the agencies that a better use of resources would be to develop site-specific species suitability curves for the NFFR (the other major element needed for the habitat predictions in the model), rather than attempting to apply the 2-D methodology to the Poe IFIM study. The agencies agreed to allow the Licensee to proceed with the standard 1-D approach along with developing the new suitability curves. The suitability work was conducted over the summer of 2000, the hydraulic data for the standard method was collected in early September 2000, and the final phase of building the data sets and running the models was completed between October 2000 and February 2001. The consultant produced two separate reports for the Poe IFIM study: 1) the Poe Instream Flow Study (TRPA 2001a) and 2) the Poe Habitat Suitability Study (TRPA 2001b). The main report is provided in Appendix E3-14, and the suitability report is provided in Appendix E3-13. A summary of the methods and results from both elements of the IFIM evaluation is provided in the following section.

### E3.1.9.2 Study Area

The Poe Reach extends for 7.6 miles from Poe Dam to Poe Powerhouse (Figure E3.1-1). The upper section between the Poe Dam and the Highway 70 Bridge (1.3 mi) is accessible from the Highway 70 side of the river and from the small community of Pulga located on the opposite side of the river. The middle section from the Highway 70 Bridge down to Bardee's Bar (2.2 mi) is canyon-bound, and is inaccessible except from the top and bottom ends. The lower portion from Bardee's Bar to Poe Powerhouse (4.1 mi) is also somewhat inaccessible. This third section can be accessed from the upper end at Bardee's Bar, from the swimming beach just upriver from the Poe Powerhouse bridge, and from the gravel parking area adjacent to the Poe Powerhouse.

### E.3.1.9.3 Habitat Mapping

Habitat mapping was conducted throughout the Poe Reach in the late summer of 1999, in anticipation of an instream evaluation later that fall. This mapping was done to determine the amounts of various macrohabitats for transect weighting and to assist with random placement of transects for the data collection. The results of the mapping effort are provided in Table E3.1-42, and have previously been shown in Figure E3.1-2.

The mapping illustrates that the consistent dominant feature in the reach was pools at 57 % of the total reach length. Runs/glides, pocket waters, and high gradient riffles/cascades represented 16 %, 13 %, and 10 %; while low gradient riffles were the least common at 4 % of the total reach length. The number of transects placed in each habitat type for the study was based on the percentages of each habitat type found in the river reach.

**Table E3.1-42**
**Poe Reach- IFIM Habitat Mapping (Payne 1999)**

| HABITAT TYPE | UPPER | MIDDLE | LOWER | TOTAL |
|---|---|---|---|---|
| | | | | |
| High Grad. Riffle/Cascade | 4 % | 14 % | 8 % | 10 % |
| Low Grad. Riffle | 6 % | 1 % | 5 % | 4 % |
| Run / Glide | 28 % | 6 % | 19 % | 16 % |
| Pocket Water | 5 % | 21 % | 11 % | 13 % |
| Pool | 57 % | 58 % | 57 % | 57 % |

### E3.1.9.4 Transect Selection

The original study plan proposed to randomly select starting points for transect selection based on the least abundant habitat type to be modeled (i.e., low gradient riffle). The mapping data were entered into a sequential database of habitat units from which the specific riffle units could be randomly picked out during the planned transect selection process. This random technique turned out to be impractical due to the limited access of the Poe Reach. During a field trip to observe high flows related to whitewater test releases conducted on May 20-22, 2000, it was determined by TRPA that representatives of the modelable habitat types could be found reasonably close to the three main access points. An alternative of accessing these habitats from the three main access points was proposed by TRPA, and the resource agencies agreed to participate in the revised transect selection process.

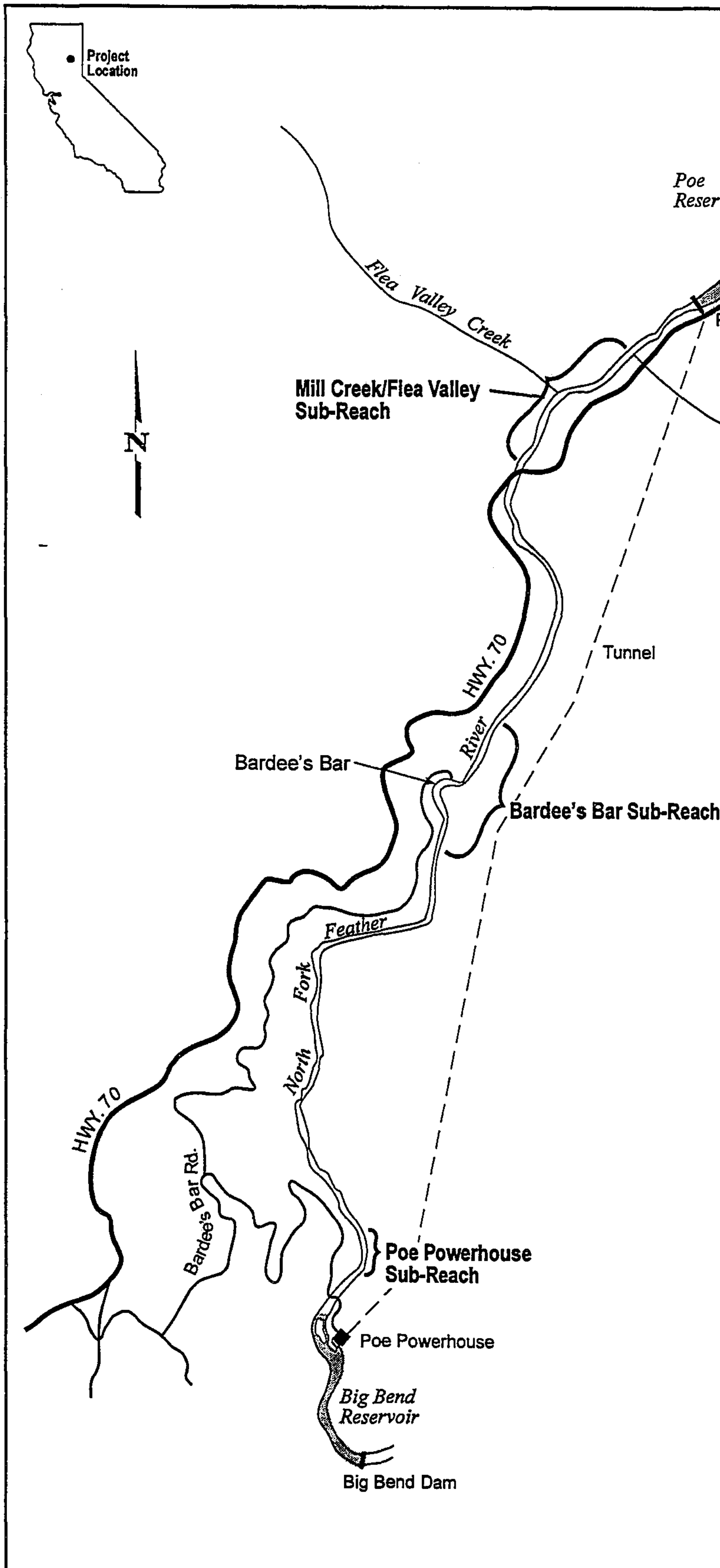
A transect selection field trip was conducted on August 2, 2000. The agencies represented at the field meeting included the USFWS (i.e., Mr. Michael Morse, Mr. Ken

Ballard, and Mr. Larry Thompson), the USFS (Ms. Tina Hopkins), and the SWRCB (Ms. Sharon Stohrer). The transects were selected by the group locating known habitat units within accessible target areas (based on the habitat mapping), and picking the specific location of each transect within each habitat unit. The numbers of transects for each area were determined prior to the field trip. However, negotiations in the field resulted in doubling the number of pool transects in most of the pools. The locations of the transect sub-reaches (i.e., the upper site near Mill Creek and Flea Valley Creek, the middle site at Bardee's Bar, and the lower site near the Poe Powerhouse bridge) are shown on Figure E3.1-19. At the upper site, 13 transects (i.e., 7 pool, 4 run, 1 pocket water, and 1 low gradient riffle) were selected between the mouth of Mill Creek and the Highway 70 Bridge. At Bardee's Bar, another 13 transects (i.e., 7 pool, 2 run, and 4 pocket water) were selected. At the lower site upriver from the Poe Powerhouse bridge, five more transects (i.e., 2 pool, 2 run, and 1 low gradient riffle) were selected.

**E3.1.9.5 IFIM Transect Data Collection**

Collection of data for the single-velocity IFG-4 hydraulic model under the existing flow condition (110 cfs at the Pulga gage) and at target test flows of 250 and 500 cfs occurred at the selected transects between August 14 and September 10. In general, each field element followed the guidelines from the PHABSIM field techniques manuals (Trihey and Wegner 1981; Milhous et al. 1984).

Cell locations across the transects, bottom profiles for each transect, substrate classifications at each cell, and low flow water surface elevations for each transect were collected under the existing flow condition prior to the test flow releases on September 8, 9, and 10. Streambed elevations at each cell and water surface elevations at each transect were surveyed using a level and a stadia rod. Elevations were referenced to benchmarks, the elevations of which were arbitrarily set at 100.00 feet to simplify calculations of depth for each cell at the various flows. Substrate data were collected for each cell by visually assessing substrate categories and assigning codes based on a modified Wentworth particle size scale (Bovee and Cochnauer 1977) as shown in Table E3.1-43.




POE PROJECT
PACIFIC GAS & ELECTRIC CO

0 2000 4000
Scale in Feet

**Figure E3.1-19 Poe IFIM Study Sub-Reach Locations.**

980780/Poe subreach

**Table E3.1-43**

**Substrate Codes, Descriptions, and Modified Wentworth Particle Sizes**

| Code | Substrate Description | Particle Size (mm) |
|---|---|---|
| 1 | Plant detritus | -- |
| 2 | Clay | -- |
| 3 | Silt | < 0.062 |
| 4 | Sand | 0.062-2.0 |
| 5 | Gravel | 2-64 |
| 6 | Cobble/Rubble | 64-250 |
| 7 | Boulder | 250-4,000 |
| 8 | Bedrock | -- |

The standard method for determining mean column velocity was to take a single measurement at 0.6 of the total depth (measured from the surface) in water less than 2.5 feet deep, and two measurements at 0.2 and 0.8 of the total depth in water greater than 2.5 feet deep. Velocities were measured at all three points if the velocity distribution in the water column was abnormal, to derive an accurate mean column water velocity. Scientific Instruments Price AA and Pygmy-type mechanical flow meters were used to measure velocities at each cell.

The quality control measures that were followed to avoid data collection errors in the field included:

1) Flow meter checks (i.e., spin tests) before, during, and after the field efforts;
2) Computations of discharges for each transect to identify meter malfunction or
3) measurement technique errors;

4) Frequent monitoring of water surface elevation gages to identify changes of stage during the sampling efforts; and

5) Double checking of water surface elevation and reference survey computations.

### E3.1.9.6 IFG4-Hydraulic Modeling

The IFG-4 single velocity model was used to develop a data set of simulated depths and velocities over the targeted range of flows. The model effectively simulates depths and velocities at flow levels 2.5 times the highest test flow. Water surface elevations at each transect were measured at the existing flow release of 110 cfs, the middle release of 250 cfs, and the upper release of 500 cfs. Velocities were measured across each transect at the highest test flow of 500 cfs, allowing the model to simulate depths and velocities up to 1,250 cfs (i.e., 2.5 times the highest test release).

### E3.1.9.7 Habitat Suitability Criteria Development

In support of the instream flow evaluation, a separate study to develop site-specific habitat suitability criteria (HSC) was conducted in July and August of 2000 (TRPA 2001b). The details of this effort are provided within the TRPA report in Appendix E3-10. The goal of the study was to develop suitability curves for the adult and juvenile life stages of five target species including: rainbow trout, Sacramento sucker, Sacramento pikeminnow, hardhead, and smallmouth bass. HSC curves were successfully developed for the adult life stages of the five target species. However, HSC curves for juveniles were only developed for rainbow trout, Sacramento sucker, and for a combined category of hardhead and pikeminnow juveniles. Juvenile-sized hardhead and pikeminnow could not be distinguished from each other in the field, so their observations were combined. For juvenile smallmouth bass, the development of HSC curves was not possible due to the low number of observations during the field effort.

The study locations included two sites in the Poe Reach, and one site in both the Cresta and Rock Creek reaches. The Cresta and Rock Creek sites were included in the study to supplement the number of observations needed to develop curves for the Poe study. In general, the abundances of all fish and, in particular rainbow trout, were much higher in these two reaches than in the Poe Reach.

Divers were used to observe fish and habitat across transects placed in the various representative macrohabitats (i.e., pools, runs, pocket water, and riffles) that occur in the study reach. From the field data, three HSC curves were developed for each habitat feature (i.e., velocity, depth, and cover) for adults and juveniles of each target species. All three of these curve types reflect direct habitat utilization (i.e., measurements of velocity, depth, and substrate/cover for each observation) corrected for habitat availability. Correcting for availability is the currently accepted technique for developing suitability criteria for IFIM studies. The curve types included: 1) density-based curves, 2) preference-based curves, and 3) presence/absence-based curves. The density-based method used estimated fish density values within ranges of depth, velocity, and cover to generate the HSC curves. The preference-based and the presence/absence-based methods used the utilization data from the set of focal point observations collected in the study. The preference-based curves were developed by dividing the utilization data by generated habitat availability data. The presence/absence-based curves were developed by assigning a presence value of "1" to each utilization data point and an absence value of "0" to each availability data point, and then the values were plotted together and fit with a regression model, which was in turn normalized to produce the HSC curves. For the Poe study, there are strengths and weaknesses for each of the curves, which are addressed in detail in the TRPA reports provided in Appendices E3-13 and E3-14.

### E3.1.9.8 IFIM Results

The standard output of the PHABSIM model is a curve of WUA verses streamflow. WUA is presented in square feet of habitat per 1,000 feet of stream, and streamflow is expressed in cubic feet per second (cfs). For the Poe study, WUA curves were developed for the adult life stages of rainbow trout, Sacramento sucker, hardhead, Sacramento pikeminnow, and smallmouth bass; and for the juvenile life stages of rainbow trout,

Sacramento sucker, and for a combined category of hardhead and pikeminnow juveniles. WUA curves were not generated for juvenile smallmouth bass. In this document, the WUA curves and the associated HSC curves are shown together for each species and life stage in Figures E3.1-20 through E3.1-27. Three sets of WUA curves based on HSC curves corrected for availability are shown on the same figure along with the WUA curve generated from the non-corrected utilization HSC curve. The non-corrected utilization curves (i.e., a pooling of all focal point observations directly into a frequency histogram) are also provided on each HSC graph for comparison purposes. The following discussion of results only pertains to the three curves that have been corrected for availability.

Figures E3.1-20 and E3.1-21 present the WUA curves for rainbow trout adults and juveniles, respectively. For rainbow adults, the WUA curves increase quickly up to flow levels near 300 cfs, and then increase more slowly between 300 and 500 cfs to their leveling-off points. The WUA results held in separate analyses for all of the habitats combined and for pool habitat greater than 4 feet in depth excluded. It was apparent from the suitability study that rainbow trout were essentially absent in depths greater than 4 feet, and from the main bodies of large pools. For juvenile rainbow trout, all of the WUA curves increase most quickly up to flows near 250 cfs, and then continue to increase at a very slow rate to flows between 700 and 900 cfs. The overall change in habitat between 250 and 900 cfs is very modest.

Figures E3.1-22 and E3.1-23 present the WUA results for adult and juvenile Sacramento suckers, respectively. For adult suckers, all of the WUA curves increase quickly up to flows near 250 cfs. The preference-derived curve levels off almost immediately, while the density-derived curve continues to increase at a slower rate up to flows near 800 cfs. The only curve that shows an inconsistent trend is the presence/absence-derived curve that shows much greater increases in the amount of available habitat as flows increase, up to flows near 950 cfs. This may be the result of different behavior patterns exhibited by adult suckers during the suitability study, and in particular, the effect of this behavior on the resulting depth HSC curve (Figure E3.1-22). Adult suckers were found in all of the habitat types and under a wide range of velocities. For juvenile suckers, all of the WUA curves follow the same trend of decreasing to flows near 275 cfs, and then increasing slightly and holding at steady levels through flows near 800 cfs before falling off.

Figures E3.1-24 and E3.1-25 present the WUA results for adult Sacramento pikeminnow and adult hardhead, respectively. The amounts of habitat for adult pikeminnow changes relatively little over the range of flows. There is a consistent increase in WUA up to flows between 200 and 400 cfs, followed by a leveling off and then a drop-off. For hardhead adults, all of the curves, with the exception of the presence/absence-derived curve, show a moderate increase up to flows of about 200 cfs, followed by a decrease. The presence/absence-derived curve steadily falls off at a consistent rate from the highest amount of habitat at flows near 50 cfs.

Figures E3.1-26 and E3.1-27 present the WUA results for a combination of hardhead and pikeminnow juveniles and for smallmouth bass adults, respectively. For the juvenile hardhead/pikeminnow combination, the pattern of the WUA curves was very similar, increasing steadily to leveling off points between 500 and 800 cfs. For smallmouth adults, the curves level off between 200 and 225 cfs and decrease steadily with increases in flow. This is the most consistent pattern shown between curves for any of the species. Juvenile smallmouth bass were not observed in high enough numbers to generate HSC criteria.

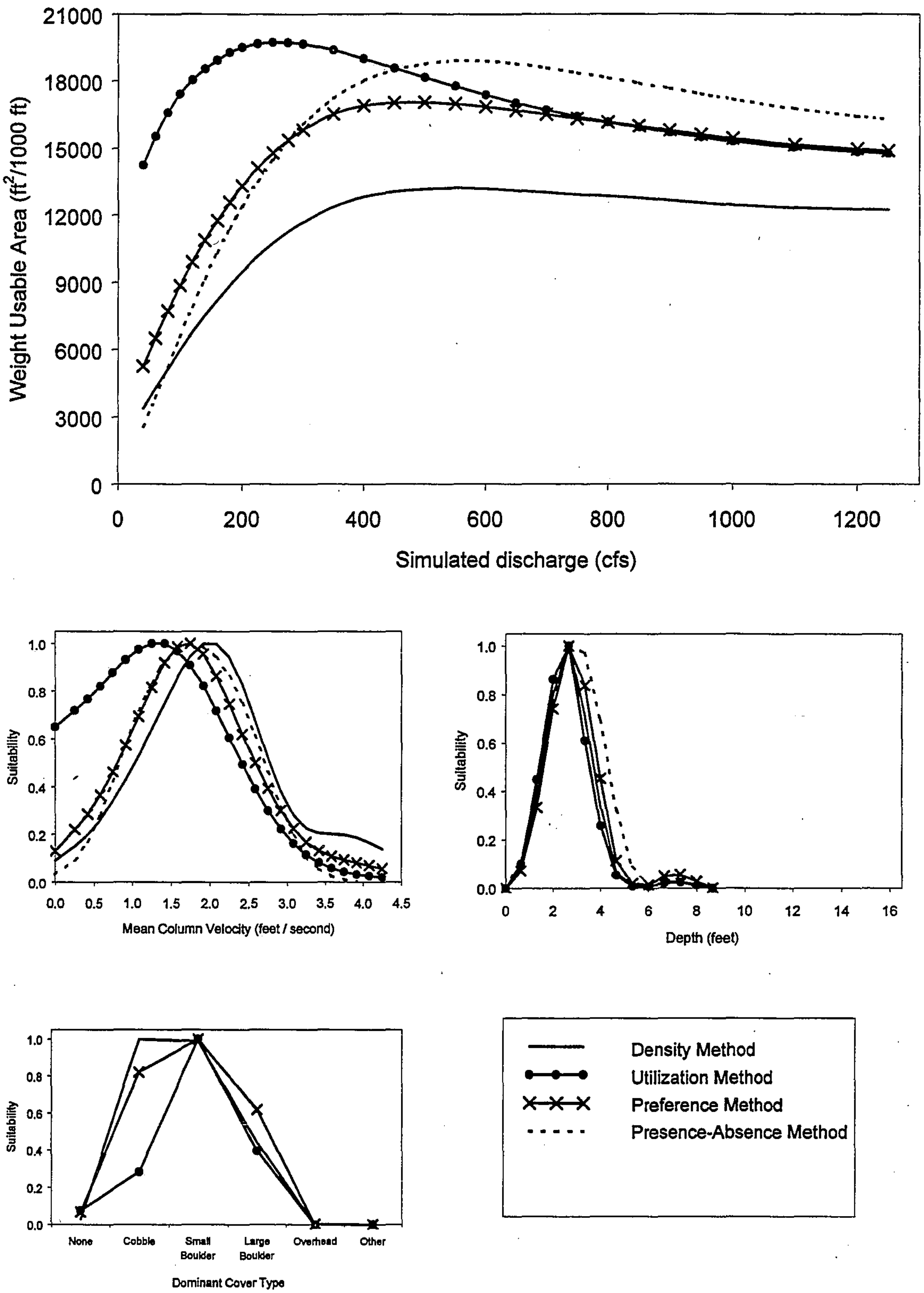



**Figure E3.1-20 Poe WUA Curves – Rainbow Trout (Adults).**

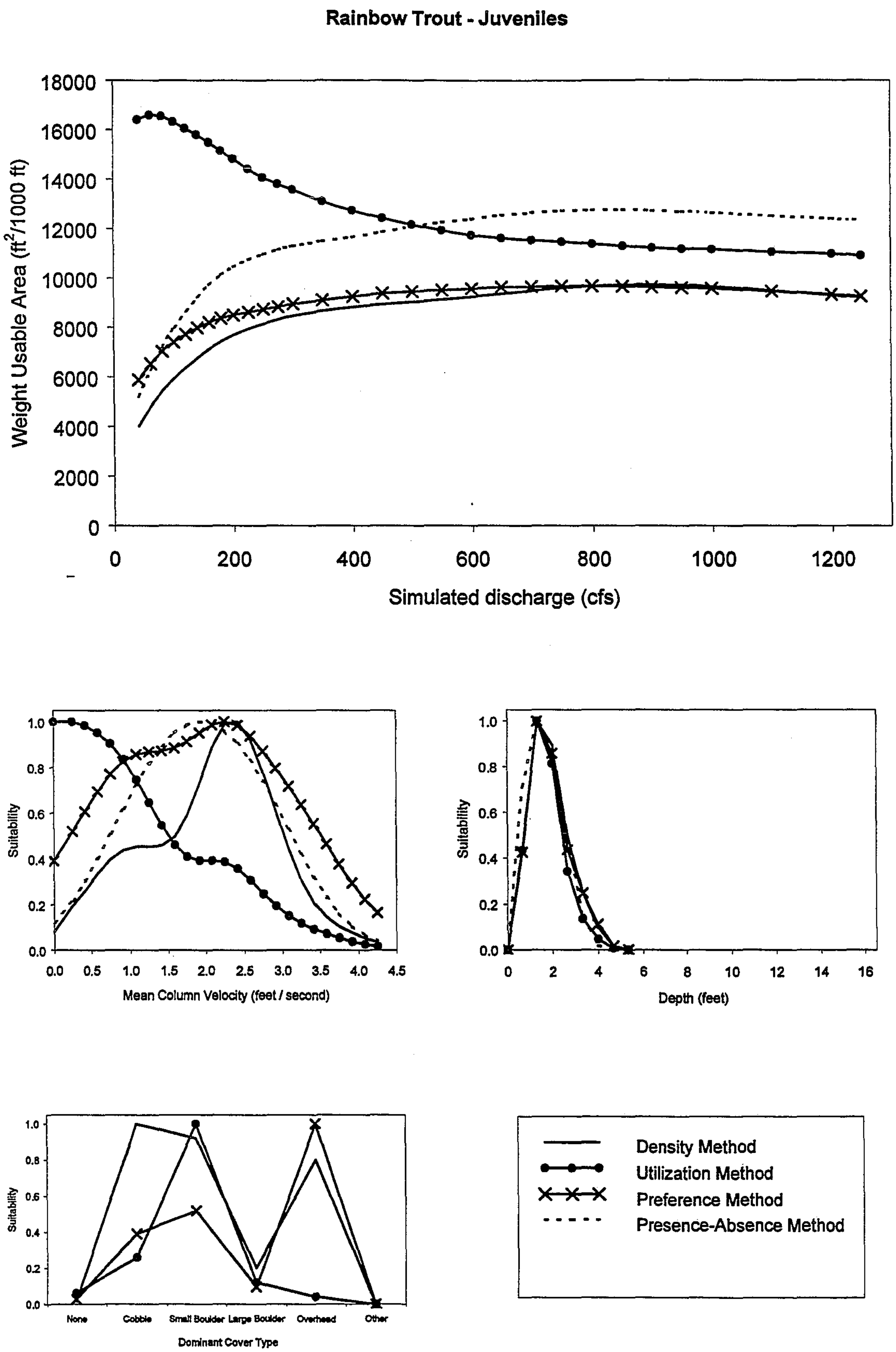



**Figure E3.1-21 Poe WUA Curves – Rainbow Trout (Juveniles).**

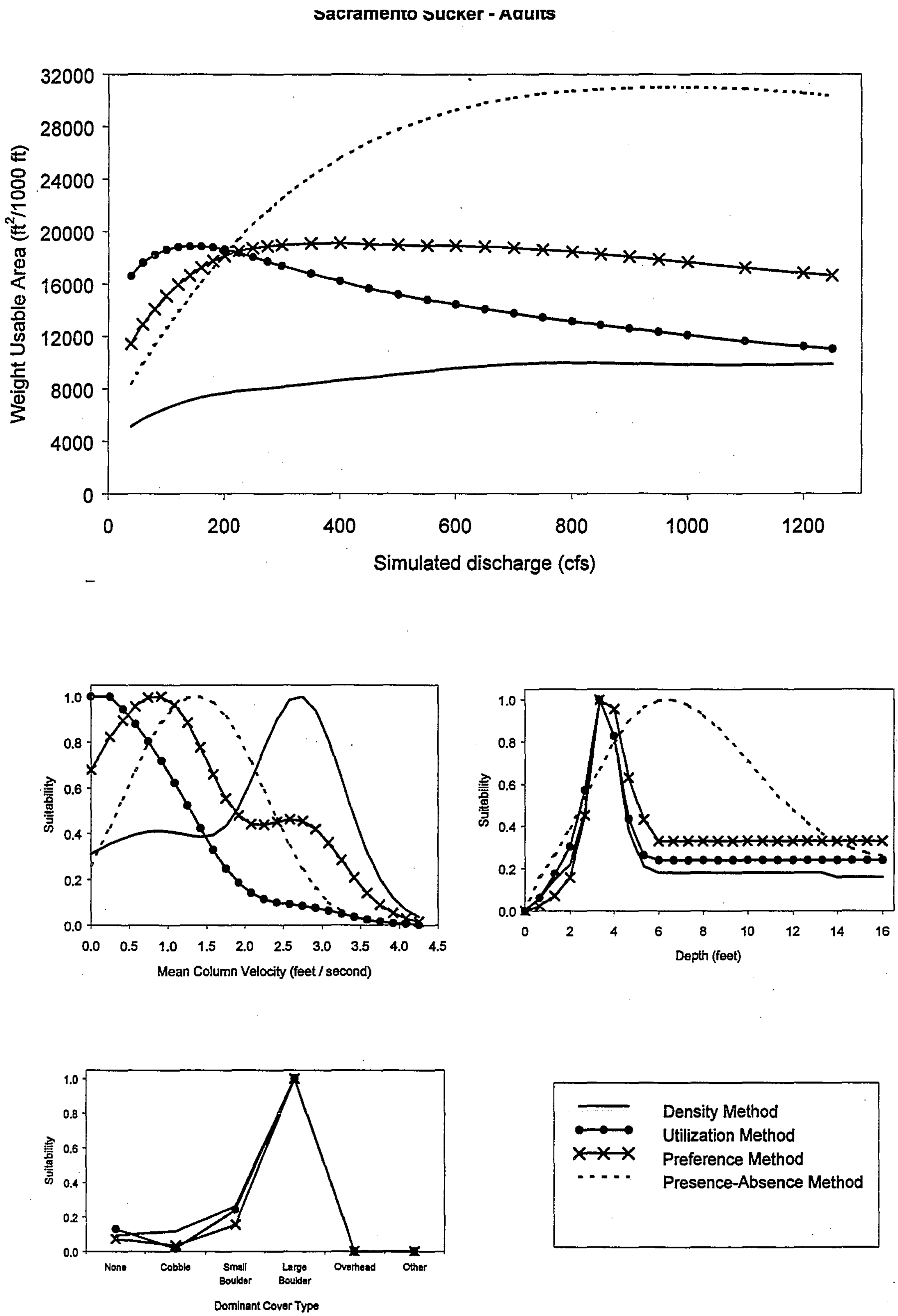



**Figure E3.1-22 Poe WUA Curves – Sacramento Sucker (Adults)**

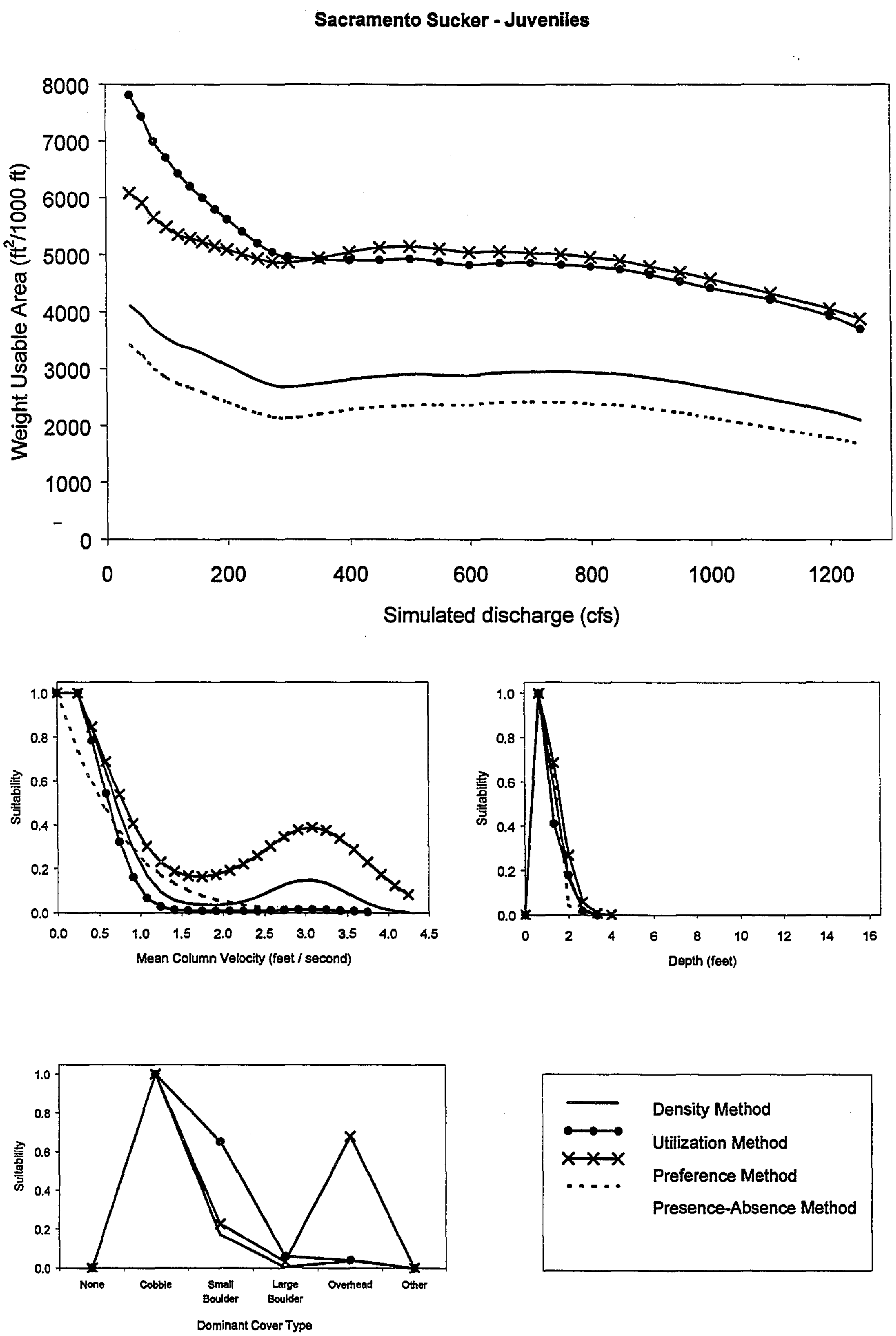



**Figure E3.1-23 Poe WUA Curves – Sacramento Sucker (Juveniles).**

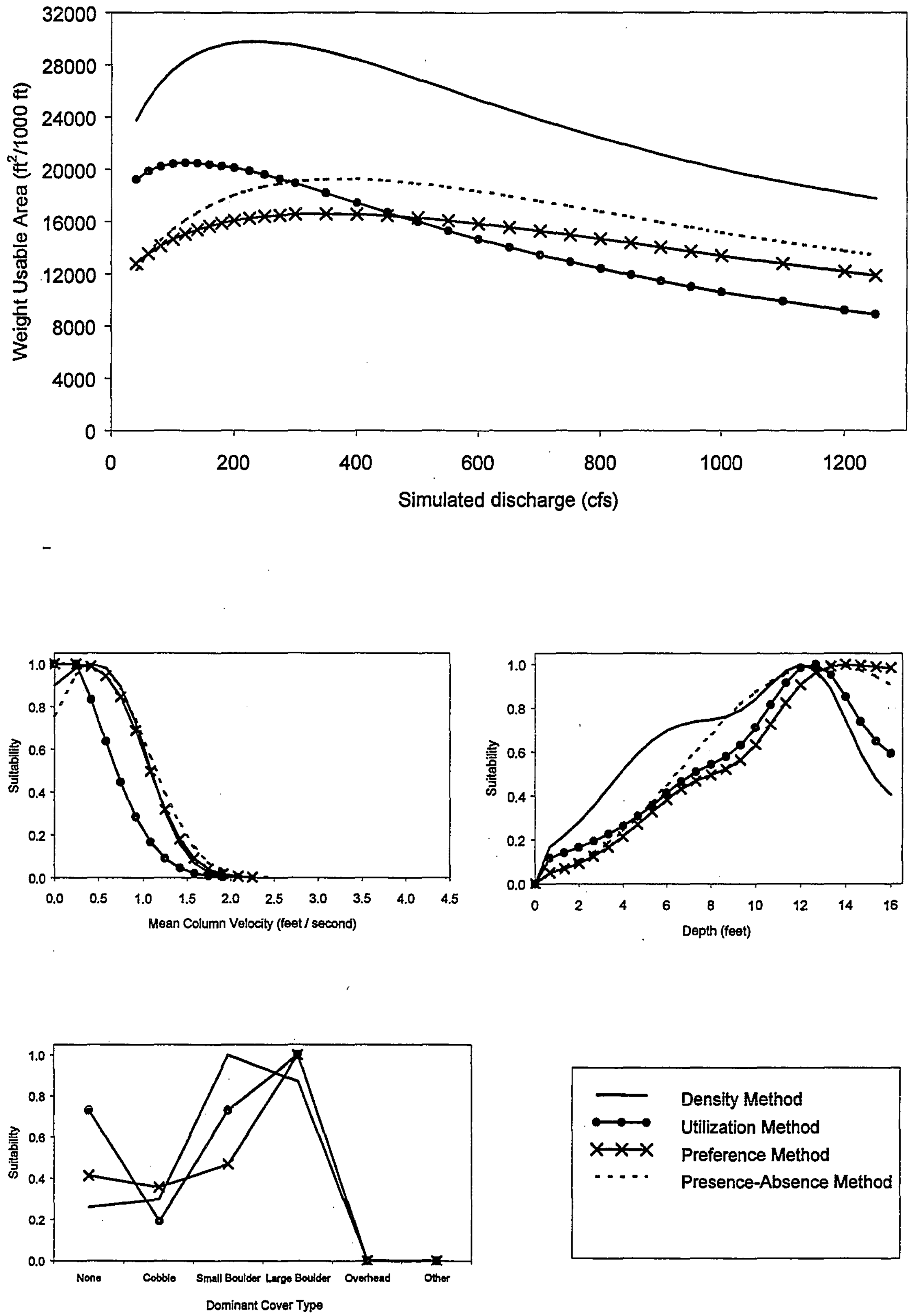



**Figure E3.1-24 Poe WUA Curves –Sacramento Pikeminnow (Adults).**

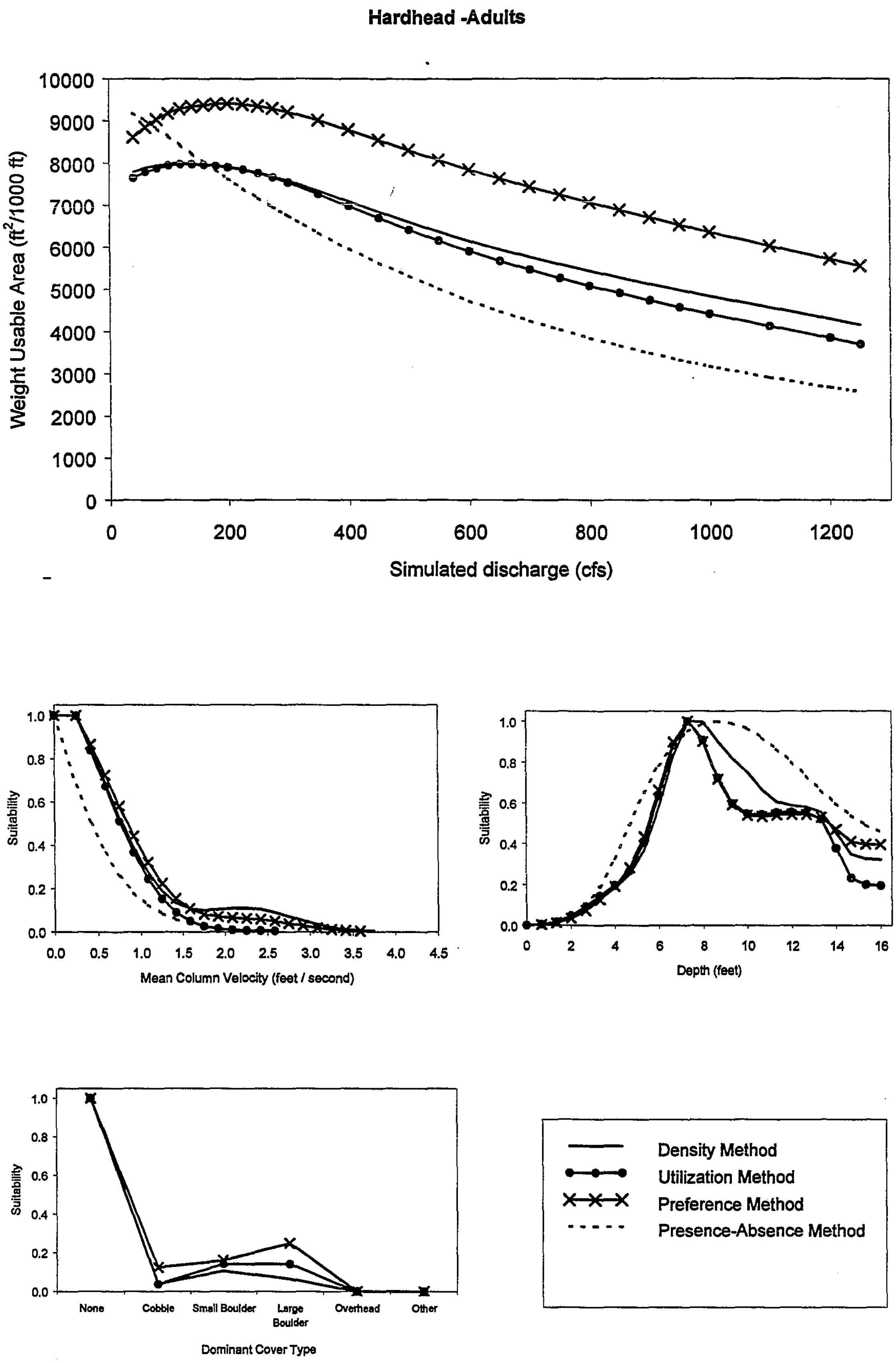



**Figure E3.1-25 Poe WUA Curves – Hardhead (Adults).**

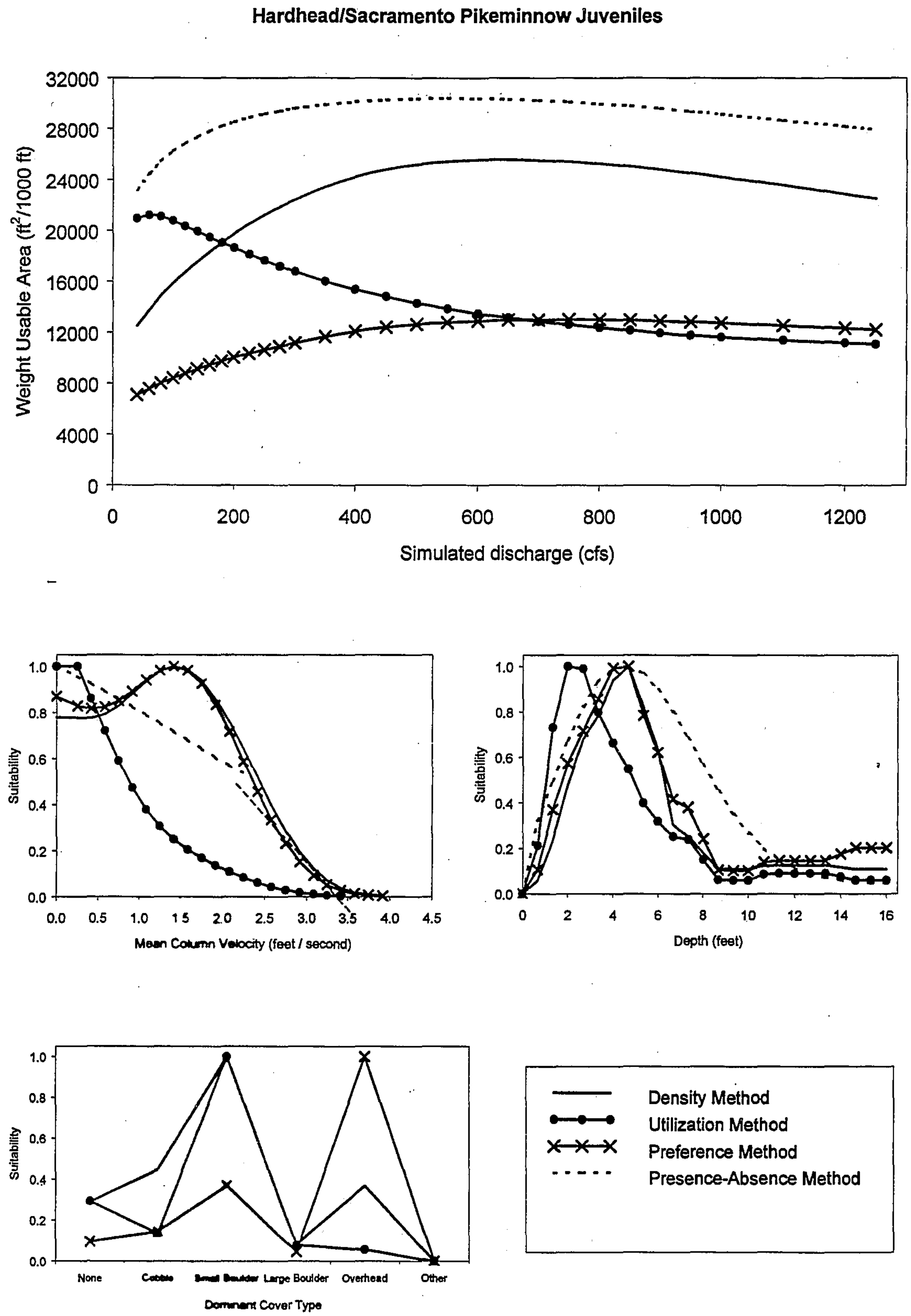



**Figure E3.1-26 Poe WUA Curves – Hardhead/Pikeminnow (Juveniles).**

**Smallmouth Bass - Adults**

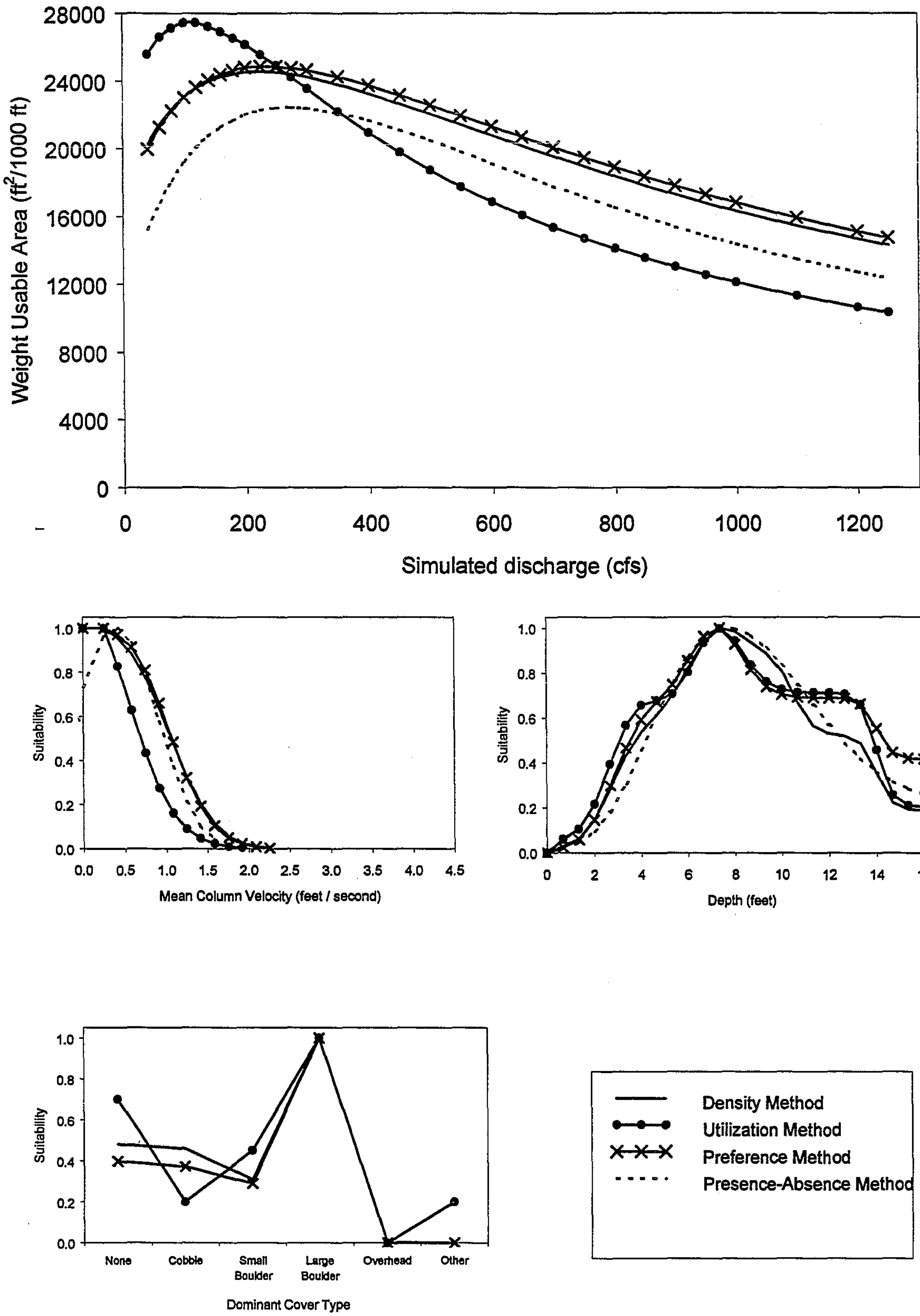



**Figure E3.1-27 Poe WUA Curves – Smallmouth Bass (Adults).**

### E3.1.9.9 Big Bend Dam Assessment (Pros and Cons).

An assessment of Big Bend Dam is provided in Appendix E3-16 to address the positive and negative aspects of the existing Big Bend Dam structure. This expanded assessment provides an historical background of the dam, its importance to existing Poe Powerhouse operations, the impact of the dam as a barrier to fish migration from Lake Oroville, the ecological impact of possible dam removal or ladder construction, recreational impacts of dam removal, impacts of removal on project operations, and estimated costs of dam removal and/or ladder construction.

### E3.1.9.10 Fish Tissue PCB/Mercury Analysis.

As proposed in the Supplement to the First Stage Consultation (2002), resident fish specimens were collected from Poe Reservoir and from Big Bend Reservoir downstream of the Poe Powerhouse to be analyzed for total mercury and PCBs. The specimens were collected during multiple field efforts in 2002 and 2003 using a combination of gill netting and boat electrofisning. The collected specimens analyzed by CDFG's Water Pollution Control Laboratory in Rancho Cordova. This effort was coordinated and designed in cooperation with the State Water Quality Control Board (SWRCB) and the Licensee in association with similar work on the on-going Upper North Fork Relicensing Project. A separate detailed study plan ***Poe Relicensing Project (FERC No. 2107) - Study Plan for Conducting Fish Tissue Contaminants Bioaccumulation Screening*** was developed by the SWRCB's Toxic Substances Monitoring Program, the state Office of Environmental Health Hazard Assessment (OEHHA), and the Licensee. The Poe plan specifies the species, target numbers and sizes, the specimen processing/storage, and the transport and chain of custody procedures. The complete study plan is provided in Appendix E3-17 along with the detailed results of the analyses.

As specified in the study plan, the primary target species for PCB analysis were smallmouth bass and Sacramento sucker, and the target species for mercury analysis were smallmouth bass and rainbow trout or Sacramento pikeminnow. All fish collected were to be resident fish within the legal "catchable" size range (minimum total length of 8 inches), with larger individuals (i.e., total length of 10-12 inches and larger) being preferred. For the mercury analysis, a target number of nine smallmouth bass and nine rainbow trout or Sacramento pikeminnow for each site was identified. In addition, six of the nine smallmouth bass used for mercury analysis and six Sacramento suckers collected from each location were to be analyzed for PCB uptake.

The target numbers of 9 smallmouth bass and 6 Sacramento suckers were collected at both reservoirs. Unfortunately, rainbow trout and pikeminnow were more difficult to catch than anticipated at both sites, and the target numbers were not met during multiple field efforts in November and December 2002 and in a follow-up effort in June 2003. For Poe Reservoir, only 1 rainbow trout and 2 pikeminnow were collected; while for Big Bend, 2 rainbow trout and 8 pikeminnow were collected. After consulting with the SWRQB's staff and their Toxic Substances Monitoring Program in July 2003, it was decided that the sampling efforts for this screening have been adequate, and no further sampling would be required at this time. It was agreed that in addition to the targeted numbers of suckers and smallmouth bass successfully collected, the rainbow trout, pikeminnow, and spotted bass would also be analyzed. The suckers, smallmouth bass, and spotted bass were processed for PCBs, while the rainbow trout, pikeminnow, and spotted bass were processed for total mercury.

Summarized results from the analysis are provided in Table E3.1-44 and Table E3.1-45 for Poe Reservoir and Big Bend Dam Reservoir, respectively.

### Table E.3.1-44

### Poe Project - Fish Tissue Analysis (PCBs and Total Mercury)
### Poe Reservoir (2002-2003)

| Site | Date Collected | Fish Species | Length (mm) | Total PCBs | Total Hg |
|---|---|---|---|---|---|
| | | | | (ppb) | (ppm) |
| Poe | 11/21/02 | Sacramento Sucker | 367 | 6.35 | NA |
| Reservoir | 11/21/02 | Sacramento Sucker | 435 | 10.70 | NA |
| | 11/21/02 | Sacramento Sucker | 376 | 6.96 | NA |
| | 11/21/02 | Sacramento Sucker | 420 | 6.37 | NA |
| | 11/21/02 | Sacramento Sucker | 411 | 6.96 | NA |
| | 11/21/02 | Sacramento Sucker | 418 | 6.86 | NA |
| | | | | Mean = 7.37 | |
| | | | | | |
| | 11/21/02 | Rainbow Trout | 408 | NA | 0.07 |
| | | | | | |
| | 11/21/02 | Pikeminnow | 396 | NA | 0.33 |
| | 11/21/02 | Pikeminnow | 376 | NA | 0.19 |
| | | | | | Mean = 0.26 |
| | | | | | |
| | 6/16/03 | Smallmouth Bass | 203 | 1.94[1] | 0.09 |
| | 6/16/03 | Smallmouth Bass | 217 | 1.94[1] | 0.11 |
| | 6/16/03 | Smallmouth Bass | 223 | 1.94[1] | 0.12 |
| | 6/16/03 | Smallmouth Bass | 221 | 1.31[2] | 0.13 |
| | 6/16/03 | Smallmouth Bass | 253 | 1.31[2] | 0.12 |
| | 6/17/03 | Smallmouth Bass | 220 | 1.31[2] | 0.90 |
| | 6/17/03 | Smallmouth Bass | 215 | NA | 0.11 |
| | 6/17/03 | Smallmouth Bass | 220 | NA | 0.11 |
| | 6/17/03 | Smallmouth Bass | 284 | NA | 0.27 |
| | | | | Mean = 1.62 | Mean = 0.13 |
| | | | | | |

1) Composite of three smallmouth bass (203, 217, and 223 mm in length).
2) Composite of three smallmouth bass (221, 253, and 220 mm in length).

## Table E3.1-45 (1 of 2)

### Poe Project – Fish Tissue Analysis Results (PCBs and Total Mercury) Big Bend Reservoir (2002-2003)

| Site | Date Collected | Fish Species | Length (mm) | Total PCBs (ppb) | Total Hg (ppm) |
|---|---|---|---|---|---|
| Big Bend | 12/4/02 | Sacramento Sucker | 450 | 4.57 | NA |
| Reservoir | 12/4/02 | Sacramento Sucker | 427 | 10.00 | NA |
| | 12/4/02 | Sacramento Sucker | 415 | 4.61 | NA |
| | 12/4/02 | Sacramento Sucker | 358 | 0.65 | NA |
| | 12/4/02 | Sacramento Sucker | 342 | 1.03 | NA |
| | 12/4/02 | Sacramento Sucker | 331 | 1.19 | NA |
| | | | | Mean = 3.68 | |
| | | | | | |
| | 12/4/02 | Rainbow Trout | 269 | NA | 0.03 |
| | 6/19/03 | Rainbow Trout | 390 | NA | 0.04 |
| | | | | | Mean = 0.035 |
| | | | | | |
| | 12/5/02 | Pikeminnow | 425 | NA | 0.22 |
| | 6/19/03 | Pikeminnow | 470 | NA | 0.84 |
| | 6/19/03 | Pikeminnow | 518 | NA | 0.57 |
| | 6/19/03 | Pikeminnow | 460 | NA | 0.33 |
| | 6/19/03 | Pikeminnow | 492 | NA | 0.98 |
| | 6/19/03 | Pikeminnow | 540 | NA | 0.80 |
| | 6/19/03 | Pikeminnow | 418 | NA | 0.35 |
| | 6/19/03 | Pikeminnow | 490 | NA | 0.50 |
| | | | | | Mean = 0.57 |
| | | | | | |
| | 6/17/03 | Smallmouth Bass | 290 | 2.67[1] | 0.32 |
| | 6/17/03 | Smallmouth Bass | 316 | 2.67[1] | 0.20 |
| | 6/19/03 | Smallmouth Bass | 278 | 2.67[1] | 0.16 |
| | 6/19/03 | Smallmouth Bass | 280 | 1.05[2] | 0.13 |
| | 6/19/03 | Smallmouth Bass | 270 | 1.05[2] | 0.17 |
| | 6/19/03 | Smallmouth Bass | 240 | 1.05[2] | 0.11 |
| | 6/19/03 | Smallmouth Bass | 255 | NA | 0.15 |
| | 6/19/03 | Smallmouth Bass | 235 | NA | 0.14 |
| | 6/19/03 | Smallmouth Bass | 270 | NA | 0.15 |
| | | | | Mean = 1.86 | Mean =0. 17 |
| | | | | | |

1) Composite of three smallmouth bass (290, 316, and 278 mm in length).

2) Composite of three smallmouth bass (280, 270, and 240 mm in length).

## Table E3.1-45 (2of 2)

**Poe Project – Fish Tissue Analysis Results (PCBs and Total Mercury)**
**Big Bend Reservoir (2002-2003)**

| Site | Date Collected | Fish Species | Length (mm) | Total PCBs | Total Hg |
|---|---|---|---|---|---|
| | | | | (ppb) | (ppb) |
| Big Bend | 6/17/03 | Spotted Bass | 333 | 4.77[3] | 0.22 |
| Reservoir | 6/19/03 | Spotted Bass | 326 | 4.77[3] | 0.29 |
| | 6/19/03 | Spotted Bass | 305 | 4.77[3] | 0.40 |
| | 6/19/03 | Spotted Bass | 360 | 4.10[4] | 0.46 |
| | 6/19/03 | Spotted Bass | 318 | 4.10[4] | 0.30 |
| | 6/19/03 | Spotted Bass | 298 | 4.10[4] | 0.19 |
| | 6/19/03 | Spotted Bass | 378 | NA | 0.65 |
| | 6/19/03 | Spotted Bass | 320 | NA | 0.29 |
| | 6/19/03 | Spotted Bass | 350 | NA | 0.19 |
| | | | | Mean = 4.44 | Mean = 0.33 |
| | | | | | |

3) Composite of three spotted bass (333, 326, and 305 mm in length).

4) Composite of three spotted bass (360, 318, and 298 mm in length).

Current regulatory criteria used to evaluate PCB and total mercury levels in fish tissues are shown in Table E3.1-46 along with mean values for each species collected from each reservoir. The criteria shown include the United States Environmental Protection Agency (EPA) Ambient Water Quality Criterion (tissue) (AWQC), Maximum Tissue Residue Levels (MTRLs), and Elevated Data Levels (EDL 85 and EDL 95) (SWRB 2000). The MTRLs were developed by the SWRCB to be used as alert levels or guidelines to protect human health from consumption of fish, shellfish, and water that contain substances at levels with potential human health concerns. These MTRLs are an assessment tool and not compliance or enforcement criteria. MTRL have been used as a relative yardstick to evaluate how much tissue levels deviate from guidelines.

## Table E3.1-46
## Regulatory Criteria for PCB and Hg Levels in Fish Tissue
## Poe Reservoir and Big Bend Dam Reservoir

| Site/Species | PCB Mean (ppb) | PCB Range (ppb) | Max. Tissue Residue Levels (MTRL) | Elevated Data Levels (EDL 85) | Elevated Data Levels (EDL 95) | EPA Screening Level | US EPA AWQC (Tissue) |
|---|---|---|---|---|---|---|---|
| | | | **5.3** | **13.7** | **63.3** | **10** | **0.064** |
| Poe Res. / SKR | **7.37** | **6.35 - 10.7** | | | | | |
| Poe Res. / SMB | **1.62** | **1.31 – 1.94** | | | | | |
| | | | | | | | |
| Big Bend / SKR | **3.68** | **0.65 – 10.0** | | | | | |
| Big Bend / SMB | **1.86** | **1.05 – 2.67** | | | | | |
| Big Bend / SPB | **4.44** | **4.10 – 4.77** | | | | | |
| | | | | | | | |
| | Total Hg Mean (ppm) | Total Hg Range (ppm) | | | | | |
| | | | **0.37** | **0.04** | **0.04** | **0.3** | **0.000051** |
| Poe Res. / SMB | **0.13** | **0.09 – 0.27** | | | | | |
| Poe Res. / RT | **0.07** | **0.07** | | | | | |
| Poe Res. / PM | **0.26** | **0.19 – 0.33** | | | | | |
| | | | | | | | |
| Big Bend / SMB | **0.17** | **0.11 – 0.32** | | | | | |
| Big Bend / RT | **0.04** | **0.03 – 0.04** | | | | | |
| Big Bend / PM | **0.57** | **0.22 – 0.98** | | | | | |
| Big Bend / SPB | **0.33** | **0.19 – 0.65** | | | | | |
| | | | | | | | |

1) SKR = Suckers, SMB = Smallmouth Bass, SPB = Spotted Bass, RT =Rainbow Trout, PM = Sacramento Pikeminnow.

The EDL is an internal SWRCB comparative measure, which ranks a given concentration of a particular substance with previous State Mussel Watch Program (SMWP) data.

The water quality criteria listed in the U.S. EPA (1987) "Gold Book" for bioaccumulation of contaminants were designed to prevent excessive bioaccumulation of hazardous chemicals that represent either an exceedance of the Food and Drug Administration (FDA) action levels in fish tissue or an increased cancer risk. More recently, the U.S. EPA has focused its effort for the control of hazardous chemicals that tend to bioaccumulate in fish. This approach has been used for PCB's and more recently for mercury.

The AWQC (tissue) is a water quality standard established under the Clean Water Act (CWA) to protect human health, pursuant to Section 304(a) of the CWA. The AWQC for mercury was originally published by the USEPA in 1980 for total mercury. The EPA 2000 revision establishes water quality criterion for methylmercury since it was determined (U.S. EPA 2000) that is more appropriate to base the methylmercury criterion on a fish tissue residue concentration than on an ambient water concentration. Methylmercury is assumed to be the form of mercury available for bioaccumulation in the food web. Most mercury in fish tissues is in the methylmercury fraction. Total mercury, however, is typically analyzed from fish tissue and is assumed to represent the methylmercury content of tissues. The Tissue Residue Criterion for methylmercury is 0.3 mg/kg-fish. This is the concentration in fish tissue that should not be exceeded based on a total fish and shellfish consumption-weighted rate of 0.0175 kg fish/day, which is the EPA total default fish intake for general adult population.

PCB levels were, in general, below the State Water Resources Control Board's (SWRCB) maximum tissue residue level (MTRL) of 5.3 ppb for both smallmouth bass and spotted bass. However, the PCB levels for Sacramento suckers were higher for all of the sucker specimens from Poe Reservoir, while the levels for suckers from Big Bend Reservoir averaged below the MTRL level but were higher for a few of the individual specimens. For total mercury, the levels for each species, excluding some of the pikeminnow and spotted bass specimens collected from Big Bend Reservoir, were lower than the State Water Resources Control Board's (SWRCB) maximum tissue residue level (MTRL) of 0.37 ppm. The average value for pikeminnow from Big Bend Reservoir was higher than the MTRL level at 0.57 ppm, while the average value for spotted bass was below the level at 0.33 ppm. Even though the target numbers of rainbow trout were not successfully collected at either site, the three rainbow trout (i.e., two from Big Bend and one from Poe Reservoir) were analyzed for mercury. The mercury values for the three trout were below the MTRL level at 0.03, 0.04, and 0.07 ppm.

**California Entities Fish Tissue Data**

The Licensee has received an additional body of information developed for the North Fork Feather River watershed in the Poe and Cresta reaches. Included in this packet are some additional PCB fish tissue analyses that were completed on two composite samples of three fish each for both Sacramento sucker and smallmouth bass collected from Big

Bend Reservoir only. That data along with the laboratory data forms are included in Appendix E3-17. The values for the sucker composites fall within the values found in the Licensee's separate effort, while the values for smallmouth bass are slightly higher than the Licensee's values.

**E3.1.9.11 Fish Disease Assessment.**

In response to Plumas National Forest comments on the First Stage Supplement, the Licensee has conducted a background evaluation of three infectious fish diseases that have been documented to occur within the North Fork Feather River Drainage (i.e., *Ceratomyxa shasta*, *Flexibacter columnaris*, and *Myxobolus cerebralis*). The following descriptions of the existing body of knowledge on the status of these fish diseases in the North Fork Feather River are provided. A significant portion of the information presented here is contained within a similar assessment prepared for the on-going Lake Oroville Project Relicensing (Montgomery Watson Harza, Draft Report SP-F2, 2003). Lake Oroville is located immediately downstream of the Poe Project, so the two projects would be expected to be exposed to similar types of fish diseases. Lake Oroville fish populations, being downstream, would be susceptible to any existing pathogen from the Poe system. The movement of disease in the upstream direction from infected Lake Oroville fish is limited somewhat by the existing Big Bend Dam. Big Bend Dam is a barrier to upstream fish migration during most times of the year, except when Lake Oroville is close to full.

In general, the present status of *Ceratomyxa shasta* and *Flexibacter columnaris* (columnaris disease) in the Poe Reach of the North Fork Feather is unknown, although *C. shasta* and *Myxobolus cerebralis* (whirling disease) have been observed in the drainage (pers. comm. Dr. William Cox, CDFG Statewide Fish Health Coordinator). It is thought that the success of past catchable trout planting programs (1970s and 1980s) in the North Fork Feather River were greatly limited by the fact that the fish placed in the river were not *Ceratomyxa*-resistant strains, and subsequent survival was very low.

Even though each of these pathogens has been documented or likely can be found in the North Fork Feather River system, no outbreaks or die-offs have been observed (Dr. William Cox, Personal communication.). It is unlikely that Poe Project operations contribute significantly to the presence and distribution of these three fish diseases. In fact, the Big bend Dam may provide some benefit by reducing the spread of fish-born disease by preventing movement from Lake Oroville into the Poe Reach of the North Fork.

Brief descriptions of the identified fish diseases as they pertain to the Pacific Gas and Electric Company's Poe Project follow:

***Ceratomyxa shasta***

The distribution of the infectious stage of *Ceratomyxa shasta* is restricted to the Pacific Northwest of the United States and Canada. In California, it is found in the Klamath, Sacramento, Mokelumne, Feather, and Pit River systems. The limited geographic range of the infectious stage of *C. shasta* is due to the distribution of the alternate host, *Manayunkia speciosa*. *M. speciosa* is a freshwater polychaete essential to *C. shasta* to complete its life cycle (Bartholomew 1997).

Infection by *C. shasta* can occur in water temperatures as low as 4 to 6° Celsius (Ratliff 1983, Ching and Munday 1984). Progress of the disease is temperature dependent (Bartholomew 1989). Uday et al. (1975) found that rainbow trout infected with *C. shasta* and held at 6.7 to 23.3°C showed little ability to recover; the temperature and time of exposure to death were directly correlated. Ratliff (1981) demonstrated that mortality in salmonids is directly related to length of exposure. Infected fish kept at higher temperatures died more quickly than fish kept at lower temperatures (e.g., approximately 155 days at 6.7°C and 14 days at 23.3°C). It must be noted, however, that the aforementioned experiments were conducted using rainbow trout strains *highly susceptible* to Ceratomyxosis (Ratliff 1981 and 1983, Uday et al. 1975). The endemic strain of rainbow trout presently found in waters associated with the Poe Project is known to be resistant.

Several experiments have been conducted to test the resistance of different species and different strains of species to *C. shasta* (Zinn et al. 1977, Buchanan et al. 1983, and Bartholomew et al. 2001a and 2001b). The results of these experiments indicated that juvenile salmonids originating from enzootic waters were more resistant compared to strains from non-enzootic waters. In studies performed on coho salmon, crosses between resistant and susceptible fish produced progeny that were intermediate in their susceptibility (Hemmingsen et al. 1986). In studies on resistance inheritance in rainbow trout, Bartholomew et al. (2001a) found that mortality in the F1 progeny from all study groups, with at least one parent of the resistant strain, was less than 5% regardless of exposure time (mortality in the F1 progeny of susceptible strain parents was 75% and 98% following three day and five day exposure periods, respectively). Conversely, Currens et al. (1997) found that introgression between endemic resistant strains and nonnative hatchery (susceptible) strains of rainbow trout compromised the resistance to the disease. This information suggests that, at a minimum, the practice of stocking salmonids from areas where *C. shasta* is not endemic (nonnative strains) to areas where the parasite is endemic (and infectious) is not likely to be successful.

It is unlikely that operation of the Poe Project contributes to the presence of *C. shasta*. The overlapping distribution of the alternate host, *M. speciosa* and the infectious stage of *C. shasta* suggest that these three species (*C. shasta*, *M. speciosa* and native salmonid stocks) have co-evolved (Montgomery Watson Harza 2003), resulting in the resistant strain of rainbow trout endemic to the North Fork Feather River.

**Whirling Disease (*Myxobolus cerebralis*).**

Whirling disease is caused by the myxosporean protozoan *Myxobolus cerebralis*. The disease can cause deformities in the axial skeleton and neural damage resulting in "blacktail" of infected fish. Heavy infection of young fish can be fatal. The tubificid worm, *Tubifex tubifex*, is the only other host specific to the completion of the life cycle of *M. cerebralis*.

The presence and current distribution of *M. cerebralis* strongly implicates past state and commercial stocking practices as a major factor contributing to the presence of whirling disease in California (Modin 1998). Whirling disease has been detected from the North Fork Feather River (Modin 1998, Dr. William Cox pers. comm.). However, there is no indication at this point that the current operation of the Poe Project contributes to the presence of whirling disease in project-affected waters.

Further, the status of whirling disease in tributaries to the Upper Sacramento River (including the North Fork Feather River) is reported to be sub clinical (Modin 1998). In addition, Modin (1998) states, "Nonquantitative empirical observations of wild salmonid populations in *M. cerebralis*-positive waters by CDFG fishery biologists and Fish Health Laboratory staff between 1965 and 1997 do not support a relationship between depressed fish population numbers and the presence of *M. cerebralis* in California waters." To minimize the threat of whirling disease, CDFG avoids importation of fish (for stocking purposes) originating from out-of-state farms (Dr. William Cox, CDFG Statewide Fish Health Coordinator as cited by Montgomery Watson Harza 2003).

**Columnaris Disease (*Flavobacterium columnare*).**

Columnaris disease is found in freshwater environments throughout the world (Plumb 2002). It is caused by the bacterium *Flavobacterium columnare*, which exists in freshwater environments and infects all species of freshwater fish. Columnaris disease is a bacterial infection caused by the pathogen *Flavobacterium columnare* and is spread between fish through the water. Once infected, the disease develops because of stress from high water temperatures, elevated organic loads, high fish stocking densities, low dissolved oxygen and/or physical trauma (Brown et al. 2002). In crowded environments (i.e. hatcheries and farms), the infections can be chronic and result in 100 percent morbidity and 70 percent mortality. In wild fish, morbidity may between one and 30 percent (Shotts et al. 1999). Duarte et al. (1993) observed that, in pond and cage-reared channel catfish columnaris disease appeared to follow outbreaks of other diseases and may act as a secondary infection. The disease, although not host specific, is most commonly seen in cultured fishes, especially juvenile channel catfish (Plumb 2002).

Fish are generally susceptible to the disease from 15 to 30°C, while young fish are more affected by columnaris disease than older fish (Brown et al. 2002). The disease is first observed as an external infection of the skin, fins, or gills, in which the fins become frayed and necrotic. Skin lesions appear as small, dull, bluish-gray blotches. Later as these lesions develop, scales are lost and the pale necrotic lesions produce little mucus. The advanced disease appears as inflamed tissue, yellowish in color (due to the large numbers of bacteria).

**E3.1.9.12 Large Woody Debris Assessment.**

In response to Plumas National Forest comments on the First Stage Supplement, the Licensee conducted an evaluation of large woody debris (LWD) movement into and through the Poe Reservoir, the Poe river reach, and Big Bend Dam reservoir. The detailed evaluation report describing the LWD sources (i.e., Poe Reservoir, the main river reach, Flea Valley Creek, and Mill Creek) and the estimated quantity from each of those sources is provided in Appendix E3-18 (Stillwater Sciences 2003). The report assesses the amount, location, and degree of embeddedness of LWD deposited on floodplains, gravel bars, and terraces along the Poe river reach. These elements are then used to detail LWD species, sizes and decay class of each species, debris inputs, transport mechanisms, and the role of LWD in the basic channel morphology structure. The evaluation also includes an assessment/quantification of wood collected behind the Poe Dam, and the current practice of debris removal at the intake adjacent to Poe Dam. Finally, the assimilated information is used to determine if project operations have resulted in detrimental changes in the movement of woody debris through the system. A summary of the methodology, results, and recommendations from the assessment are provided in the following section.

**Objectives**

The objectives of the LWD study included the following:

1. Broadly characterize the distribution and amount of LWD in the Project reach and Poe Reservoir using available high-resolution orthophotography;
2. Inventory the physical characteristics (number, size distribution, location, and condition) of LWD at study sites located in the Project reach, the tributaries, and Poe Reservoir;

3. Summarize LWD transport processes and the influence of LWD on channel morphology in the Project reach;
4. Describe sources of LWD to the Project reach; and
5. Recommend measures to maintain and enhance LWD functions in the Project reach.

**Methodology**

LWD surveys were conducted at four sites in the Project reach, two sites in tributaries to the Project reach, and in Poe Reservoir.

Geomorphic Characterization

The approach to geomorphic characterization of the survey streams involved initial reconnaissance investigation of the channel reaches using USGS 7.5-minute quadrangles and orthophotography taken in 2000. Long profile characteristics and slope estimates were determined from quadrangle maps. Estimates of channel confinement, stored sediment, and relative LWD supply and storage were interpreted from the orthophotography.

The Project river reach was then divided into 4 sub-reaches: 1) Poe Dam to Highway 70, 2) Highway 70 to a break in slope 1.1 km (0.66 mi) upstream of Bardees Bar, 3) the break in slope upstream of Bardees Bar to a break in slope approximately 1.6 km (1 mi) downstream of Bardees Bar, and 4) the break in slope downstream of Bardees Bar to Poe Powerhouse. One representative study site was chosen in each sub-reach. Study sites were also established in Poe Reservoir, Mill Creek, and Flea Valley Creek.

Survey methods at the study sites involved estimating bankfull width, reach-average slope, and the median particle diameter of the bed surface at representative channel cross sections. These parameters were then used to define study site boundaries with generally consistent channel morphology, gradient, and substrate. The reach length at each study site was at least 20 to 30 bankfull channel widths or three riffle-pool sequences, whichever was shorter.

Large Woody Debris Characterization

A complete count of all LWD that occurred within the bankfull width was made at each study site. Only pieces longer than 0.9 m (3 ft) and greater than 15 cm (6 in) diameter were recorded. Pieces that met the minimum size criteria were recorded if any portion of their length occurred within the bankfull channel width. Logs that were entirely suspended over the bankfull channel were not recorded. Pieces were tallied into 20 unique size classes based on five length classes and four diameter classes. Pieces with rootwads were tallied separately. The orientation, geomorphic function, species, and degree of decay were noted for key pieces (length >1.2 times bankfull channel width). Presence of LWD accumulations, potential LWD source areas, and evidence of LWD transport were noted for each site.

The midpoint of each length and width size class was used to calculate volumes from the tally data. The total volume of each length and diameter class was calculated based on the equation for the volume of a cylinder: where $D_{mp}$ is the diameter at the midpoint of the size class and $L_{mp}$ is the piece length at the midpoint of the size class.

$$Volume = \pi \frac{{D_{mp}}^2}{4} L_{mp}$$

Because reach lengths varied between study sites, LWD frequency by size class was normalized to a 100 m (328 ft) stream length and LWD volume was normalized to a hectare (10,000 $m^2$ [107,584 $ft^2$]).

Study sites located in Poe Reservoir were used to assess the amount and size distribution of stored LWD. Surveys of the size distribution and abundance of LWD along the reservoir shoreline using the methods described above, and anecdotal accounts of annual LWD removal from Poe Reservoir were used to estimate LWD storage in the Poe Dam impoundment (Cordone, Andrew, pers. comm. 2002).

**Results of LWD Studies**

The summarized results of the field surveys for each of study sites are provided in Table E3.1-47. For all of the main river sites (sites 1-4), loading values are low compared with those reported by Ruediger and Ward (1996) for young timber stands (50 to 90 years old) in the Stanislaus National Forest. The North Fork Feather River channel, however, is considerably wider and receives much larger peak discharges than those reported by Ruediger and Ward (1996). For the tributary sites on Mill Creek and Flea Valley Creek, loading values were similar to the Ruediger and Ward values.

## Table E3.1-47

**Summary of LWD study reach characteristics.**

| Study Site | Length, (m) | Slope (%) | Bankfull Width, (m) | Channel Reach Morphology* | LWD Frequency (pieces/100 m) | LWD Volume ($m^3$/hectare) |
|---|---|---|---|---|---|---|
| Site 1 | 1,454 | 0.52 | 52 | Bd/Br step-pool<br>Bd/Cb riffle-pool | 3.1 | 1.7 |
| Site 3 | 2,133 | 36 | 70 | Bd/Br step-pool<br>Bd/Cb step-pool | 4.4 | 1.9 |
| Site 4 | 1,219 | <1 | 70 | Bd/Cb riffle-pool | 1.3 | 1.2 |
| Flea Valley Creek | 122 | 56 | 7.6 | Bd/Cb/Gr cascade | 5.7 | 20.6 |
| Mill Creek | 183 | 68 | 9.1 | Bd/Br step-pool | 8.7 | 30.4 |
| Poe Reservoir | 2,743 | N/A | N/A | N/A | 0.58 | N/A |

* Bd = bedrock    Cb = cobble
Br = boulder    Gr = gravel

A separate discussion for each of the study sites follows:

North Fork Feather River - Site 1

Site 1 was located on the North Fork of the Feather River directly downstream of Poe Dam. The head of the large pool near the Mill Creek confluence served as the upstream boundary and the Highway 70 bridge crossing served as the downstream boundary. The 1,454 m long (4,770 ft) reach exhibited pool-riffle morphology with alternating boulder/cobble bars in the 1,263 m (4,145 ft) between Mill Creek and Flea Valley Creek, and boulder/bedrock step-pool morphology for approximately 190 m (625 ft) downstream of the large left-bank bar near the Flea Valley Creek confluence. A large left-bank sand bar and associated deep pool occurred at the Mill Creek confluence. Average water surface slope was approximately 0.5% above Flea Valley Creek and 3.5% downstream of Flea Valley Creek. Estimated bankfull width ranged from 46-52 m (150-170 ft).

Mean LWD frequency and volume at Site 1 were 3.1 pieces/100 m (0.94 pieces/100 ft) and 1.7 $m^3$/ha (24 $ft^3$/ac), respectively. The majority of LWD in the reach fell in the two smallest diameter classes and smallest length class, and were found as solitary pieces on the crest and back edges of alternating bars upstream of Flea Valley Creek. LWD did not occur within the wetted perimeter. Woody riparian vegetation was dominated by an over-story of young (<5 years old) alder and willow, with little or no large riparian trees available for LWD recruitment to the channel. The railroad grade on the right bank limited recruitment of large logs from the valley side slope.

North Fork Feather River - Site 2

Site 2 was located on the North Fork of the Feather River between the Highway 70 bridge and a prominent break in slope located 1.1 km (0.66 mi) upstream of Bardees Bar. This subreach is the steepest and most confined in the Project reach. Channel morphology is predominantly boulder/bedrock step-pool with extremely high transport capacity relative to sediment supply. Average water surface slope exceeds 7%. Estimated bankfull width ranged from 30-37 m (100-120 ft).

Due to difficult and potentially hazardous access to the site, LWD characteristics were assessed from orthophotography and reconnaissance surveys from Highway 70. No LWD was observed within the narrowly confined valley in the photos or from limited vantage points along Highway 70.

North Fork Feather River - Site 3

Site 3 was located on the North Fork of the Feather River directly upstream and downstream of the abandoned railroad bridge at Bardees Bar. The 2,133 m (7,000 ft) reach extended 1,066 m (3,500 ft) upstream and downstream of the bridge. The reach exhibited predominantly boulder/bedrock step-pool morphology with a water surface slope of approximately 36%. The channel in the vicinity of Bardees Bar exhibited boulder/cobble riffle-pool and plane-bed morphology with bedrock control along the left bank. Estimated bankfull width ranged from 5661 m (185200 ft). Little or no woody riparian vegetation occurred within the flood prone valley width. The reach was highly disturbed by railroad construction. Several large slides originating from the railroad grade have delivered large volumes of boulder and cobble to the river channel.

Mean LWD frequency and volume at Site 3 were 4.4 pieces/100 m (1.3 pieces/100 ft) and 1.9 $m^3$/ha (27 $ft^3$/ac), respectively. The majority of LWD in the reach fell in the two smallest diameter classes and smallest length class. Most of the tallied LWD pieces were found in a single deposit on the left bank at the head of the Bardees Bar pool upstream of the abandoned bridge, where high flow combined with changing flow direction have deposited concentrations of LWD at or above the bankfull elevation. Solitary small pieces were occasionally found wedged between boulders throughout the reach. LWD did not occur within the wetted perimeter.

North Fork Feather River - Site 4

Site 4 was located on the North Fork of the Feather River directly upstream of the access road bridge to Poe Powerhouse. The tail of the large pool approximately 300 m (1,000 ft) upstream of the bridge served as the downstream boundary. The 1,219 m long (4,000 ft) reach exhibited freely-formed and meandering pool-riffle morphology with alternating boulder/cobble bars. Average water surface slope was <1%. Estimated bankfull width ranged from 5661 m (185200 ft). Woody riparian vegetation was dominated by an over-story of young (<5 years old) alder and willow, with little or no large riparian trees available for LWD recruitment to the channel. The Poe Fire burned east-facing slopes along the right bank of the reach. Little LWD delivery to the channel was observed in the burn area.

Mean LWD frequency and volume at Site 4 were 1.3 pieces/100 m (0.4 pieces/100 ft) and 1.2 $m^3$/ha (17 $ft^3$/ac), respectively. The majority of LWD in the reach fell in the smallest length and diameter class and were found as solitary pieces on the higher surfaces of alternating bars and wedged between boulders. As with the other river sites, LWD did not occur within the wetted perimeter.

Flea Valley Creek

LWD was inventoried along a 122 m long (400 ft) reach of Flea Valley Creek directly upstream of the Pulga Road bridge crossing. The road crossing served as the downstream boundary and a corrugated metal pipe crossing the creek served as the upstream boundary. The reach exhibited boulder/cobble/gravel cascade morphology with a water surface slope of approximately 5-6%. Estimated bankfull width ranged from 6.0-7.6 m (20-25 ft). The channel reach bordered Pulga Road and was entrenched within vertical 2 m colluvial banks along its entire length.

Mean LWD frequency and volume at the Flea Valley Creek site were 5.7 pieces/100 m (1.8 pieces/100 ft) and 21 $m^3$/ha (300 $ft^3$/ac), respectively. All LWD in the reach fell in the two smallest diameter classes and smallest length class. LWD was found as solitary pieces and small accumulations extending into the wetted perimeter but did not influence channel morphology. Active recruitment of small LWD (< 0.5 bankfull width) was observed throughout the reach. Recruitment of larger logs from adjacent hillslopes was limited by Pulga Road along the right bank and a private road paralleling the left bank.

Mill Creek

LWD was inventoried along a 183 m long (600 ft) reach of Mill Creek directly upstream of the Highway 70 crossing. The road crossing served as the downstream boundary. The reach exhibited boulder/bedrock step-pool morphology with local cobble/gravel deposits associated with large obstructions and plan form changes. Water surface slope was approximately 6-8%. Estimated bankfull width ranged from 9.1-10.7 m (30-35 ft).

Mean LWD frequency and volume at the Mill Creek site were 8.5 pieces/100 m (2.7 pieces/100 ft) and 30 $m^3$/ha (429 $ft^3$/ac), respectively. The majority of LWD in the reach fell in the two smallest diameter classes and smallest length class. LWD was found as solitary pieces and small accumulations extending into the wetted perimeter. Several logs spanned the channel above the bankfull elevation. Active recruitment of small LWD (< 0.5 bankfull width) was observed throughout the reach.

Poe Reservoir

LWD was inventoried along shorelines of Poe Reservoir. Poe Reservoir inundates approximately 2,743 m (9,000 ft) of the North Fork Feather River channel. The shoreline is predominately comprised of large boulders and steep bedrock slopes. Mean LWD frequency in Poe Reservoir was 0.6 pieces/100 m (0.2 pieces/100 ft). The majority of LWD in the reach fell in the two smallest diameter classes and the second to smallest length class. LWD was found as solitary pieces along the shoreline. Pacific Gas and Electric Company operation and maintenance records indicate that approximately 20 to 30 logs (>6 inches in diameter) are removed annually from the trash racks in Poe Reservoir, representing a volume of approximately 76 $m^3$ (2,700 $ft^3$) (Cordone pers. comm. 2003).

A reconnaissance survey of LWD in the Big Bend afterbay was also conducted to assess trapping of LWD that was transported through the Project reach. Few LWD pieces were observed along the afterbay shorelines. The low LWD occurrence in the lower reservoir could be related to low LWD supply into the afterbay from upstream sources and to the transport of LWD over Big Bend dam during high flow periods.

**Potential Effects of Project Operations on Large Woody Debris**

Several factors influence the stability of LWD and its influence on channel processes, including size (length and diameter), degree of anchoring or burial in banks and/or substrate, orientation in relation to streamflow, location within the bankfull channel, tree species, condition upon entry to the channel, type of input mechanism involved, and piece complexity. One of the most important factors contributing to stability is size. Length relative to channel width has been found to be the most important attribute in determining piece stability (Bilby 1984; Swanson et al. 1984; Harmon et al. 1986; Lienkaemper and Swanson 1987). Pieces longer than the bankfull width of the channel have a much greater tendency to be stabilized on stream banks and channel obstructions (Bilby 1984), and much of their weight may be supported by ground outside the channel (Swanson et al. 1984). Lienkaemper and Swanson (1987) found that high flows move many pieces that were shorter than the bankfull width.

The Poe Project reach is comprised of very wide channels that experience occasional large peak discharges with high unit stream power. Channels of this type typically do not retain LWD within their bankfull width. High unit stream power, transport capacity, and peak discharge typically lead to the transport of LWD through the reach as well as rapid disintegration of LWD within the reach. Young riparian stands regenerating after the 1997 flood through the Project reach do not recruit LWD, and oak woodlands and early-to-mid-seral stage conifers stands adjacent to the reach do not contain trees with length and diameters large enough to be retained within the bankfull channel. Bedrock and the coarse boulder substrate do not allow LWD anchoring. Consequently, LWD has very little effect on channel morphology in this setting.

**Management Recommendations**

In their comments to the First Stage Supplement, the Forest Service outlined possible mitigation steps that might be taken by the Licensee if detrimental changes in LWD movement due to the project are identified in this assessment. Those steps included such things as cabling logs to the reservoir shorelines, re-introduction of wood trapped behind the dam to the downstream reach, and the release of flushing flows to move perched wood from the upper channel margins and bars to the active channel.

Based on what was found in the study, potential for improving LWD management in the Poe Project is fairly limited by the high flows that occur in the reach in the winter and spring. Possible measures could include the following:

- Manage Poe Dam to maximize LWD passage, if possible.
- Keep maintenance records regarding the amount and size of LWD stored behind log booms and on shorelines at the Poe Reservoir, as well as LWD that is removed during maintenance operations.
- Minimize land uses that remove large trees from the stream corridor downstream of Poe Dam.

### E3.1.9.13 Salmonid Trap and Haul Assessment.

In response to the First Stage Consultation Package Supplement, the National Marine Fisheries Service (the Service) requested that the Licensee assess the restoration potential of the Poe Project reach for the reintroduction of selected anadromous fish species. Specifically, the Service asked that two federally-listed threatened species (i.e., the spring-run Chinook salmon and the Central Valley steelhead) be the primary targets for the restoration assessment. Further, the Service recommended in their response that a 'trap-and-haul' program might be an appropriate way to restoring passage for Chinook salmon and steelhead runs in the Poe Project reach of the North Fork Feather River. The critical components of a 'trap-and-haul' program focus on the capture, transport, and release of both upstream-migrating salmon and steelhead adults and downstream-migrating juveniles.

The Licensee has conducted an analysis of a 'trap-and-haul' program for the Poe Project reach. The Licensee also added to the Poe effort an evaluation of the Cresta river reach's potential for salmon and steelhead, in response to the Service's comments. The more traditional fish passage structures (i.e., fish ladders and fish screens) are covered separately in other sections of this Application.

This evaluation includes the following elements: 1) an historic evaluation of trap-and-haul programs in other parts of the country (e.g., the Pacific Northwest, etc.), 2) applicability and practicality of a trap-and-haul program in the Poe Project (e.g., capture facilities, transport to release sites, etc.), 3) habitat availability in the Poe and Cresta river reaches (e.g., the amounts of spawning gravel, adult over-summering pools, juvenile rearing, etc.), 4) suitability of water temperatures in both reaches (existing and into the future) to support adult and juvenile salmon and steelhead, and 5) possible conflicts with other species and project aspects/goals.

**Historical Evaluation and Applicability for the Poe Reach of the NFFR**

Under contract to the Licensee, GEI Consultants, Inc. (a consultant from the Pacific Northwest familiar with 'trap and haul' operations) conducted a historical survey of existing "trap and haul" programs for anadromous salmonids in the Pacific Northwest (focusing on spring-run Chinook salmon and steelhead). Using the assimilated information on existing programs, GEI completed an overall assessment of the potential success for a similar program in the Poe and Cresta reaches of the NFFR. The results of the effort are provided in white paper report format in *Poe Project Fish Passage – North Fork Feather River* (GEI 2003) (Appendix E3-19). Within the report, descriptions of various programs similar to what might be required for the Poe site are provided. For each of the programs, the report provides a discussion of what has worked well and what has not worked well in these types of programs. Further, the report outlines the general problems for implementing this type of program in the Poe Reach, identifies the various physical facilities that would be needed, and specifies the key problems associated with a re-introduction into the Poe Reach. In addition, the assessment included a less extensive evaluation of allowing fish to establish a run in the Cresta Reach, presumably by providing access to the Cresta Reach with a fish ladder at Poe Dam.

## Existing 'Trap and Haul' Operations

Essentially, various 'trap and haul' programs have been used throughout the Pacific Northwest, most of which were developed to mitigate for on-going power project operations. A range of success to failure has been found in the efforts. GEI reviewed 'trap and haul' programs from 18 different river systems, and provided details regarding many of the existing facilities at those sites. Projects that have employed a downstream-migrating smolt collecting device know as the gulper collector (in use at Baker Dam on the Baker River) has the highest potential application for the NFFR where the collection of smolts will determine the success or failure of a program in the NFFR. A similar collector was used at the Green Peter Dam on the Santiam River in Oregon.

## Applicability of Existing Programs to Poe and Cresta

For the NFFR reaches, GEI identified the major overall concerns with the Poe and Cresta reaches, and the types of collection, processing, and transport facilities that may be needed.

The overall concerns included:

<u>Downstream-Migrants</u>

- Collection of NFFR downstream migrants below Poe Powerhouse.
- The likelihood that juvenile spring Chinook and steelhead will emigrate out during peak hydrograph flows making recapture difficult due to high discharge volumes. If migration occurs during spill, the proportion of juveniles spilling and

entering the intake as a starting hypothesis will be directly proportional to spill volumes and intake. Capture or bypass efficiency will also be proportional to the volume of water that is screened. A screen that can handle velocities less than 0.2 – 0.4 fps such as those used for spring chinook in California require about 3-5 sq ft of screen for each 1 cfs of water; thus for 3000 cfs, a screen facility of 15,000 square feet might be needed.

- The juvenile mortality rate from losses even in a well-designed passage system may be overcome from sources of mortality unrelated to passage such as predation and cumulative stress during migration.
- The potential for entrainment of juvenile fish into the Poe intake. (This applies if adults are provided access to the Cresta Reach as part of the program.)

Adult Passage

- Big Bend Dam as an upstream impediment. The dam may require passage facilities for adult fish from Lake Oroville. (Adults could be released directly into Lake Oroville as part of a 'trap and haul' program or as a result of fallback from fish released into the Poe river reach.)

- Attraction flows from Poe and Cresta powerhouses. Powerhouse flows may cause adults to delay or remain in the tailrace and not swim upriver into the bypass reach. Bypass flows far less voluminous than powerhouse discharges may make the bypass reach less attractive. Also, warmer temperatures of the bypass flow might also discourage adult use or migration into the bypass reach.

- Potential predation by humans and other animal predators, including piscivorous fish species.

- The limited space for developing a 'trap and haul' or ladder facility at Poe Dam. These facilities may need to function at high discharge when the dam is spilling and may affect the project's capacity to discharge the design flow for safety reasons.

- The potential for fallback of adults into the Poe reach after passage into Poe Reservoir and/or Cresta reach.

Condition of Salmonid Populations / Stocks

- Self-sustainability. Historic populations in the pre-dam condition may have been moderate to small, with a relatively low natural return rate. (The eventual return rate of adults may not support sustainable numbers of adults.)

- Existing genetic stock. Stocks that were historically adapted to conditions in this watershed may no longer exist, thus the question of whether the proper stock can be developed to adapt to current conditions, much less historic conditions is an important question that should be addressed.

The minimum physical facilities of a 'trap and haul' program and their functions were also identified by GEI. They included:

<u>Adult Capture Facilities.</u> (Adult capture, eventual loading, and transport in trucks from Oroville Fish Hatchery into the upper basin.)

<u>Delivery Sites</u>. (Access site(s) to deliver adults into the Poe Reach. Trucks would need a safe place to unload adults or juveniles. The site would depend on accessibility and the locations of other possible facilities such as tailrace or fall back barriers (see below).)

<u>Hatchery Production Facilities.</u> (Needed to separate stocks of fish adapted and intended for reproduction in the upper NFFR sub-basins. These would be likely located at the Oroville Fish Hatchery. Fish would be marked with either coded wire tags, PIT tags, or other useful means to identify them as reintroduced stocks and re-identify them upon return as adults. They might then be separated from other hatchery products for the up-river program by marking.)

<u>Acclimation/Research Facilities.</u> (Possibly needed for juveniles to imprint on NFFR water or whatever target tributaries are intended for reintroduction. These might be off-channel ponds or net-pen facilities, hatchery tanks, etc., located somewhere in the Poe Project reach. In fact, the existing dam or powerhouse might be used as a site location. The initial generations of juveniles could imprint on this water. After adults are successfully acclimated into spawning in the targeted areas, such acclimation sites could be abandoned and imprinting could be accomplished *in situ* in the river, rather than with hatchery out-plants. This type of program would have the purpose of building a

genetically acclimated stock. The Cowlitz River Program covered in the GEI report does not separate hatchery-produced fish from upper basin fish and continually introduces hatchery-produced fish into the upper watershed. This has become an important question in deliberations of whether to reintroduce anadromous fish over the PGE Round Butte Dam in Oregon. This may be an issue for the Poe proposal. How will the distinction be made between wild spring-run and hatchery fish produced fish ? It should be made clear what the goal of the program is at the start.)

Fish Ladder or Trap and Haul Facility at Poe Diversion Dam. (This assumes that adult spawning is desired in the Cresta bypass reach, not just the introduction of juveniles. The introduction of adults provides nutrients from carcasses that can be provided artificially but depends on the type of system targeted. Biological interference from non-native fish must be considered in this decision. Examples of interference include competition for food, egg consumption, disease, and predation on juvenile salmon. There is research on artificial nutrient loading of river systems to increase productivity in Oregon (e.g. Stan Gregory, Oregon State University).)

Juvenile Bypass Facilities at the Poe Project or Poe Power Intake Structure. (A number of alternative schemes are possible including screening with a drum type screen (*cf.* Roza Diversion) or other types of screens. Juveniles in the former scheme would be kept in the river and presumably spilled into the Poe reach and thence into Lake Oroville where a Gulper collector is proposed. Alternatively, a screened intake/bypass to a flume or pipe for transport of juveniles downstream to the bypass reach or to a collection facility such as exists at Cowlitz Falls Dam or, North Fork Dam where they are passed back to the river through a pipe. In the former, juveniles would be truck-transported to below Oroville Dam. In the latter, the Gulper handles transport. Efficient (large percentage) removal of juveniles unharmed from a high flow condition generally requires a very large screen area and facility. If out-migration were to occur during peak runoff as with many spring chinook populations, passage efficiency around the intake would be proportional to the spill. To reduce the cost and criteria for screens, it might be more cost effective to spill more water and generate less electricity than to screen all water into the hydro facility. However, if fry move out of the system at a very small size and age, which they might do, and during a low flow season when there is no spill, it would be more difficult and expensive to screen them out of the hydro intake.)

<u>Tailrace Barriers</u>. (Possibly needed to prevent adults from swimming into the draft tubes of the Poe and Cresta Powerhouses as they migrate upstream. The powerhouses could provide more attractive conditions in volume, depth, and temperature compared to the bypass reaches; and spawning congregations might occur there instead of the more broadly targeted bypass reaches. On the positive side, cooler tailrace areas / water may provide some holding water prior to reproductive readiness and migration upriver to spawning areas.)

<u>Downstream Barriers</u>. (If pre-spawning adults were to swim downstream of Poe tailwaters over the existing Big Bend Dam and into Lake Oroville they would be unable to re-ascend. This would create a new set of engineering challenges. Creating a downstream barrier would be difficult due to high flows, debris, bedload, and potentially hydraulic issues associated with the safety of the Project. Other options include a fish

ladder at the Big Bend dam or removal of the structure. Removal could have consequences to hydro operations at the Poe Powerhouse. A better outcome would be to ensure that the environmental conditions in the target bypass areas are attractive in terms of depth, velocity and temperature. The problem repeats itself, but less significantly in each reach because as adults ascend the system, they will encounter a powerhouse and attraction flow there coupled with a low flow bypass. In the upper reaches, if fish fall back over a diversion dam, the fish would be able to re-ascend any fall-back because there would be a trap and haul collector or ladder at each upstream dam. Or if juveniles were to be introduced with eggs or fish from the hatchery, the adult fall-back problem goes away.)

Baker Type Juvenile Collection Facility. (A juvenile collection facility located in NFFR arm of Lake Oroville has been proposed in the NMFS proposal. It might emulate the "Gulper" systems operating at Baker Dam and Green Peter discussed in the GEI paper. This would presumably be operated by the Oroville Project and would be an alternative to collecting juveniles at an upstream site above Poe Powerhouse. It might not preclude the need to exclude juveniles from the Poe intake. There are a number of caveats and severe limitations to locating such a Gulper where it is proposed that are discussed in the following section.)

Further, GEI listed the following key questions or unknowns related to collecting the juveniles in the NFFR:

*When and at what age and size would juvenile migrants leave the NFFR system?* The size of the fish and the discharge conditions in the river and at the intakes are critical to designing criteria to pass sufficient numbers of juveniles. At high flows, much of the river will spill through Big Bend and Poe dams and carry a large proportion of the juveniles. For Poe Dam, the starting hypothesis is that the number of juveniles entrained through the spillway will be proportional to the intake/spill volume. So at 6000 cfs with 3000 cfs each of spill and power consumption, without screens, assume 50% of the migrants would be lost without screens. At 3000 cfs, assume 100% would be lost and at 30,000 cfs only 10% would be lost. Spill is the preferred passage route on the Columbia and Snake rivers even with the advent of modern screens in the intakes.

*Would a "Baker Gulper" type juvenile collector work in the NFFR system?* Major differences between the Baker Dam Project and Poe/Oroville fish passage conditions include: (1) the distances in the proposed capture location of the juveniles at Oroville is about 20 miles away from the dam in the North Fork arm compared to 300 yards from the dam in Baker Lake. This is similar to the Green Peter system in the Willamette system; (2) no other dams exist in the upper Baker and Willamette watersheds, where most of the upper watershed is developed in the NFFR by diversion and storage dams; (3) no major populations of warmwater or exotic predators exist in Baker and Willamette systems that consume the migrants whereas Oroville has several types of resident exotic predators likely to key onto the attraction facility and concentration of migrants in the arm of the Lake; (4) there are no thermal stratifications occurring in the Baker or Green Peter forebays; and (5) the juvenile capture net is in deep water at Baker and Green Peter. In contrast, the North Fork arm will provide variable attraction velocities at the upper end of the reservoir in relatively shallow and fluctuating depths. Changing reservoir depths may create operating and maintenance problems including net hang-up on the reservoir bottom, debris loading into the net, and variable velocities affecting capture efficiencies. Lessons learned at Round Butte applicable at Oroville/Poe include the problems that juvenile fish have in escaping from large reservoirs. There are limited velocities for the fish to find the downstream exit and then the challenge is to find a means to screen them out without injury and without wasting large volumes of water with added spill or other attraction mechanisms.

*Would sufficient numbers of juveniles be produced to make the cost of the facilities and operation and maintenance of them worthwhile compared to other mitigation alternatives?* There are fish facilities including traditional hatcheries in the Pacific Northwest in which the cost per fish exceeds $1,000 per returning adult fish. These types of questions can only be answered with information on production estimates of the habitat combined with mortality rates expected from the facilities, their capture or bypass efficiencies, and the ocean return rates once fish get past the dams.

**Estimated Costs for Selected "Trap and Haul" Program Features**

In addition to providing information on the history of "trap and haul" in the Pacific Northwest and on the types of facilities that might be needed to support a program in the Poe and Cresta reaches of the NFFR, GEI was asked to provide estimated construction costs for some of the required facilities. The total preliminary construction cost summary for four fish passage structures is $48 million to $62 million and is summarized below. Costs for each of the following features are provided here and the caveats/assumptions used for each of the estimates are included in a separate letter report from GEI included in Appendix E3-19. No operation and maintenance costs have been estimated.

| Facility | Estimated Construction Cost Range (x $1,000) |
|---|---|
| • Fish Ladder at Poe Dam | 2,800 – 4,400 |
| • Fish Screen at Poe Intake | 37,000 – 49,000 |
| • Smolt Collecting Facility | 6,250 – 6,250 |
| • Fall-back Protection Barrier | 1,500 – 2,000 |
| • Total | 47,550 - 61,650 |

**Habitat Availability/Suitability**

Spawning Gravel and Juvenile/Adult Habitat

Gravel mapping was conducted in the Poe Reach in May and June of 2003, and in the Cresta Reach in conjunction with mesohabitat mapping in the Cresta Reach completed in October 2003. The surveys were done by accessing the complete reach by foot, and by making bankside and snorkeling observations. All gravel patches (with gravel ranging from 4-150 mm in size) greater than 1 square meter were located, measured, and marked on aerial photographs. Gravel patches within three vertical feet of the water surface were also documented and their differential elevations were noted.

The total area of gravel measured in the Poe Reach was 12,714 $m^2$ (136,854 $ft^2$), with 9,241 $m^2$ (99,470 $ft^2$) within the wetted channel at the base flow. The flow at the time of the surveys ranged from about 135 to 160 cfs. Gravel patches were later assessed, using the particle size information, for their potential use for spawning by Chinook salmon and steelhead. The criteria used in this assessment was based on the information in the California Salmonid Stream Restoration Manual, which lists the particle sizes appropriate for Chinook spawning being between 0.5 to 10 inches (13 mm to 254 mm) and dominated by 1 to 3 inch (25 mm to 76 mm) gravel. This resulted in 8,879 $m^2$ (95,574 $ft^2$) of potential Chinook spawning gravel throughout the Poe Reach, with 5,906 $m^2$ (63,572 $ft^2$) currently within the wetted channel.

For the Cresta Reach, ninety-six individual gravel patches were identified during the October 2003 survey. The total area of these deposits was 1,600 $m^2$ (17,222 $ft^2$), with 1,472$m^2$ (15,845 $ft^2$) within the wetted channel at the mapped base flow of 220 cfs. Of the out-of-water gravel patches, the area was approximately equal at the two elevation classes used during the survey. The majority of gravel patches (68% of total area) occurred in a 2.6 km stretch between Arch Rock and the confluence of Grizzly Creek, with most of the remainder scattered from Cedar Creek downstream to the Cresta Powerhouse. As observed in previous surveys, the overall amount of gravel for the same length of river is much lower in the Cresta reach than in the Poe reach. However, gravel patches in the Cresta Reach were dominated by larger particle sizes more suitable for spawning by larger anadromous salmonids. For example, the vast majority (91%) of the available spawning gravels met the size criteria for suitable spawning for Chinook salmon (1,460 $m^2$), whereas only 20% of the mapped gravel (318 $m^2$) was dominated by trout-sized substrate elements. Overall, this resulted in 1,460 $m^2$ (15,715 $ft^2$) of potential

Chinook spawning gravel throughout the Poe Reach, with 1,340 $m^2$ (14,424 $ft^2$) within the wetted channel at the current base flow.

Assuming that the size of a single Chinook redd is about 194 $ft^2$ (Kier Associates, 1999) and that 50% of the available adequately-sized gravel patches would be used by Chinook salmon, 155 and 73 redd sites would have been available in the Poe Reach within the wetted channel and outside of the wetted channel, respectively, at flows between 135 and 160 cfs. For the Cresta Reach, an estimated 23 redd sites would have been available in the Cresta Reach, all within the wetted channel at the existing base flow of 220 cfs. None of the gravel patches mapped outside of the wetted channel were of sufficient size for salmon or steelhead. For steelhead, the estimated numbers of redd sites within the wetted channel were higher because of the smaller redd size. Assuming a smaller redd size of 150 $ft^2$ and the same size distribution of gravel for steelhead, 204 and 97 redd sites would have been available in the Poe Reach within and outside of the wetted channel; and 30 redd sites would have been available in the Cresta Reach, again all within the wetted channel. For both main river reaches, the numbers of available redd sites is very modest and would limit the numbers of spawning adults that the reaches could support.

Additional spawning area and suitable gravel is available within the accessible tributaries located in both reaches, primarily for steelhead. For the Poe Project reach, Mill Creek and Flea Valley Creek are the two main tributaries that steelhead could use. Both streams are accessed now during the spring migration period by resident rainbow trout from the main river. Flea Valley is fairly open, but is limited by its size; while passage into Mill

Creek is blocked by the Highway 70 road culvert and numerous upstream natural barriers (See Section E3.1.3.2.4). For the Cresta Reach, the most suitable and only accessible tributary is Grizzly Creek, which is located at the top end of the reach within a ¼-mile of Cresta Dam.

Adult/Juvenile Habitat (e.g., Over-summering, juvenile rearing, etc.)

Mesohabitat surveys have also been conducted in both the Poe and Cresta reaches. The Poe surveys were conducted in 1999 supporting the IFIM study effort, while the Cresta surveys were done in October 2003. Pools are the dominant feature in both reaches, particularly in Poe, while low gradient riffle habitat was relatively uncommon. For both of these reaches, holding pools of sufficient depth and size are available for over-summering spring-run salmon in both river reaches. The unknown factor for spring-run Chinook salmon using these holding pool habitats is elevated water temperature over the summer period.

For juvenile salmonids, suitable habitat is available throughout the Poe and Cresta reaches. The fact that resident rainbow trout of all age classes have been documented in past monitoring efforts demonstrates that suitable habitat exists in both reaches. To further assist in this evaluation, weighted useable area (WUA) values for Chinook salmon and steelhead juveniles were generated for both reaches using the hydraulic modeling results from the IFIM studies conducted in 1986 (Cresta) and 1999 (Poe). The suitability curves for chinook and steelhead fry and juveniles from the Oroville Project Feather River were used along with the depth and velocity simulations from the earlier IFIM efforts. Habitat simulations were run for fry and juveniles of both species. Essentially for both Poe and Cresta, habitat values for Chinook fry, Chinook juveniles, and steelhead fry all drop in magnitude from low to high flows. The steelhead juvenile values rise and flatten out at about 150-200 cfs.

Even though the physical aspects of suitable habitat for anadromous salmonids (e.g., gravel availability, presence of holding pools, depths and velocities for fry and juveniles, etc.) are present in both reaches, the quality of the habitat for salmonids is in question, primarily due to elevated water temperatures throughout the NFFR in this area. This is particularly limiting for the lower section of the Poe Reach below Bardee's Bar, which, under current conditions, is of marginal quality in terms of water temperature for much of the summer period.

**Water Temperature Suitability (Pre and Post Prattville Intake Improvements)**

The temperature modeling that was conducted for this Application (See Report E2) indicates that average water temperatures at the Poe Powerhouse in July and August would be below 20°C with flows above 500 cfs, under normal environmental conditions. Under extreme environmental conditions, the average temperatures at this site would be above 20°C at all flows up to 1,250 cfs during this period. With a 1 or 2°C improvement associated with the upper project modifications, average temperatures at the Poe Powerhouse site would be below 20°C at flows above 200 cfs and above 100 cfs respectively, under normal conditions. Under extreme environmental conditions, the average temperatures at the Poe Powerhouse would be below 20°C at flows of 1200 and 200 cfs for the 1 and 2° C improvement scenarios, respectively.

For adult spring-run salmon holding in the Poe Reach, these extreme environmental conditions in July and August could create a problem. For the Butte Creek population of spring-run salmon, large run size coupled with extreme weather conditions in the summer has resulted, in the past, in loss of large numbers of adult fish during those periods. For adult salmon holding within the lower section of the Poe reach, there is the possibility that the fish could move upriver into the upper section above Bardee's Bar to avoid rising temperatures. For the resident rainbows and steelhead juveniles within the Poe reach, the same conditions will pressure those fish to seek out cooler refuge areas also.

**Potential Conflicts with Other Species, Humans, Diseases, Project Aspects / Goals**

Species Predation

The presence of smallmouth bass, a non-native predator species, in the NFFR system could impact the survival of juvenile salmon and steelhead through direct predation, particularly in the Poe Reach where the abundance of smallmouth can be high. The numbers of smallmouth throughout the NFFR appears to fluctuate with high flood flow events in the main river. In consecutive years with few spill events, the bass population builds up in the river sections, while following years with high flows, the bass numbers fall off. The numbers of spotted bass, another black bass moving up from Lake Oroville into the lower section of the Poe Reach, may also increase in abundance in the future.

This species could exert additional pressure on all other fish species present including salmonids in the lower Poe Reach.

Predation on downstream-migrating salmonids by both the non-native bass species and native Sacramento pikeminnow could also be pronounced at 'trap and haul' collection facilities that might artificially concentrate juveniles at those sites. As an example, this condition could definitely occur below the Big Bend Dam where young fish would be moving downstream at the same time when other species (e.g., the pikeminnow) would be moving upstream in the spring. Sacramento pikeminnow are large predator fish that have taken advantage at other dam sites where juvenile salmon are funneled through openings or constrictions (e.g., Red Bluff Diversion Dam on the Sacramento River). Predation is one of the major factors that will influence a "trap and haul" program's success.

Poaching/Disturbance

Human disturbance including fish poaching would be an issue for adult spring run salmon in the Poe Reach. These adult fish can be easily observed in their holding pools and are vulnerable. On the positive side, the portions of river between the Powerhouse Bridge and Bardee's Bar and between Bardee's Bar and the Pulga Bridge are remote and would be difficult to access, providing some protection.

Recreation

The impacts of managing threatened populations of salmon and steelhead in the Poe Reach on recreational opportunities are not clear at this point. Would sport fishing be allowed in the river section? Would public access be limited? What level of enforcement would be needed? Would any restrictions on the Poe Reach be applied to the Cresta Reach if fish are moved into this section? Would there be any impacts on existing recreation (whitewater) flow releases in the Cresta Reach or in the Poe Reach under a possible whitewater boating program in the future (e.g., during the September/October spawning period, during the May-August over-summering period, etc.)?

Fish Disease

The potential upstream transport of fish diseases into the NFFR may have negative impacts on the existing fish populations in the Project reaches. This potential will need to be addressed, particularly if adults are held at the Oroville hatchery for an extended period, or if juvenile fish produced at the hatchery are used to support the re-introduction. A potential also exists of transmitting disease to other aquatic organisms in the Poe Reach (including the foothill yellow-legged frogs). This type of 'fish to amphibian' transmittal of disease has been documented between hatchery-reared rainbow trout and western toad embryos in laboratory experiments conducted in Oregon (Kiesecker et al. 2001). The transmitted pathogen in this case was *Saprolegnia ferax*.

**Trap and Haul Assessment Summary**

There are two basic issues for assessing the proposed re-introduction of salmon and steelhead into the NFFR reaches: 1) are suitable habitat conditions available within the river reaches to support self-sustaining, reproducing populations of fish if artificial transport is provided? ; and 2) are the physical facilities needed to operate a 'trap and haul' operation practical within the Poe Project (e.g., adult and juvenile collecting structures and locations, appropriate release sites, tailrace barriers, processing sites, transport methods, fish ladders, fish screens, etc.), considering the flashy hydrology of the NFFR in the project area (i.e., extreme high flood flows in the winter/spring period) ?

Based on the physical aspects of habitat (i.e., depth, velocity, and substrate) for the various life stages of the target species evaluated in this effort, it appears that: 1) limited amounts of spawning gravels are present in both reaches (with lower amounts in the Cresta Reach); 2) juvenile and yearling habitat does exist in both reaches; and 3) holding pools of sufficient size for over-wintering adult spring-run fish are also present in both reaches. Perhaps a more critical factor than the limited amounts of gravel and spawning area for both of these species is the suitability of adult holding habitat for spring-run and juvenile nursery habitat for steelhead during the summer period, when water temperatures can average above 20°C and present marginal conditions for salmonids. With temperature improvements associated with proposed modifications to the upper reservoirs of the NFFR drainage, conditions are expected to become more suitable for salmonids. The extent of the improvement is yet to be determined. However, under extreme environmental conditions that occur periodically during the warmest part of the summer, the lower portion of the Poe Reach will likely be marginal in quality even with the improvements, especially for adult salmon over-summering in holding pools. Overall, the habitat conditions on the Poe and Cresta Project reaches may not be adequate to sustain a feasible and cost-effective salmon and steelhead introduction program.

At a minimum, the physical facilities needed to support a 'trap and haul' program on the Poe Reach include: 1) an adult collection facility, 2) a transfer and transport operation for adults, 3) adequate adult release sites, 3) downstream smolt collection facilities, 4) transfer and transport operations for juveniles, and 5) appropriate smolt release sites. The adults could be collected at the hatchery and moved by truck to the Poe Reach. A preferred release point for adults would be far enough upstream of the Poe Powerhouse to avoid fall-back to the Poe Powerhouse tailrace or even into the North Fork arm of Lake Oroville. If the adult fish were released close to the powerhouse, an in-river barrier to prevent fall-back might be needed. One scenario would be to lower fish into the river directly from the Poe Powerhouse Bridge. Overall, working with the adult fish from the hatchery would be relatively easy.

The most difficult element for a successful 'trap and haul' program in the NFFR would be collecting downstream-migrating smolts. The downstream migrants, particularly salmon smolts, would move under high flow conditions in the winter/spring, when an in-river structure spanning the river (e.g., located above the Poe Powerhouse) would be the most difficult to operate. In some years with low winter/spring flows, this type of facility might work; but under higher flows, its use would be limited. Any structure would need to be installed annually, as a permanent structure would not be practical here. The proposed alternative, a Baker gulper netting system placed in the North Fork arm of Lake Oroville, would be difficult to operate efficiently due to the fluctuating water levels and velocities in the lake at this time of year. An added potential problem with the gulper-type device and any other structure in this system would be the predation of downstream migrants by existing populations of predatory fish including smallmouth bass, spotted bass, and Sacramento pikeminnow concentrating at the structure sites.

Other difficult aspects of a 'trap and haul' operation or conflicts with other Project resources would include: 1) predation of juveniles by black bass in the river reaches themselves, 2) human disturbance (e.g., poaching, harassment, etc.), 3) impacts on project-related recreation (e.g., sport fishing, white-water boating, access improvements, etc.), and 4) the possible introduction of disease into the up-river reaches from downstream sources. Introduced disease could impact not only the fish populations in the target reaches, but other sensitive organisms inhabiting these reaches. The potential problems and conflicts with other Project activities coupled with the limited amounts of existing spawning gravels, the elevated summer water temperatures, and the difficulty in collecting downstream migrating smolts during high flows would limit the success and cost effectiveness of a 'trap and haul' program in either the Poe or Cresta Project reaches.

### E3.1.9.14 Signal Crayfish Assessment.

Signal crayfish (*Pacifastacus leniusculus*) are present throughout the North Fork Feather River system, and have been identified as potentially having a significant impact on the aquatic ecosystem based on their abundance. The species is an aggressive crayfish introduced into the North Fork Feather River system between 50 and 100 years ago (Personal Communication, Ellis 2002). They are native to northwestern California and the Pacific Northwest, but not to most of the river systems in the Sierra Nevada. When first introduced into a new area, signal crayfish colonize rapidly and within a short time will threaten other species, in particular other native populations of crayfish. In the same way, the species has shown the ability to recolonize an area quickly after a localized decline in abundance.

Various aspects of the signal crayfish's reproductive behavior and general life history strategy allow the species to survive under a variety of natural conditions. Signal crayfish reproduction occurs in three basic phases: 1) the male deposits spermatophores on the ventral surface of the female at the base of the last pair of walking legs in late September/October, 2) the female extrudes, fertilizes, and lays her eggs on the ventral surface of her abdomen in October/November and carries the eggs over the winter, 3) the eggs hatch in late winter or early spring depending on day length, water temperature, and other factors, and 4) the female carries the instars on the ventral surface of her abdomen until the 3rd instar (a miniature of the adult) becomes free-living generally in the late spring (Personal Communication, Ellis 2002).

Signals are short-lived, fast growing, and mature at an early age of 2 years. They are active day and night and can use all types of refugia to escape threats (e.g., boulders, existing holes, etc.). The species has a broad omnivorous diet, and is highly opportunistic.

There is some evidence that signals may prey on amphibian egg masses and tadpoles (Nystrom et al. 2001, Axelsson et al. 1997). In fact, evidence of signal crayfish feeding on FYLF egg masses was found during Rock Creek-Cresta and Poe amphibian studies conducted in 2003. This was followed by direct observations of crayfish predation on egg masses during studies on the Cresta reach later in 2003 (Ganda, 2003).

Specifically for the Poe Project, the threat of crayfish predation on foothill yellow-legged frogs (FYLF) egg masses and tadpoles has been identified as one factor that may be limiting the overall FYLF population along the Poe Reach. As previously discussed in the amphibian section, FYLF populations are distributed throughout the Poe Reach. It has been proposed through recent Poe Project relicensing consultations with the regulatory agencies and others that the use of pulse flows may be one mechanism of reducing signal crayfish populations and, in turn, protecting FYLF's in the Poe Reach. Based on studies of signal crayfish and flows in other systems (Personal Communication, Theo Light, 2002), pulse flows that would impact crayfish would need to be at flow levels high enough to move moderate-sized cobble. Under conditions when the larger cobbles (i.e., 5-6 inches in diameter) are moved, some direct mortality could be found, particularly for smaller individuals. However, the range of pulse flows (i.e., up to 1600 cfs) currently in place for the Rock Creek-Cresta Project (as an example) would realistically have no impact on the abundance and distribution of crayfish in the Poe Reach, except perhaps in steeper riffle habitats. A study of gravel bar dynamics conducted in 1994 on the Cresta river reach provides some basic information on the movement of large cobble (150 mm in diameter) over a range of flows (Resource

Consultants & Engineers 1994). The study site was a gravel bar located in a low gradient section of the Cresta Reach, similar in slope to much of the Poe river reach. In general, a shift of crayfish moving out of the steeper gradient areas (riffles, runs, and pocket waters) to the larger, more protected pool areas would be expected as flows get higher into the 2,000 to 10,000 range. Even under these higher flow levels, signals are adept at finding refuge from high flows in crevices, in existing burrows or holes along the edge, and between boulders within the main channel. In fact, even following the high flood events on the NFFR in 1986 and 1997, the crayfish population in the NFFR has continued to thrive. It is likely that both the abundance and distribution were impacted after these events, but there is no documentation of the resulting change or the speed of recovery.

**E3.1.10 Impacts of Existing Operation.** The impacts of existing Project operation on aquatic resources were largely determined from a review of historic information on aquatic resources and water quality conditions in the Project area and from the results of aquatic resource and water quality studies conducted during the initial 2-year study phase (i.e., 1999 and 2000), continued focused studies between 2001 and 2003 on selected components of the aquatic community identified during the 1999-2000 efforts (e.g., amphibians and macroinvertebrates), and additional assessments/evaluations identified in the First Stage Supplement and conducted in response to agency comments to the Supplement (e.g., assessment of large woody debris, fish disease, trap and haul feasibility, fish collection and tissue analysis, and spawning gravels and adult trout spawner surveys).

Available historic information and study results used in this evaluation are described in Sections E3.1-1 through E3.1-8 (Aquatic Resources) and Sections E2.1-1 through E2.1-10 (Water Use and Quality) of this document, and the identified impacts are summarized in the following paragraphs.

### E3.1.10.1 Aquatic Habitats

Existing Project operation results in the following impacts on aquatic resources: 1) reduced flows and reduced aquatic habitat within the 7.6-mile river reach between Poe Dam and Poe Powerhouse; 2) elevated water temperatures within the river reach due to the reduced flow levels; 3) maintenance of lacustrine habitat at Poe Reservoir and Big Bend Dam Reservoir in place of riverine habitat; 4) reduced upriver and downriver movement of fish past Poe Dam; 5) loss of fish that are entrained at the Poe intake and passed through Poe Powerhouse; 6) disruption of normal sediment transport into the river reach from upriver sources; and 7) short-term fluctuations in flow related to project operation.

**Reduced Flows and Reduced Aquatic Habitat.** Development of the Poe Project and upstream hydro facilities has altered hydrological conditions in the Project area, most notably streamflow during the low-flow period in late summer (see Section E2). Prior to any development in the system, late summer flows in the NFFR at Pulga were on the order of 800 cfs. In comparison, the current Project license requires a minimum flow of 50 cfs at Pulga, although summer flows during the 2-year study period were close to100 cfs due to leakage around the gate seals at Poe Dam. During the remainder of the year, streamflows under existing operations follow the same seasonal pattern as unimpaired flows but at a lower magnitude; notably, the peaks of high flow events have been reduced. The altered (reduced) streamflow condition has been in place for over 40 years, and the aquatic ecosystem has adjusted to this "new" long-term condition.

The direct effect of reduced flows has been to reduce the overall amount of aquatic habitat available in the river reach and to alter the quality of that habitat for various aquatic organisms. The aquatic organisms affected by changes in the aquatic habitat addressed in this document include fish, amphibians, and macroinvertebrates. A discussion of flow effects on each of these groups is provided in the following paragraphs.

*Fish Populations / Habitat (IFIM Evaluation)* - As an element of the relicensing effort, the instream flow study was conducted in the Poe Reach to quantify amounts of fish habitat over a range of release flows. In this type of IFIM analysis, available habitat is expressed as a function of depth, mean column velocity, substrate, and cover. The Poe study was targeted at the adult and juvenile life stages of five fish species including rainbow trout, hardhead, Sacramento sucker, Sacramento pikeminnow, and smallmouth bass.

The results of the IFIM analyses show that reduced flows have the largest impact on the amounts of available habitat for adult and juvenile rainbow trout and for adult Sacramento sucker, but have less impact on available habitat for hardhead, smallmouth bass, and Sacramento pikeminnow. These results are primarily driven by the change in velocity under various flows. Because pools dominate the river reach (>50% of the reach) and because depth and cover do not change much under different flow releases in the pools, changes in velocities control the output. For pikeminnow, hardhead, and smallmouth bass, the lower velocity areas in the pools are the most heavily used habitat. WUA curves for the adult life stages for these three species level off or start to decrease after moderate increases in flow between 200 and 400 cfs (Figures E3.1-24, E3.1-25, and E3.1-27). However, rainbow trout and Sacramento sucker showed higher use of higher velocities, resulting in higher WUA values as the velocities increase. For rainbow adults, the WUA curves increase quickly up to flow levels near 300 cfs, and increase more slowly between 300 and 500 cfs to their leveling-off points (Figure E3.1-20). For rainbow trout adults, the WUA results held for separate analyses with all of the habitats combined and with pool habitat greater than 4 feet in depth excluded. It was apparent from the suitability study that rainbow trout were essentially absent in depths greater than 4 feet. For juvenile rainbow trout and adult suckers, all of the WUA curves, except one, increase most quickly up to flows near 250 cfs, and then continue to increase at a slow rate to flows between 700 and 900 cfs (Figures E3.1-21 and E3.1-22). The only curve that shows an inconsistent trend is the presence/absence-derived curve for adult suckers (Figure E3.1-22). This curve suggests much greater increases in the amount of available habitat as the flows increase. This may be the result of different behavior patterns exhibited by adult suckers. They were found in all of the habitat types and under a wide range of velocities.

*Amphibians* - The studies conducted between 2000 and 2003 indicate that foothill yellow-legged frogs (FYLF) are well-established throughout portions of the Poe Reach. The highest concentrations observed occur near and within tributaries, springs, and seeps adjacent to the main river flow. Impacts to FYLF resulting from changes in flow releases in the main river are not clear, but some inferences can be made from the study results. It appears that FYLF are primarily using the edges of the river, and that in many locations, a similar amount of suitable river edge habitat will be available over a wide range of flows. However, low relief boulder/sedge habitat and small side channels and isolated pools along cobble/gravel bars were either substantially reduced or eliminated at higher flows. At the extreme level, high spill flows can eliminate some edge areas temporarily. In such cases, adult FYLF appear to have the ability to avoid these conditions, presumably by moving up and out of the main channel. Mature tadpoles and metamorphs have also shown the ability to tolerate at least some high flow conditions, by seeking cover in the substrate. During years with prolonged spill periods, the tributaries may become more valuable as temporary sanctuaries.

To help evaluate the effect of flows on FYLF habitat in the Poe Reach, a special study effort was conducted in 2002 to assess the amounts of available habitat over a range of flows from 110 cfs to 310 cfs. The results of the evaluation showed that the amounts of preferred and marginal FYLF habitat varied across flow levels. The largest change in habitat (a decrease) occurred between the 250 and 310 cfs test flow levels. An analysis of the data using the amounts of FYLF habitat area found at subsites as replicates showed that at 310 cfs significantly less habitat area was available for FYLF than at 110 cfs. This reduction in available habitat, while statistically significant, did not represent loss of all or most habitat; rather, it showed a mean loss of 4.4 $m^2$ of FYLF habitat per site, from 25.4 $m^2$ to 21.0 $m^2$ or about 17% habitat loss.

*Macroinvertebrates* - The relationship between the macroinvertebrate community and streamflow is not well-established for the Poe Reach. However, changes in the community would be expected in the riffle areas under different flow conditions. For example, with an increase in flow, the riffle area that existed under the lower flow condition would experience higher velocities and greater depths, potentially resulting in a shift in species occurrence and abundance. However, at the same time, new habitat with similar velocities and depths as existed in the lower flow channel would become available in the newly watered areas for displaced organisms. The overall result of higher base flows would likely be an increase in macroinvertebrate production due to the increased area of riffle habitat. The overall effect of streamflow changes on the macroinvertebrate community, however, is somewhat limited by the relatively low percentage of high productive riffle habitat in the Poe Reach.

Riffles, runs, and pocket water account for 14, 16, and 13 % of the habitat in the whole reach, while pools constitute 57% of the reach length. Above each large pool, some combination of cascade, high gradient riffle, and low gradient riffle exists, providing macroinvertebrate input to the pool habitat. Therefore, any changes in the macroinvertebrate community that may occur in riffles as a result of streamflow changes would impact, to some extent, the large pools, particularly near the upper ends of the pools. It is less clear what impact flow changes may have on the macroinvertebrate productivity in the main portion of the pools.

The baseline macroinvertebrate survey work that was conducted in the Poe Reach between 1999 and 2002 for the relicensing project indicates a fairly unstable community with significant variability between station replicates (sites), between stations within the Poe Reach, and between years (Hydrozoology 2000a, Hydrozoology 2000b, Hydrozoology 2001, and Ganda 2003). The variability between stations is, at least partly, related to subtle differences in habitat conditions at the stations; while the variability between years is also partly related to differing hydrological conditions each year, including the timing, frequency and magnitude of high flow events. Extreme flow events can mobilize gravel and rubble substrates in riffles and can result in reduced production of macroinvertebrates.

The focus of the baseline CSBP surveys was to determine the health of the macroinvertebrate community under existing streamflow conditions. It was anticipated that this same method might be applied in the future under different flow conditions to evaluate the effects of flow on the macroinvertebrate community. The monitoring results to date describe the macroinvertebrate community fairly well, but also demonstrate the variation that was found using this method over the four-year period. This variability found under existing flow conditions suggests that using this method to evaluate impacts of future flow changes may be difficult.

## Table E2.3-5
## Summary of precipitation data associated with the Project region.

| | | Precipitation Data (inches) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station | Period | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sept. | Annual Total |
| Portola (4850 ft) | 1999 WY* | 0.56 | 3.91 | 2.55 | 5.90 | 7.66 | 2.30 | 1.22 | 0.00 | 0.08 | 0.21 | 0.51 | 0.14 | 25.04 |
| | %-Normal | 43% | 179% | 73% | 152% | 247% | 87% | 88% | 0% | 12% | 60% | 204% | 47% | 121% |
| | 2000 WY* | 1.11 | 1.57 | 0.25 | 8.27 | 6.6 | 0.79 | 0.87 | 0.63 | 0.07 | 0 | 0 | 0.16 | 20.32 |
| | %-Normal | 85% | 72% | 7% | 213% | 213% | 30% | 63% | 55% | 10% | 0% | 0% | 53% | 98% |
| | 2003 WY* | 0.00 | 3.36 | 8.01 | 1.77 | 0.81 | 1.74 | 3.77 | 0.65 | 0.05 | 0.08 | 0.84 | 0.00 | 21.08 |
| | %-Normal | 0% | 153% | 230% | 46% | 26% | 66% | 273% | 57% | 7% | 23% | 336% | 0% | 102% |
| Chester (4525 ft) | 1999 WY* | 0.82 | 8.29 | 1.81 | 4.66 | 7.95 | 2.75 | 1.54 | 0.18 | 0.76 | 0.00 | 0.60 | 0.00 | 29.39 |
| | %-Normal | 41% | 222% | 35% | 48% | 152% | 68% | 71% | 12% | 82% | 0% | 214% | 0% | 92% |
| | 2000 WY* | 1.75 | 3.05 | 1.63 | 9.02 | 10.94 | 1.97 | 2.13 | 2.16 | 0.19 | 0 | 0 | 0.87 | 33.71 |
| | %-Normal | 87% | 82% | 31% | 150% | 209% | 49% | 98% | 148% | 20% | 0% | 0% | 145% | 106% |
| | 2003 WY* | 0.00 | 4.53 | 9.81 | 4.79 | 2 | 4.37 | 3.15 | 1.95 | 0.12 | 0.02 | 1.34 | 0.00 | 32.08 |
| | %-Normal | 0% | 121% | 187% | 80% | 38% | 109% | 144% | 134% | 13% | 9% | 479% | 0% | 101% |
| Brush Creek (3560 ft) | 1999 WY* | 2.43 | 20.67 | 5.83 | 15.96 | 24.21 | 7.10 | 5.28 | 0.53 | 0.62 | 0.00 | 0.23 | 0.00 | 82.86 |
| | %-Normal | 57% | 256% | 48% | 110% | 206% | 76% | 97% | 21% | 67% | 0% | 79% | 0% | 118% |
| | 2000 WY* | 4.05 | 10.63 | 1.82 | 15.88 | 31.13 | 7.42 | 3.24 | 2.77 | 0.86 | 0.00 | 0.00 | 1.12 | 78.92 |
| | %-Normal | 96% | 132% | 15% | 110% | 265% | 79% | 60% | 111% | 93% | 0% | 0% | 140% | 113% |
| | 2003 WY* | 0.00 | 7.73 | 37.55 | 11.26 | 5.01 | 8.09 | 15.22 | 4.27 | 0.00 | 0.00 | 0.99 | 0.00 | 90.12 |
| | %-Normal | 0% | 96% | 309% | 78% | 43% | 87% | 280% | 171% | 0% | 0% | 341% | 0% | 129% |
| DeSabla (2710 ft) | 1999 WY* | 2.14 | 14.80 | 4.10 | 6.81 | 17.49 | 6.18 | 4.04 | 0.19 | 0.21 | 0.00 | 0.18 | 0.00 | 56.14 |
| | %-Normal | 56 | 194% | 37% | 55% | 167% | 74% | 79% | 9% | 225 | 0% | 78% | 0% | 89% |
| | 2000 WY* | 3 | 8.31 | 2.04 | 13.9 | 28.07 | 6.65 | 4.29 | 2.38 | 0.68 | 0.00 | 0.00 | 1.22 | 70.54 |
| | %-Normal | 78% | 109% | 19% | 113% | 268% | 79% | 84% | 110% | 72% | 0% | 0% | 167% | 112% |
| | 2003 WY* | 0.00 | 5.21 | 36.49 | 9.43 | 5.52 | 8.02 | 14.75 | 3.55 | 0.00 | 0.00 | 0.37 | 0.01 | 83.35 |
| | %-Normal | 0% | 68% | 334% | 77% | 53% | 96% | 289% | 164% | 0% | 0% | 161% | 1% | 133% |
| Chico Univ. (185 ft) | 1999 WY* | 1.47 | 4.89 | 1.94 | 1.67 | 6.19 | 1.73 | 1.22 | 0.08 | 0.66 | 0.00 | 0.08 | 0.00 | 19.93 |
| | %-Normal | 95% | 158% | 42% | 32% | 147% | 55% | 59% | 9% | 150% | 0% | 62% | 0% | 77% |
| | 2000 WY* | 0.63 | 2.9 | 0.75 | 5.48 | 8.32 | 3.39 | 2.37 | 0.96 | 0.39 | 0.00 | 0.00 | 0.26 | 25.45 |
| | %-Normal | 41% | 94% | 16% | 105% | 198% | 107% | 114% | 108% | 89% | 0% | 0% | 72% | 99% |
| | 2003 WY* | 0.00 | 2.22 | 11.74 | 4.5 | 2.9 | 3.1 | 4.3 | 1.03 | 0.00 | 0.00 | 0.48 | 0.00 | 30.27 |
| | %-Normal | 0% | 72% | 253% | 86% | 69% | 98% | 207% | 116% | 0% | 0% | 369% | 0% | 117% |

* Water year is period October 1 through September 31.

**Reduced Flows and Elevated Temperatures.** A secondary effect of the reduced flows in the Poe Reach is elevated water temperatures during the summer period. Water temperature is an important factor for determining the distribution and abundance of aquatic organisms. In particular, the maintenance of coldwater habitat during summer is necessary for the protection of productive trout populations. As part of the recently completed Settlement Agreement for the Rock Creek-Cresta Project, which is located immediately upstream of the Poe Project, Pacific Gas and Electric Company and the other collaborating parties selected the following water temperature objective: "In order to reasonably protect cold freshwater habitat, maintain mean daily temperatures of 20 °C or less in the Rock Creek and Cresta Reaches up to the funding and flow limits specified in the Settlement" (Pacific Gas and Electric Company). The same temperature objective can be applied to the Poe Reach for the purpose of evaluating the extent and maintenance of coldwater habitat.

In general, the temperatures in the Poe Reach are at their lowest point immediately below Poe Dam, increase slowly down to Bardee's Bar, and then increase more steadily downriver between Bardee's Bar and Poe Powerhouse. During the temperature monitoring effort in 1999 and 2000, the warmest temperatures occurred at the NFFR station near Poe Powerhouse. In 1999, the average daily water temperatures at this location ranged from 18.7 to 23.4 °C and averaged 21.2 °C (1999); and in 2000, they ranged from 19.5 to 23.4 °C and averaged 21.3 °C. Summer flows in the Poe Reach at Pulga averaged 91 and 98 cfs in 1999 and 2000, respectively. These flows were in excess of the required minimum of 50 cfs, and were due to leaks in the gate seals at Poe Dam.

the temperature modeling and the insteam flow study, the significantly higher flows in 1999/2000 provided cooler temperatures that were more suitable for trout and increased levels of physical habitat (WUA) for adult and juvenile trout.

*Macroinvertebrates and Amphibians* - The impact of elevated water temperatures on macroinvertebrates and amphibians in the Poe Reach are unknown. Both these groups have adjusted to the existing flow regimes and resulting temperatures associated with normal Project operations. FYLF populations appear to be doing well in the Poe Reach under existing conditions, including the existing water temperature regime. Any change in temperature due to a change in release flows or upriver modifications may potentially impact both amphibians and the macroinvertebrate community. Clues to the responses of these organisms to changes in water temperatures may be found in continued monitoring not only in the Poe Reach, but also in upriver reaches of the NFFR, and from monitoring efforts at other hydroelectric projects in the Sierra Nevada.

**The Conversion of Riverine Habitat into Lacustrine Habitat.** The conversion of NFFR riverine habitat into lacustrine habitat at Poe Reservoir and Big Bend Reservoir has affected the use of these areas by the various aquatic species within the drainage. However, these reservoirs are very different structurally, and, thus, provide different habitat conditions. Poe is much deeper and wider, and velocities in the middle of the reservoir are not discernible. Big Bend is shallow and more narrow, and mid-reservoir velocities are often apparent when the powerhouse units are operating at full load. Poe Reservoir is approximately 1.63 miles (8,600 ft) in length, while Big Bend Reservoir is

0.84 miles (4,426 ft) in length. This comes to a total of 2.47 miles of river that has been converted to reservoir.

Essentially, the change from riverine to lacustrine habitat has reduced the overall abundance of salmonids in the affected sections of the NFFR, and has concentrated the salmonids in the uppermost, fast water areas of the reservoirs. A few trout were found within the main body of Poe Reservoir near the inflow from small tributaries, but their numbers were low. Previous sampling efforts have shown that some large trout (both rainbows and browns) may be residing in the main body of Poe Reservoir, but their numbers are limited. A single rainbow trout was collected during the Big Bend Reservoir electrofishing efforts in 2000. It was surprising that more rainbow trout were not found concentrated in the Poe Powerhouse tailrace area. During the 1999 fishing survey, two rainbow trout were caught by anglers fishing the tailrace waters, demonstrating that rainbow trout do, periodically, utilize the Poe tailrace.

While salmonid populations have been reduced by the change from riverine to lacustrine habitat, populations of species that prefer slower water habitat (e.g., hardhead, pikeminnow, and smallmouth bass) may have increased. The reservoir fish populations are dominated by hardhead, pikeminnow, sucker, and smallmouth bass. Based on sampling in 1992 and in 2000, Poe, Cresta, and Rock Creek reservoirs all contain relatively high numbers of hardhead. It appears that these reservoirs provide important habitat for this sensitive species.

**Upriver and Downriver Movement of Fish at Poe Dam.** Poe Dam prevents fish (e.g., adult rainbow trout) from moving upriver during spawning migrations or other natural dispersal mechanisms. The structure also prevents fish from successfully moving downriver past the dam except through the opening of radial gates for instream releases or spill events. Survival through the release openings or over the dam face for downriver migrants is unknown, but is expected to be limited.

Even though no concentrations of fish, specifically rainbow trout, were observed immediately below the dam face during selected spring-time field visits in 1999 and 2000, adult rainbow trout likely concentrate below the dam during their spring migration period. As discussed in previous sections of this document related to Mill Creek and Flea Valley Creek (the primary tributaries to the Poe Reach, both of which enter the NFFR within ¾ mile of Poe Dam), adult rainbow trout were observed in both tributaries in the spring of 2000. These fish observed in the tributaries were identified as spawners from the main river based on their large size and distinctive coloration. Flea Valley Creek held a large number of fish in the portion of the stream between the mouth and ½-mile upstream. In Mill Creek, adult river-sized fish were observed in the pool below the Highway 70 box culvert, approximately 200 ft above the stream mouth. Continued monitoring in Mill Creek over the summer suggested that the fish were not able to pass successfully through the culvert, at least in 2000. However, the sightings of large adults above Highway 70 in other years indicate that the Mill Creek box culvert may not be a barrier under all conditions.

Under current conditions, adult rainbows are forced to remain in the Poe Reach and utilize the two major tributaries or main river sites for spawning purposes. Abundant numbers of YOY rainbows appear to be produced each year at the mouths of the two tributaries, particularly Flea Valley Creek. Main river spawning may also occur, but has not been documented. The results of the snorkeling surveys indicate that the YOY trout are found primarily in the upper sub-reach, indicating that not many YOY trout are produced in the lower sub-reaches of the Poe Reach. In general, the Poe Reach does contain more gravel substrate suitable for spawning than the upriver Cresta and Rock Creek reaches.

It is unclear whether the rainbow trout population in the Poe Reach would benefit from passage being provided over Poe Dam (presumably with a fish ladder). If adult rainbows from the Poe Reach were provided access to the Cresta Reach of the NFFR through Poe Reservoir for spawning purposes, the adults and the YOY produced by these adults would face many challenges. Initially, the adults would have to find and negotiate the ladder, and then migrate upriver through Poe Reservoir past the outflow from Cresta Powerhouse and into the Cresta Reach. Due to the much larger flows from Cresta Powerhouse than from the Cresta Reach, the majority of fish would tend to be attracted to the tailrace flows. Those fish that did continue to move upstream into the Cresta Reach would then need to locate suitable spawning areas, which are limited in the reach. Finally, after spawning in the Cresta Reach, the adults and the YOY produced would need to return to the Poe Reach, first through Poe Reservoir and then either through the ladder, the release openings, or over the dam during spill events. During downriver movement through the reservoir, the YOY trout would experience added exposure to the resident smallmouth bass in Poe Reservoir. The survival rates for these fish would be expected to be low. Based on the presumed limited spawning success in the Cresta Reach for trout from the Poe Reach, the overall benefit of providing passage at Poe Dam for rainbow trout is of questionable value.

**Upriver and Downriver Movement of Fish at Big Bend Dam.** Big Bend Dam is a barrier to upriver fish migration under most conditions. Fish passage can occur when Lake Oroville is full or close to full. The NFFR Arm of Lake Oroville usually extends to the base of the dam during normal and wet years following the runoff period in the spring. When the close-to-full condition exists (as in 1999 and 2000), fish are probably able to jump from the pool below the dam into the cutout portion in the center of the dam and enter Big Bend Reservoir. During these years, the jump into the cutout ranged from 1 to 2 feet in height for some period of time in the winter/spring. Under lower below-full levels, fish may also be able to move through the V-notch in the middle of the cutout portion of the dam directly into the reservoir during various combinations of powerhouse operations and resulting water velocities through the notch. In other years when the water level in Lake Oroville can be higher, as was observed in the May-June period in 2003, the flow through the cutout and notch can be almost flat or laminar. Under these conditions, fish can easily swim through the notch or over the cutout and move up into the Poe Reach.

Even though no observations of fish successfully moving over the dam were made during site visits coincident with other 1999-2000 field study efforts, anglers fishing Lake Oroville from the top of the dam indicated (through interviews during the 1999 fishing survey) that they had observed fish moving up and through the cutout into Big Bend Reservoir. One angler indicated he observed fish other than trout (e.g., hardhead or pikeminnow) attempting to move over the dam. It is not known at what lake level the dam becomes impassable, but the ability to make the physical jump likely varies for the different fish species in Lake Oroville. The salmonids (i.e., rainbow trout, brown trout, and chinook salmon) would have the easiest time under these conditions, while the native minnows (i.e., hardhead and pikeminnow) and bass (i.e., largemouth, spotted, and smallmouth) would find it more difficult.

In 2003 when Lake Oroville was extremely high, any of the fish species in Lake Oroville could have passed up into the Poe reach. In fact, during the collection phase for a fish tissue study in June 2003, concentrations of adult spotted bass (likely upstream migrants from Lake Oroville) were found at the upper end of Big Bend Reservoir near the powerhouse. Another Lake Oroville fish species, coho salmon, also appeared to pass into the Poe Reach this year, as groups of salmon were concentrated within the Poe Powerhouse tailrace during this same time period. The current CDFG planting of coho salmon in Lake Oroville has replaced the prior chinook salmon / brown trout planting program. For many years, chinook salmon and brown trout were planted annually in Lake Oroville to support put-and-take fisheries. Providing better access over Big Bend Dam for salmon, in particular, would not be consistent with the management strategy for

Lake Oroville, essentially allowing the fish to avoid being caught by reservoir anglers. In addition, even if the salmon were given more opportunity to move past Big Bend Dam, the success of these fish producing any viable young fish or of even finding appropriate sized substrates in the Poe Reach for spawning is unlikely.

While brown trout and rainbow trout from Lake Oroville would potentially move into the lower portion of the Poe Reach more easily if access was provided or improved, the amount of suitable spawning gravels for trout is small. This was documented in gravel surveys conducted in 1992, 1999, and 2003. There are no spawning tributaries in the lower portion of the reach, and the amount of main river spawning that takes place is not known. To help address this issue, a survey for adult spawning activity was also conducted in 2003 in conjunction with the gravel mapping effort. No adult activity was observed during this effort, and only a few possible redd sites were found. The low numbers of YOY trout observed in the snorkeling efforts in the lower sub-reaches suggest that spawning is limited here. The recruitment of young trout in the Poe Reach appears to be primarily from Flea Valley Creek and Mill Creek located in the upper sub-reach.

Finally, even though various species of black bass are currently found throughout the Poe Reach, Big Bend Dam may limit the size of the non-native bass populations in the reach, in particular the lower portion, by preventing bass from Lake Oroville from moving upstream, at least in many years. .

**Loss of Fish Entrained at the Poe Intake.** Overall, the monthly tailrace sampling effort indicates a low level of entrainment through Poe Powerhouse. However, based on the results from this 12-month tailrace effort, through-plant survival appears to be minimal, as almost all of the collected specimens were found dead in the live box. The dominant fish collected were YOY cyprinids. No large, adult specimens and no salmonids of any size (i.e., rainbow trout or brown trout) were collected during the sampling program.

The large numbers of native minnows (particularly hardhead) not only in Poe Reservoir, but also in Cresta and Rock Creek reservoirs, contribute to the annual production of YOY cyprinids in the NFFR system. There appears to be a seasonal movement of YOY cyprinids in the system, a portion of which enters the Poe intake and moves through the powerhouse. Even if all of the YOY specimens are assumed to have been alive when they entered the intake, the total loss of estimated adult equivalents, including hardhead, would not have much impact at the population level.

**Disruption of Normal Sediment Transport into the Poe River Reach.** The lack of downriver gravel recruitment within the NFFR system has been identified as one of the major factors controlling the size of trout populations within the NFFR (DWR 1986, CDFG 1988). One of the major contributors in preventing the natural downriver movement of sediment was determined to be the Rock Creek-Cresta Project immediately upriver from the Poe Project. The proposed Sediment-Pass-Through (SPT) Project was to provide some movement of sediment out of the Rock Creek and Cresta reservoirs into downriver reaches. During the SPT negotiation process, Poe Dam was also identified as contributing to the problem by preventing movement of sediment out of Poe Reservoir into the Poe Reach. However, the sediment-trapping problem at Poe Dam was deemed not as significant as it was for Rock Creek and Cresta reservoirs, because the operation of Poe Dam during spill events allows sediment from the bottom of the reservoir to more easily be mobilized and move downriver. In fact, visual estimates of suitable trout spawning gravel during habitat surveys along the Poe Reach conducted in 1992, 1999, and 2003 showed that the Poe Reach does contain a limited amount of gravel substrate. In addition, a portion of this gravel was of suitable spawning size and located in sites that would be available to fish during the spawning period in the spring. It is not known how much of the available gravels within the Poe Reach are actually used for spawning. Again, a survey for adult spawning activity on the main river was conducted in 2003, and no adult activity was observed and only a few possible redd sites were found. The snorkeling surveys conducted in 1992, 1999, and 2000 suggest that the majority of YOY trout are found in the upper section of the Poe Reach, and that most of that production is from Flea Valley Creek and Mill Creek.

**Short-Term Fluctuations in Flow.** Flow fluctuations in the Poe Reach can occur as the result of both natural events (e.g., runoff from storms and snow melt) and Project operations. The most common flow fluctuations associated with the Project operations occur: 1) when one or both of the Poe Powerhouse units are taken off line, while upstream powerhouses continue to run, causing an increase in flow in the Poe Reach; and 2) when the Poe Powerhouse units are put back on line following an outage, causing a decrease in flow (back to normal levels) in the Poe Reach.

For these types of flow fluctuations, the time of year, the magnitude of change, and the rates of ramping up and down are the most critical elements for determining impacts on aquatic resources. The ramp-up can flush organisms out of shallow, protective areas along shorelines and can expose them to higher velocities or even predator species in deeper, mid-channel areas, while the ramp-down can strand organisms in dewatered zones. For organisms that can react and move quickly, the level of impact would be less than for those that are not as mobile. Gradual ramping is preferred to minimize losses related to this type of fluctuation.

### E3.1.11 Agency Recommended Measures

The agencies and NGOs did not provide specific recommendations for resource protection, mitigation, and enhancement measures through their comments on the Supplement to the First Stage Consultation Package. The primary recommendation advanced by the collective body of agencies and NGOs was to have the Licensee initiate a collaborative process through which all interested parties could have input into the development of such measures. As indicated in the following section, the Licensee has agreed to a collaborative effort to address this recommendation.

### E3.1.12 Licensee Proposed Measures

**Minimum Streamflows.** Licensee proposes to maintain a continuous, year-round, minimum instream flow of 150 cfs in the NFFR, as measured at the Pulga gage (NF23). This proposed streamflow has been based on the balancing of numerous resource considerations, as discussed in the Project Resource Summary. Recognizing that there are uncertainties related to the actual responses of habitat characteristics (e.g., water temperature) and affected resources (e.g., fish, amphibians, macroinvertebrates, bald eagles, and riparian vegetation) to changes in streamflow, the Licensee proposes to monitor those responses.

**Recreation and Pulse Flows.** Licensee proposes no recreation or pulse flow releases due to the potential for impact on foothill yellow-legged frog (most importantly, egg masses, tadpoles, and metamorphs) and bald eagles (foraging habitat and forage fish species). Under current Project operations, high flow events occur in the Poe Reach of the NFFR on a periodic basis as a result of natural spills at Poe Dam during winter storms and the spring run-off period. These flow events will continue to provide ecological and recreational benefits.

**Ramping Rates.** Licensee proposes to implement the same ramping rate requirements as those recently developed for the upstream Rock Creek and Cresta dams under the Rock Creek-Cresta Relicensing Settlement Agreement to protect aquatic resources. During periods when ramping can be controlled at spill flows less than 3,000 cfs at Poe Dam, the initial ramping rates shown below are proposed. These rates would be followed as close as reasonably practicable given radial gate operating limitations. It is recognized that certain operating situations, such as a unit trip when incoming flows to Poe Reservoir cannot be controlled, would likely cause an exceedance of these rates. Revision to these rates could occur as the result of monitoring Rock Creek-Cresta flow impacts.

March, April, and May – 250 cfs/hr up-ramp and 150 cfs/hr down-ramp
June 1 – June 15 – 300 cfs/hr up-ramp and 150 cfs/hr down-ramp
Remainder of the year – 400 cfs/hr up-ramp and 150 cfs/hr down-ramp

**Collaborative Process for Developing Protection, Mitigation, and Enhancement Measures.** Licensee proposes to conduct a collaborative process to reach agreement with all stakeholders willing to fully participate with the goal of developing appropriate protection, mitigation, and enhancement measures for the Project.

### E3.1.13 Anticipated Impacts of Continued Operation

The proposed minimum flow of 150 cfs would provide increases in habitat for the five most abundant fish species identified in the Poe Reach (i.e., rainbow trout, Sacramento sucker, Sacramento pikeminnow, hardhead, and smallmouth bass). Smallmouth bass is the only non-native species of this group. An increase in flow would have a secondary effect of cooling the water temperature, which should improve the quality of the habitat for coldwater species like rainbow trout, especially in the upper portion of the reach above Bardee's Bar. The decrease in water temperatures would not be large enough to significantly impact the suitability of the habitat for the other four fish species, including smallmouth bass. In the lower portion of the reach below Bardee's Bar, warmer water temperature during the summer months and the abundant number of large pools would still limit the rainbow trout populations in this section. The Poe Reach is relatively free of natural migration barriers; thus, trout do have the option to move upstream out of this lower portion during periods of extreme heat.

The proposed minimum flow release of 150 cfs has been selected to provide protection for foothill yellow-legged frog (FYLF) breeding habitat, while allowing for the evaluation of the effects of this increased base flow on populations of FYLF within the Poe Reach. Impacts to FYLF and their habitat are not anticipated at the proposed flow. Based on available data, a preliminary analysis of potential habitat changes with increasing flows and a targeted habitat evaluation over a series of flow releases up to 310 cfs, the proposed 150 cfs release should not significantly affect FYLF or their habitat.

A preliminary analysis of bed profile data conducted in 2000 from the 1999 instream flow study (IFIM) indicated that, at most of the IFIM transect sites located in areas where FYLF breeding has been documented, suitable edge water habitat for FYLF breeding and tadpole development may be impacted as flows increase. Based on the results of further FYLF visual encounter surveys and an evaluation of the effects of increased flows on FYLF habitat conducted in 2001, overall habitat appeared to be reduced at flows around 200 cfs compared to existing conditions (approximately 100 cfs). Finally, the special flow study effort conducted in 2002 demonstrated that FYLF breeding and tadpole habitat starts to drop off more significantly at flow levels between 250 and 310 cfs. A conservative flow level of 150 cfs has been proposed to ensure that adverse impacts to the FYLF populations are avoided. Additional monitoring of habitats utilized by FYLF to evaluate the immediate and long-term effects of the proposed increase in base flow is an important component of this proposal. These studies would be focused on determining the direct and indirect effects of the proposed base flow on FYLF and their habitat, as well as identifying some of the limiting factors affecting FYLF in the Poe Reach.

Implementation of the proposed ramping rates in the Poe Reach would protect aquatic resources by minimizing displacement of aquatic organisms (i.e., fish, amphibians, and macroinvertebrates) as flows increase and by minimizing potential stranding of aquatic organisms as flows decrease.

### E3.1.14 Resource Agency Consultation

All agency consultation letters and Licensee responses are provided in Appendix E5-1.

### E3.1.15 Literature Cited for Aquatic Resources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**Report E3**

**FISH, WILDLIFE, AND BOTANICAL RESOURCES**

**Section E3.2**

**WILDLIFE RESOURCES**

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## Report E3
## FISH, WILDLIFE, AND BOTANICAL RESOURCES
## Section E3.2
## WILDLIFE RESOURCES

### E3.2 Wildlife Resources

### E3.2.1 Introduction

The immediate vicinity of the Poe Project, located along the NFFR approximately 24 km north-northeast of Oroville in Butte County, supports a diversity of habitats and associated wildlife species. This project is within the jurisdiction of the Plumas National Forest (PNF) at an elevation of approximately 1,000 to 1,400 ft in the Sierra Nevada foothills. Elevations within one mile of Project features extend up to about 3,000 ft on the slopes of the NFFR canyon.

Major habitat types found within one mile of Project features were identified via the California Gap Analysis (Scott et al. 1993). Using the Gap database and the Licensee's geographic information system, the following wildlife habitat types were identified in the immediate Project vicinity: fresh emergent wetland, annual grassland, orchard/vineyard, montane hardwood, montane riparian, ponderosa pine, Sierra mixed conifer, montane hardwood-conifer, riverine, and lacustrine. From these data, the computerized California Wildlife Habitat Relationships System (CWHR) was used to obtain information on wildlife species potentially occurring within habitats found in the immediate Project vicinity. Appendix E3.2-1 provides a complete list of these species. Table E3.2-1 contains a list of recreationally and commercially important species potentially occurring in the immediate vicinity of the Project.

The PNF has identified discrete geographical areas in the forest to better manage its known resources. The Poe Project is within the French Creek Management Area (USFS 1988). The PNF Standards and Guidelines established in 1988 highlight the importance of managing winter habitat for bandtailed pigeons, northern goshawk, California spotted owl, deer (winter range), and bald eagle (foraging habitat along the NFFR above Lake Oroville). At least six spotted owl "Protected Activity Centers" (PACs) and three "Goshawk Territories" have been established to protect these species within the project vicinity (S. Pascal, PNF, personal communication 1998). The PNF has recently developed a "Landscape Analysis" program for the French Creek Basin. This program includes "opportunities" for 1) manipulating and improving vegetation and wildlife habitats, 2) restoring and enhancing riparian areas, 3) rehabilitating and improving roads and stream crossings, and 4) inventorying and better managing land use and ownership.

Black-tailed deer (*Odocoileus hemionus columbianus)* and mule deer (*O. h. californicus*) are the most abundant big game species in the PNF (USFS 1988). According to historical data, the maximum population the forest could support is 157,000 deer. However, the PNF owns mostly summer range; therefore, a population of 22,000 deer is being used as a

**Table E3.2-1**
**Recreationally and Commercially Important Wildlife Species**
**Potentially Occurring in the Immediate Vicinity of the Poe Project**

| Species | Habitat Type [1] |
|---|---|
| BIRDS | |
| American coot (*Fulica americana*) | Annual grassland, fresh emergent wetland |
| American crow (*Corvus brachyrhynchos*) | Montane hardwood, annual grassland |
| American widgeon (*Anas americana*) | Fresh emergent wetland, riverine, annual grassland |
| Band-tailed pigeon (*Columba fasciata*) | Montane hardwood conifer |
| Barrow's goldeneye (*Bucephala islandica*) | Fresh emergent wetland, riverine |
| Blue grouse (*Dendragapus obscurus*) | Annual grassland, montane hardwood-conifer |
| Blue-winged teal (*Anas discors*) | Fresh emergent wetland, lacustrine |
| Brant (*Branta bernicia*) | Annual grassland, fresh emergent wetland |
| Bufflehead (*Bucephala albeola*) | Fresh emergent wetland, lacustrine |
| California quail (*Callipepla californica*) | Montane hardwood, montane hardwood conifer |
| Canada goose (*Branta canadensis*) | Riverine, fresh emergent wetland, annual grassland |
| Canvasback (*Aythya affinis*) | Fresh emergent wetland |
| Cinnamon teal (*Anas cyanoptera*) | Fresh emergent wetland, lacustrine |
| Common goldeneye (*Bucephala merganser)* | Riverine |
| Common merganser (*Mergus merganser*) | Riverine, fresh emergent wetland |
| Eurasian widgeon (*Anas americana*) | Fresh emergent wetland, riverine, annual grassland, lacustrine |
| Gadwall (*Anas Strepera*) | Fresh emergent wetland, lacustrine, riverine |
| Greater white-fronted goose (*Anser albifrons*) | Riverine, fresh emergent wetland, annual grassland |
| Green-winged teal (*Anas crecca*) | Lacustrine, riverine, fresh emergent wetland |
| Hooded merganser (*Lophodytes cucullatus)* | Fresh emergent wetland, riverine |
| Lesser scaup (*Aythya affinis*) | Fresh emergent wetland, lacustrine |
| Mallard (*Anas platyrhynchos*) | Fresh emergent wetland, riverine, annual grassland |
| Mountain quail (*Oreortyx pictus*) | Montane riparian, montane hardwood-conifer, montane hardwood |
| Mourning dove (*Zenaida macroura*) | Montane hardwood-conifer, montane hardwood, annual grassland |
| Northern pintail (*Anas acuta*) | Fresh emergent wetland, riverine, lacustrine |
| Northern shoveler (*Anas clypeata*) | Fresh emergent wetland, lacustrine, annual grassland |
| Redhead (*Aythya americana*) | Fresh emergent wetland, lacustrine |
| Ring-necked pheasant (*Phasianus colchicus)* | Fresh emergent wetland, annual grassland, montane hardwood |
| Ross' goose (*Chen rossii*) | Riverine, fresh emergent wetland, annual grassland |
| Ruddy duck (*Oxyura jamaicensis*) | Fresh emergent wetland, lacustrine |
| Snow goose (*Chen caerulescens*) | Riverine, fresh emergent wetland, annual grassland |
| Wild turkey (*Melaegris gallopavo*) | Montane hardwood-conifer, montane hardwood |
| Wood duck (*Aix sponsa*) | Lacustrine, riverine |

[1] Optimum habitat of those occurring within the immediate vicinity of the Poe Project

**Table E3.2-1(Continued)**
**Recreationally and Commercially Important Wildlife Species**
**Potentially Occurring in the Immediate Vicinity of the Poe Project**

| Species | Habitat Type [1] |
|---|---|
| MAMMALS | |
| American badger (*Taxidea taxus*) | Annual grassland, orchard/vineyard |
| American beaver (*Castor canadensis*) | Lacustrine, fresh emergent wetland |
| Black bear (*Ursus americanus*) | Montane hardwood-conifer, montane hardwood, lacustrine |
| Black-tailed hare (*Lepus californicus*) | Annual grassland, orchard/vineyard |
| Bobcat (*Lynx rufus*) | Montane hardwood, annual grassland |
| Brush rabbit (*Sylvilagus bachmani*) | Annual grasslands, orchard/vineyard |
| Common muskrat (*Ondrata zibethicus*) | Fresh emergent wetland, lacustrine |
| Coyote (*Canis latrans*) | Annual grasslands, orchard/vineyard |
| Desert cottontail (*Sylvilagus audubonii*) | Annual grasslands |
| Douglas' squirrel (*Tamiasciurus douglasii*) | Montane hardwood-conifer |
| Ermine (*Mustela erminea*) | Montane hardwood-conifer |
| Gray fox (*Urocyon cinereoargenteus*) | Annual grassland, montane hardwood |
| Long-tailed weasel (*Mustela frenata*) | Montane hardwood-conifer, annual grassland |
| Mink (*Mustela vison*) | Fresh emergent wetland, lacustrine |
| Mule deer (*Odocoileus hemionus*) | Montane hardwood, montane hardwood-conifer |
| Raccoon (*Procyon rotor*) | Annual grassland, montane hardwood |
| Red fox (*Vulpes vulpes*) | Montane hardwood-conifer |
| Snowshoe hare (*Lepus americanus*) | Montane hardwood |
| Striped skunk (*Mephitis mephitis*) | Montane hardwood, annual grassland |
| Virginia opossum (*Didelphis virginiana*) | Annual grassland, fresh emergent wetland |
| Western gray squirrel (*Sciurus griseus*) | Montane hardwood-conifer |
| Western spotted skunk (*Spilogale gracilis*) | Annual grassland, montane hardwood |
| Wild pig (*Sus scrofa*) | Annual grassland |
| AMPHIBIANS | |
| Bullfrog (*Rana catesbeiana*) | Annual grassland, lacustrine, fresh emergent wetland |

[1] Optimum habitat of those occurring within the immediate vicinity of the Poe Project

management target. The overall forest population in 1982 was 19,100. Deer populations have declined in recent years, because of 1) the low survival rate of fawns, 2) conversion of brush fields to plantations, 3) the use of herbicides, 4) increased road densities, 5) loss of riparian areas, and 6) competition with livestock for forage. The PNF and CDFG have cooperatively prepared deer herd management plans for each herd found in the forest. The Bucks Mountain Herd occurs in the vicinity of the Poe Project. The Bucks Mountain Herd population, which peaked in 1963–67, was estimated at 8,467 (Snowden 1984). The population in 1985 was estimated at 3,015 deer, which represents a 60% decline over a 20-year period. The Bucks Mountain Management Plan strives to maintain a population of at least 4,000 deer.

Poe Reservoir and the NFFR provide habitat for a variety of water-dependent species, such as the Canada goose, other waterfowl, and shorebirds. The montane hardwood and montane hardwood-conifer habitats support a variety of other important upland wildlife species, such as California quail, mountain quail, blue grouse, mourning dove, ring-necked pheasant, and wild turkey.

The PNF has not yet created any Research Natural Areas; however, 14 potential "candidate areas" have been identified (USFS 1988). The state of California has identified a number of Significant Natural Areas within the project vicinity (CDFG 2000a). The selection of such areas is based on 1) locations of extremely rare species populations or natural communities, 2) locations where three or more rare species populations or natural communities occur together, 3) locations of the best examples known for natural communities or CNDDB species, or 4) centers of high species diversity. The Great Valley Cottonwood Riparian Forest (USGS Cherokee and Oroville quadrangles) and Northern Basalt Flow Vernal Pools (USGS Cherokee and Oroville quadrangles) have been identified as occurring in the project vicinity (CDFG 1998).

### E3.2.2 Sensitive Wildlife Species

The NFFR canyon in the vicinity of the Poe Project is located within the potential range of numerous special status wildlife species. Table E3.2-2 shows the federal/state listed and other sensitive species potentially occurring in the immediate Project vicinity. Those species that were the subject of study as part of the Project relicensing effort include the bald eagle (*Haliaeetus leucocephalus*; federal threatened species, but proposed delisted, and state endangered), valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*; federal threatened species), peregrine falcon (*Falco peregrinus*; state endangered and federally delisted), northern goshawk (*Accipiter gentilis*; California Species of Special Concern, federal Special Concern Species, and Forest Service Sensitive), California spotted owl (*Strix occidentalis occidentalis*; California Species of Special Concern, federal Special Concern Species, and Forest Service Sensitive), willow flycatcher (*Empidonax traillii*; state endangered, federal Special Concern Species, Forest Service Sensitive), Pacific fisher (*Martes pennanti pacifica*; California Species of Special Concert, federal Special Concern Species, and Forest Service Sensitive), and river otter (*Lutra canadensis sonorate*; California Species of Special Concern and federal special Concern Species).

## Table E3.2-2

## Federally Listed, State-Listed, and Other Sensitive Species Potentially Occurring in the Immediate Vicinity of the Poe Project

| Species | Status [1] | Optimum Habitat [2] |
|---|---|---|
| BIRDS | | |
| American white pelican (*Pelecanus erythrorhynchos*) | CSC | Lacustrine |
| Bald eagle (*Haliaetus leucocephalus*) | SE, FT,CP | Lacustrine, riverine |
| Bank swallow (*Riparia riparia*) | ST | Montane riparian |
| Barrow's goldeneye (*Bucephala islandica*) | CSC | Lacustrine |
| Black tern (*Chlidonias niger*) | CSC | Lacustrine, fresh emergent wetlands |
| California gull (*Larus californicus*) | CSC | Lacustrine, riverine, montane riparian |
| Common loon (*Gavia immer*) | CSC | Lacustrine |
| Cooper's hawk (*Accipiter cooperi*) | CSC | Montane riparian |
| Dark-eyed junco (*Junco hyemalis caniceps*) | CSC | Montane hardwood-conifer |
| Double-crested cormorant (*Phalacrocorax auritas*) | CSC | Riverine, lacustrine |
| Ferruginous hawk (*Buteo regalis*) | CSC | Annual grassland |
| Golden eagle (*Aquila chrysaetus*) | CP,CSC | Montane hardwood-conifer |
| Horned lark (*Eremophila alpestris actia*) | CSC | Annual grassland |
| Loggerhead shrike (*Lanius ludovicianus*) | CSC | Annual grassland |
| Long-billed curlew (*Numenius americanus*) | CSC | Wet meadow |
| Long-eared owl (*Asio otus*) | CSC | Montane riparian |
| Merlin (*Falco columbarius*) | CSC | Montane hardwood-conifer |
| Northern goshawk (*Accipiter gentilis*) | CSC, FS | Montane hardwood-conifer |
| Northern harrier (*Circus cyaneus*) | CSC | Annual grassland, fresh emergent wetland |
| Osprey (*Pandion haliaetus*) | CSC | Lacustrine, riverine, montane hardwood |
| Peregrine falcon (*Falco peregrinus*) | SE, FS,CP | Montane riparian |
| Prairie falcon (*Falco mexicanus*) | CSC | Annual grassland |
| Purple martin (Progne subis) | CSC | Montane riparian |

[1] The status of listed species includes:

- SE = Listed as *Endangered,* by the State of California
- ST = Listed as *Threatened,* by the State of California
- CSC = Listed as *Species of Special Concern,* by the State of California
- CP = Listed as *Protected Species,* by the State of California
- FE = Federally listed as *Endangered*
- FT= Federally listed as *Threatened*
- FS = Forest Service, *Sensitive Species*

[2] Information obtained from the California Natural Diversity Database (CNDDB)

**Table E3.2-2 (Continued)**

**Federally Listed, State-Listed, and Other Sensitive Species Potentially Occurring in the Immediate Vicinity of the Poe Project**

| Species | Status [1] | Optimum Habitat [2] |
|---|---|---|
| BIRDS (Continued) | | |
| Sharp-shinned hawk (*Accipiter striatus*) | CSC | Montane riparian, montane hardwood |
| Short-eared owl (*Asio fammeus*) | CSC | Annual grassland, wet meadow |
| California spotted owl (*Strix occidentalis occidentalis*) | FT,CSC,FS | Montane hardwood-conifer |
| Great gray owl (*Strix nebulosa*) | FS | Montane hardwood conifer |
| Swainson's hawk (*Buteo swainsoni*) | ST | Montane riparian |
| Tricolored blackbird (*Agelaius tricolor*) | CSC | Annual grassland, wet meadow, fresh emergent wetland |
| Vaux's swift (*Chaetura vauxi*) | CSC | Montane hardwood-conifer |
| Black shouldered kite (*Elanus caeruleus*) | CP | Annual grassland |
| Willow flycatcher (*Empidonax traillii*) | FE, SE, CSC | Montane riparian, wet meadow |
| Yellow warbler (*Dendroica petechia brewsteri*) | CSC | Montane riparian |
| Yellow-breasted chat (*Icteria virens*) | CSC | Montane riparian |
| MAMMALS | | |
| Pacific fisher (*Martes pennanti pacifica*) | CSC, FS | Montane hardwood-conifer, montane riparian |
| Pallid bat (*Antrozous pallidus)* | CSC, FS | Montane hardwood-conifer |
| Western red bat (*Lasiurus blossevillii*) | CSC, FS | Montane hardwood-conifer |
| Sierra Nevada red fox (*Vulpes vulpes necator*) | ST, FS | Montane hardwood-conifer, montane riparian |
| Ringtail (*Bassariscus astutus*) | CP | Montane hardwood-conifer |
| Sierra Nevada snowshoe hare (*Lepus americanus tahoensis*) | CSC | Montane riparian, wet meadows |
| Townsend's big-eared bat (*Plecotus townsendii pallescens*) | CSC, FS | Montane hardwood-conifer |
| Pine marten (*Martes americanus*) | FS | Montane hardwood-conifer |
| River otter (*Lutra canadensis sonorae*) | CSC | Riverine, montane riparian |

[1] The status of listed species includes:

- SE = Listed as *Endangered,* by the State of California
- ST = Listed as *Threatened,* by the State of California
- CSC = Listed as *Species of Special Concern,* by the State of California
- CP = Listed as *Protected Species,* by the State of California
- FE = Federally listed as *Endangered*
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- FS = Forest Service, *Sensitive Species*

[2] Information obtained from the California Natural Diversity Database (CNDDB)

## Table E3.2-2 (Continued)

### Federally Listed, State-Listed, and Other Sensitive Species Potentially Occurring in the Immediate Vicinity of the Poe Project

| Species | Status [1] | Optimum Habitat [2] |
|---|---|---|
| REPTILES | | |
| California horned lizard (*Phrynosoma coronatum frontale*) | CP,CSC | Montane riparian |
| Western pond turtle (*Clemmys marmorata marmorata*) | CP,CSC | Montane riparian, riverine |
| AMPHIBIANS | | |
| Foothill yellow-legged frog (*Rana boylii*) | CP,CSC,FS | Lacustrine, wet meadows, montane riparian |
| California red-legged frog (*Rana aurora draytonii*) | FT,CP,CSC | Montane riparian |
| Western spadefoot toad (*Scaphiopus hammondii*) | CP,CSC | Orchard-vineyard, annual grassland |
| INSECTS | | |
| Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) | FT | Riparian, uplands |

[1] The status of listed species includes:

- SE = Listed as *Endangered,* by the State of California
- ST = Listed as *Threatened,* by the State of California
- CSC = Listed as *Species of Special Concern,* by the State of California
- CP = Listed as *Protected Species,* by the State of California
- FE = Federally listed as *Endangered*
- FT= Federally listed as *Threatened*
- FS = Forest Service, *Sensitive Species*

[2] Information obtained from the California Natural Diversity Database (CNDDB)

The following text describes research conducted on these species in the immediate Project vicinity during 1999 and 2000. Recent eagle research and management activities are covered in Section E3.2.3. The Bald Eagle Management Plan is discussed in Section E3.2.4. The remaining sensitive wildlife species are covered in Section E3.2.5. Please note that all aquatic amphibian and reptile species are addressed in Section E3.1 (Aquatic Resources).

### E3.2.3 Bald Eagle Research and Management

In 1988, the Licensee prepared a bald eagle management plan for the Poe Powerhouse bald eagle territory based on field data collected in 1986 and 1987 (Pacific Gas and Electric Company 1988). The focus of the 1999-2000 relicensing study was to determine current bald eagle reproduction at the Poe Powerhouse site, identify existing bald eagle foraging habitats of the adult pair, and document human use patterns and existing or potential human disturbances that may threaten bald eagle productivity in this territory. With this recent information, an updated bald eagle management plan was prepared for the Poe Powerhouse bald eagle territory (Section E3.2.4).

#### E3.2.3.1 Methods

##### E3.2.3.1.1 Reproductive Surveys

The Poe Powerhouse bald eagle nest was checked several times during the 1999 and 2000 breeding seasons to determine its status and the eventual outcome of each nesting event. The nest was surveyed from the ground and from a helicopter flown high (500 ft.) above the nest to avoid disturbing nesting adults. The nest was checked a minimum of three times each season, as recommended by CDFG (Jurek 1990): early in the season (March) to determine occupancy; in mid-nesting season (April-May) to determine the presence of eggs or young; and late in the season (early to mid-June) to determine success and the number of young fledged. In addition to the 1999-2000 surveys, past bald eagle surveys conducted by the Licensee and others (Licensee files; CDFG unpublished data; Jurek 1990) were reviewed to complete the historical breeding records for the territory management plan. Nesting activity was classified and described using the following categories, after Jurek (1990):

- **Occupied**: two adults present in a territory during the breeding season.
- **Occupied, Not Successful**: an occupied territory where no eggs were laid or where no young were produced (failed) because of egg breakage, egg death, or nestling death.
- **Unoccupied**: indicates one or no adults in a nesting territory.
- **Active**: adult incubating or brooding or nestlings present.
- **Inactive**: no incubation, brooding, or nestlings in an occupied territory.
- **Failure**: nesting attempt failed due to egg breakage, egg death, or nestling death.
- **Successful**: one or more young fledged from the nest.

Mean annual productivity was calculated by dividing the total young produced by the number of times the territory was occupied over a period of years. Young-per-occupied-site was used to account for nonbreeding periods, as recommended by Postupalsky (1974), and to be consistent with other researchers.

#### E3.2.3.1.2 Bald Eagle Distribution and Habitat Use

To document bald eagle habitat use and foraging locations, the Poe Powerhouse territory was visited approximately weekly from March through July 2000, and bi-weekly from August through November 2000. Since eagles were not radio-tagged (see below), two observers relied on making observations at pre-selected points and communicating through hand-held radios to maintain contact with foraging eagles. This method enabled the observers to record the eagle's direction of movement from a number of locations including the nest area, many perching locations, and some foraging sites without the use of telemetry. By leap-frogging to the various observation points, the observers were usually able to maintain sight of birds in the following areas: Big Bend Reservoir (to approximately 1 km below the powerhouse), the nest area directly opposite Poe Powerhouse, and the NFFR from Poe Powerhouse upstream to Bardee's Bar (approximately 6 km), including a large pool drained by a bifurcated channel just upstream of the powerhouse (600 m). No effort was made to follow foraging eagles that soared off or flew downstream in the direction of Lake Oroville, though data were recorded on timing and direction of travel.

Both morning and afternoon observation sessions were included in the sampling. During the nesting period, while incubating or feeding their young (March-July), foraging eagles departed directly from the nest or nest area and were relatively easy to follow. Often, the adults would soar up hundreds of feet above the nesting area and glide off in the direction of their foraging destination, typically the lower arms of Lake Oroville. When utilizing the upper reservoir, powerhouse vicinity, and upstream reaches of the NFFR, eagles usually flap-flew to those destinations. For each foraging flight, data were recorded on the direction of travel, time of departure and subsequent arrival at the nest. In addition, data were also collected on whether the foraging trip was successful and, if so, a description of the prey item. When eagles hunted from perches, perch tree species and aquatic habitat characteristics (e.g., run, riffle, pool, etc.) were recorded, and the location of the perch was marked on a 7.5 minute USGS topographic map for later entry in a GIS program. For each observed foraging event, data were collected on aquatic habitat at the strike point, depth, distance to shore, and prey species from remains (see below). After the juveniles departed in August, the adults were more difficult to locate while foraging, although they often night-roosted near the nest tree and could be found hunting from perches along the upper river and in powerhouse vicinity.

To facilitate studies of eagle foraging and habitat use, attempts were made to capture one of the adult bald eagles at the Poe Powerhouse territory to attach a VHF radio transmitter. However, all attempts to capture the adults during trapping sessions on September 13, 1999, January 20-21, 2000, and February 8-9, 2000 were unsuccessful. A noosed bait fish technique, described by Cain and Hodges (1989) and Jackman et al. (1993), was used. Bait fish were anchored in shoreline locations by a 4-kg weight attached to a 10-m long nylon retrieval cord and a 3-m length of shock cord. Bait sets were laid out before dawn in important eagle foraging locations. Because of low water levels at Lake Oroville, trappers were unable to utilize deeper water sets, which is the preferred method since they have a higher success rate due to the additional shock absorption of a longer monofilament leader. Instead, shallow water sets were placed along the margins of the NFFR in the vicinity of Poe Powerhouse. The adult eagles grasped five different sets and broke two nooses, got one fish off the nooses[1], and failed to pull another fish from the nooses. On the fifth, and final, bait set (with a revised shock absorption system experimentally modified for shallow water), an itinerant subadult bald eagle beat the adults to the fish and was caught. Trappers banded this second-year male bald eagle with

[1] Adult eagles are successful in getting fish off the nooses about 50% of the time, thus rewarding the eagle.

a standard USFWS aluminum leg band, made standard measurements to determine sex, and released him on site. No other capture attempts were made after February 9 to avoid disturbing the eagles' forthcoming breeding attempt (eggs were laid in March).

**E3.2.3.1.3 Bald Eagle Prey Studies**

Several methods were used to quantify the diet of the Poe Powerhouse bald eagles, including the analysis of prey remains collected in and below the nest, observations of prey deliveries to the nest, and collecting prey remains from foraging/feeding sites. Prey remains were collected in and below the nest in 1999 and 2000, following the migration of the young. Surveyors collected all bones, feathers, and fur from inside nests, plus a sample of nest lining for identification of scales. Because of the distance between the observation point and the nest, only a few of the prey deliveries could be identified to species.

To help identify remains and estimate fish sizes, a reference collection of common fish species of various size categories developed during previous studies was consulted (Hunt et al. 1992a, 1992b). These reference bones and keys (Casteel 1976) and reference scales and scale keys (Lagler 1940; Casteel 1972) were used to identify the species and size of fish represented by each prey item found in the prey collections (Hunt et al. 1992b). For each fish species in the reference collection bone-length to total-body-length regression equations were developed for opercula, cleithra, crania, dentary, and other species-diagnostic bones (McConnell 1952; Hansel et al. 1988). Using these equations, total fish lengths were calculated for each prey item, and duplicate prey items were eliminated by matching parts representing like-sized individuals falling within 95 percent confidence intervals. The ages of fish scales were determined by standard methods (i.e., counting annuli; Bagenal and Tesch 1978); length/annulus tables (Carlander 1969, 1977) were used to estimate size of fish represented only by scales. Since scales can only be aged and not assigned to individual fish numbers, no attempt was made to quantify fish prey from scales unless scales were the only remains for a particular species. In those cases, one fish was counted for each age represented. Total weights were calculated for the selected (non-duplicate) prey items using length-to-weight equations from the reference fish and from Carlander (1969, 1977). From these total weights, the weights of bones plus five percent of the total weight (estimated unavailable or discarded biomass) were subtracted to arrive at the edible biomass for each prey fish (Hunt et al. 1992b). Non-fish remains were identified by comparison with museum collections, and biomass for non-fish prey was calculated from standard mean weights (Burt and Grossenheider 1964; Steenhof 1983; Dunning 1984) minus 10 percent to account for bones and unavailable biomass. Because of the similarity of bone structure, bass species (i.e., spotted bass, *Micropterus punctulatus;* largemouth bass, *Micropterus salmoides*, and smallmouth bass, *Micropterus dolomieui*) could not be consistently differentiated in the identification of prey remains.

**E3.2.3.1.4 Human Disturbance and Public Use**

To document human use patterns in the Poe Powerhouse bald eagle territory, surveyors regularly recorded the numbers of vehicles at certain access points in the vicinity of the nesting area during eagle observation periods in 2000. These included Poe Powerhouse, the swimming beach adjacent to the powerhouse, the railroad landing above the powerhouse, and the NFFR bridge area upstream of the powerhouse. Also included were two access trails to the river from the powerhouse road just upstream of the bridge. Boating use of the upper NFFR arm of Lake Oroville was not sampled, although relatively low water conditions in the lake prevented boating access to Big Bend Dam (located about 1.3 km downstream of the nest area) in 2000. Access to the NFFR between the powerhouse bridge and Bardee's Bar is extremely limited. Surveyors opportunistically gathered data on human use around Bardee's Bar when searching for eagles and during other wildlife surveys in the vicinity.

The following data were collected on each recreationist or other human activity observed: date and time of observation; weather conditions; location; position relative to water; user activity type and mode of travel; and number of occurrences. One occurrence was recorded for each vehicle observed.

### E3.2.3.2 Results

#### E3.2.3.2.1 Reproductive Surveys

The Poe Powerhouse bald eagle territory produced two young in 1999. While climbing the nest tree in September 1999 to collect prey remains, evidence of bear entry into the nest was found. There were claw marks going up the tree, and the nest was mostly removed. This intrusion probably occurred post-fledging, since no eaglet remains were evident under the nest tree, and two large young had been observed in the nest in mid-June. Bears are known scavengers and predators of eagle nests, occasionally capturing and eating young (Jackman and Hunt 2000).

No bear problems occurred in 2000, and the pair rebuilt the nest and successfully raised one young in the same nest tree. Incubation began around March 21; the juvenile eagle took its first flight between July 7 and 20 and migrated from the nest area in early August. During foraging observations of the adults, surveyors noticed that the adult female was banded with a silver USFWS band on her right leg; the left leg was unbanded.

The current nest is located about 52 m (170 ft.) up a 56 m (185 ft.) ponderosa pine (*Pinus ponderosa*) with a DBH (diameter-at-breast-height) of 117 cm (46 in.). Two remnant nests still occur in the nesting area, one in a dead ponderosa pine immediately upslope of the current nest tree that was used in early 1990s and the other in a live ponderosa pine well upslope of the others, used during the 1970s to mid-1980s (Figure E3.2-1).

**E3.2.3.2.2 Bald Eagle Distribution and Habitat Use**

The foraging destinations of the nesting adults at Poe Powerhouse are categorized in Table E3.2-3. The majority of flights during the early nesting period (March-May) were to Lake Oroville (>65%). Most of these foraging trips were long distance soaring flights to the lower arms of western Lake Oroville. Compass readings indicated nearly all flights were in the direction of the West Branch Arm and the mid-to-lower NFFR Arm of the lake, or beyond.

As the nesting season progressed (June-August), use of Lake Oroville decreased to about 41 percent of all foraging trips, with most of these to the upper portion of the NFFR Arm, below Big Bend Reservoir. This may have been influenced by water levels in the lake. At full pool (274 m, 899 ft. elevation), Lake Oroville extends all the way up to Big Bend Dam, located about 1.3 km downstream from Poe Powerhouse. During observations in 2000, the lake level increased from about 257 m (845 ft.) elevation in March to 266 m (873 ft.) by the end of May, then decreased steadily to about 232 m (762 ft.) by November (California Department of Water Resources, file data). By mid-July, the top of the lake was about 1.6 km below the Big Bend Dam, exposing that portion of the NFFR's former channel and riverine habitat. By the end of August 2000, the exposed portion of the channel extended about 5 km below Big Bend Dam.

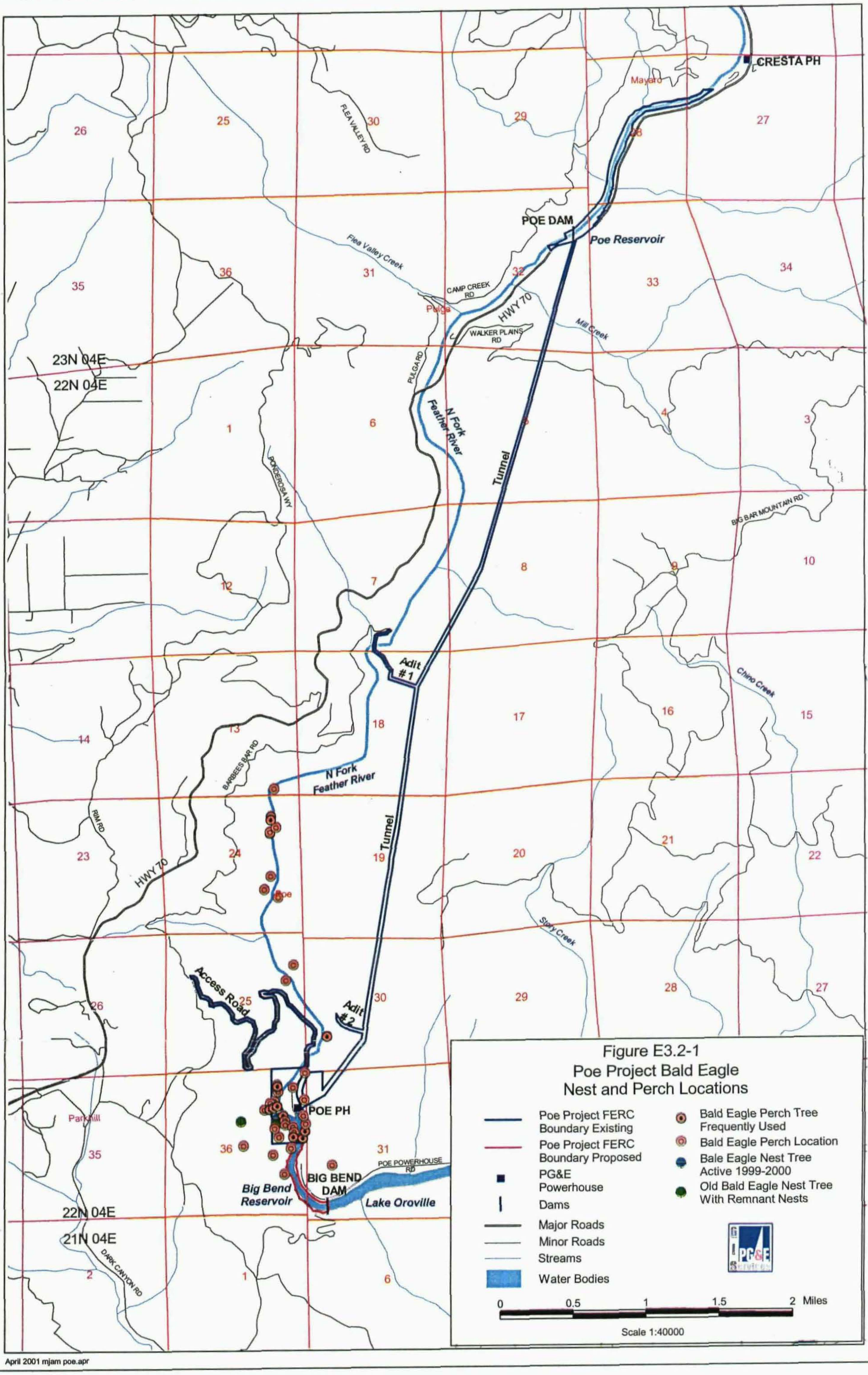


Figure E3.2-1
Poe Project Bald Eagle
Nest and Perch Locations

April 2001 mjam poe.apr

## Table E3.2-3

**Foraging destinations of adult bald eagles in the Poe Powerhouse territory as determined from 43 observation sessions in 2000.**

| | March-May No. Trips (%) | June-August No. Trips (%) | Sept.-Nov. No. Trips (%) | Total |
|---|---|---|---|---|
| FORAGING DESTINATION | | | | |
| Oroville Reservoir (soared far) | 21 (51.2) | 3 ( 8.8) | 0 ( 0.0) | 24 (30.4) |
| Oroville Reservoir (flew near) | 6 (14.6) | 11 (32.4) | 0 ( 0.0) | 17 (21.5) |
| Big Bend Reservoir | 2 ( 4.9) | 9 (26.5) | 2 (50.0) | 13 (16.5) |
| Pool/Channel above Powerhouse | 3 ( 7.3) | 4 (11.8) | 0 ( 0.0) | 7 ( 8.9) |
| Upstream N.F. Feather River | 8 (19.5) | 7 (20.6) | 2 (50.0) | 17 (21.5) |
| Direction Concow Res. (soared) | 1 ( 2.4) | 0 ( 0.0) | 0 ( 0.0) | 1 ( 1.3) |
| TOTAL FORAGING TRIPS | 41 | 34 | 4 | 79 |
| OBSERVATION PERIODS | | | | |
| No. morning surveys | 13 | 10 | 5 | 28 |
| Total observation hours | 79.5 | 59.3 | 16.5 | 155.3 |
| No. afternoon surveys | 4 | 7 | 4 | 15 |
| Total observation hours | 17.7 | 27.8 | 10.0 | 55.5 |

Eagles returned with nine prey deliveries (64% of total observed for period) from lower Lake Oroville during the March to April period, including at least one bass and one carp. Only one fish was brought in from the upper lake during that period (7% of period total); however, three fish prey deliveries originated from this nearer portion of Lake Oroville in the later period (50% of total prey deliveries observed for later period). The eagles returned with no prey from their soaring flights to the lower portions of Lake Oroville during June to August. It is probable that eagles exploited a source of carrion fish, most likely bass, originating as post-spawn and angling mortalities from the main lake body in the spring. Indeed, several carrion spotted bass were observed floating on the middle and lower NFFR Arm of Lake Oroville in May 1999. During a recent study on another northern California reservoir, carrion bass were most abundant after spawning in May on Shasta Lake, and nesting eagles there readily exploited this food source (Jackman and Hunt 2000). For logistical reasons, surveyors did not observe eagles foraging on Lake Oroville or in the riverine portions of the former NFFR channel exposed by low lake levels. While there, eagles may have exploited fish stranded in pools by receding levels or fish making spawning runs from the reservoir into riverine habitats.

Use of Big Bend Reservoir was minimal during the early nesting period (Table E3.2-3). Eagle use of this reservoir during the later nesting period (June-August) increased to over one-quarter of all hunting trips made by the pair. The elevation of this relatively shallow reservoir fluctuates with the operation of the two powerhouse units. When both units operate at full load, the reservoir reaches its highest elevation. Typically, eagles would hunt (i.e., perch, watch) over an exposed gravel bar downstream of the powerhouse on mornings when one or both units were shut down. Apparently, the suckers moved into the shallow water of this bar as they grazed on the reservoir bottom and thus became vulnerable to eagle strikes. Two live suckers were observed taken in this manner. An adult eagle retrieved another sucker as carrion from the confluence of the riffle inlet with the reservoir pool. This fish possibly originated as a post-spawn mortality further upstream, or may have been killed and left by an angler.

Over 30 percent of all foraging destinations during the entire nesting cycle occurred along the NFFR upstream of Poe Powerhouse (Table E3.2-3). Use of the NFFR was relatively constant during both early and late periods. While hunting the large pool area just upstream of the powerhouse, the eagles typically perched above the shallow pool tailout area, or above the shallow braided channel draining the pool. Upstream of this pool, surveyors identified 10 perching locations chosen by hunting eagles and classified the aquatic habitats at these 10 locations as follows: 6 at pools (4 pool tails, 1 top of pool, 1 mid-pool); 2 at pocket water/boulder gardens; 1 gravel bar run; 1 riffle above a pool. These habitat choices generally reflected the overall occurrence of these habitats in the portion of the Poe Reach from Bardee's Bar to Poe Powerhouse (i.e., 57% pool, 19% run/glide, 13% riffle, 11% pocket water) (Section E3.1.2). All of these areas appeared to contain shallows where fish may become vulnerable to eagle predation; however, no actual foraging events were witnessed. Four prey fish deliveries to the nest from adults hunting the upstream reach of the NFFR were documented, representing 20 percent of all prey delivery observations. One of these fish resembled a Sacramento pikeminnow. Often, comm.; J. Gangemi, American Whitewater, pers. comm.), when both Poe Powerhouse eagles were in their nest area. On July 20, surveyors flushed an adult bald eagle perched along the NFFR about 200 m upstream of the Mill Creek confluence. This eagle flew upstream toward Poe Dam. Numerous ground and helicopter searches along the NFFR yielded no new bald eagles nests between Belden and Lake Oroville.

#### E3.2.3.2.3 Bald Eagle Prey Studies

The number of individual prey items and estimated biomass of the prey species identified from remains collected below the Poe Powerhouse bald eagle nest are shown in Table E3.2-4. The sample size is relatively low for such collections spanning two seasons, probably due to the tendency of this pair to deliver fish without heads (i.e., identifying bones), a known characteristic of some bald eagles. Even so, it was determined that the Poe Powerhouse pair utilized a combination of native and introduced fish species that also likely originated from both reservoir (e.g., Lake Oroville) and NFFR riverine habitats. This pair relied heavily on fish during the nesting season; however, two birds, including one American coot, were also present in the remains. Sacramento sucker and bass were the most numerous fish taxa in the prey collection, followed by carp and pikeminnow. The relative abundance of fish scales identified in the nest lining reflected these trends, as well.

## Table E3.2-4

**Number of Individuals and Estimated Biomass (g) of Prey Identified from Remains Collected in and Below the Poe Powerhouse Bald Eagle Nest on September 13, 1999, September 21, 2000, and October 12, 2000**

| Species | No. | Percent | Biomass (g) | Percent |
|---|---|---|---|---|
| Sacramento sucker (*Catostomus occidentalis*) | 5 | 26.3 | 5,000 | 36.1 |
| Bass sp. (*Micropterus* sp.) | 5 | 26.3 | 2,960 | 21.3 |
| Common carp (*Cyprinus carpio*) | 3 | 15.8 | 3,195 | 23.0 |
| Sacramento pikeminnow (*Ptychocheilus grandis*) | 3 | 15.8 | 1,700 | 12.3 |
| Brown bullhead (*Ameiurus nebulosus*) | 1 | 5.3 | 376 | 2.7 |
| Subtotal Fish | 17 | 89.5 | 13,231 | 95.4 |
| American coot (*Fulica americana*) | 1 | 5.3 | 578 | 4.2 |
| Unidentified Passerine | 1 | 5.3 | 56 | 0.4 |
| Subtotal Birds | 2 | 10.5 | 634 | 4.6 |
| Total | 19 | 100.0 | 13,865 | 100.0 |

### E3.2.3.2.4 Human Disturbance and Public Use

Several researchers have demonstrated that nesting and foraging eagles avoid areas of human use or development (Buehler et al. 1991; McGarigal et al. 1991; Brown and Stevens 1997). Stalmaster and Kaiser (1998) found wintering eagle numbers and feeding activity to be negatively correlated with recreational events along a northwestern river. While Wood (1999) had evidence that boating reduced eagle use of a lake in Florida, she saw little measurable effect on the eagles, suggesting that those eagles choosing to perch on the lake were habituated to boating activity. So, while it is documented that bald eagles are susceptible to human disturbance, it appears that they may become habituated to certain activity levels.

The results of recreational and human use surveys conducted in the vicinity of the Poe Powerhouse bald eagle nest are presented in Table E3.2-5. Most surveys were conducted on weekdays in conjunction with bald eagle observations, although two weekend days were sampled in May. In general, the levels of public use were light at all survey locations, probably owing to the limited amount of space at these access points in the narrow canyon of the NFFR. We expect that weekend use would be higher, especially during the warmer months. The greatest number of vehicles counted at the beach area below Poe Powerhouse was six on May 22, 2000. Activities observed at this beach were mostly camping, swimming, and fishing; apparently this is one of only a few access points to the lower NFFR for local recreationists. Only one potential eagle/human conflict was observed. On August 18, while an adult eagle was perched about 150 m downstream of the beach, people camping there fired off five rounds from a small caliber hand gun, not directed at the eagle. The eagle looked closely at the people involved, but did not flush. The lack of a major response shows some degree of habituation to this sort of activity.

## Table E3.2-5

**Recreational and Human use (Vehicle Occurrences/Survey) of Selected Locations in the Vicinity of the Poe Powerhouse Nesting Area as Determined by 37 Public-use Surveys During Bald Eagle Observations in 2000**

| Month | No. Surveys | Poe Powerhouse Beach Area | Railroad Access Area | Poe Powerhouse | Bridge Area |
|---|---|---|---|---|---|
| March | 3 | 0.3 | 0.3 | 0.0 | 0.0 |
| April | 5 | 0.4 | 0.8 | 0.0 | 0.0 |
| May | 7 | 2.1 | 0.7 | 2.0 | 0.0 |
| June | 7 | 1.3 | 0.3 | 0.7 | 0.7 |
| July | 6 | 0.8 | 0.2 | 0.7 | 0.0 |
| August | 3 | 1.3 | 0.0 | 1.0 | 1.7 |
| September | 2 | 1.0 | 2.0 | 1.0 | 0.0 |
| October | 2 | 0.0 | 0.5 | 1.0 | 0.0 |
| November | 2 | 0.0 | 4.0 | 0.0 | 0.5 |
| TOTAL | 37 | 1.0 | 0.7 | 0.8 | 0.3 |

The adult eagles were also tolerant of trains passing periodically and seemed completely oblivious to the activities at Poe Powerhouse. The Union Pacific Railroad line passes within about 300 m of the nest and across the NFFR at about the same elevation. On one occasion, an adult perched within 20 m of the tracks at the level of a passing train appeared undisturbed; however, a second train passed, blowing its whistle, and the eagle flushed. Human use of the railroad landing above the powerhouse was mostly railroad maintenance vehicles and occasional anglers or hunters who parked there to use the tracks to access Lake Oroville around Big Bend Dam. A dirt road also reaches Big Bend Dam directly from the south, and anglers also utilized this access. Powerhouse activity generally included movements in and out of the fenced compound by Licensee vehicles and occasional moderate noise events. Periodically, the Licensee's helicopter landed at the powerhouse with no apparent reaction by the eagles.

Several steep trails allow access to the NFFR in the vicinity of the Poe Powerhouse Road bridge, about 0.5 km upstream of the powerhouse. Recreational use of this area occurred mostly during the summer (Table E3.2-5) and up to three vehicles were observed parked at the trailhead on one occasion in August. During approximately 10 visits to the Bardees Bar area from March to August 2000, human activity was observed only twice; one individual was camping and another sightseeing.

Overall, the Poe Powerhouse bald eagle pair appeared very tolerant of the diverse and relatively constant human activities occurring in their nesting area. However, their actual nest tree is located up a very steep and nearly inaccessible slope that protects them from pedestrian intrusions originating from the powerhouse beach area or elsewhere. Overlooking the occasional reckless discharge of weapons, the level and nature of most powerhouse beach area activity appeared benign and was tolerated by the eagles. Large, mature trees for nesting are limited in this territory, and the eagles make use of their availability in the vicinity of the powerhouse and apparently habituate to the activity around them. In general, bald eagles can adapt to these situations as long as they do not perceive activities to be focused on them or their nest.

Probably due to the inaccessible nature of most foraging areas, no evidence of human activity excluding eagles from foraging areas was observed. No attempt was made to follow the birds to Lake Oroville where, in similar open water habitats, it has been shown that the presence of boats may prevent bald eagles from foraging in particular areas (McGarigal et al. 1991). However, it is probable that most of the prey obtained on open water habitats of this lake was in the form of carrion. Carrion is more easily obtained by eagles than live prey, reducing possible area conflicts that might otherwise be encountered if eagles sought undisturbed waters to hunt live fish. Also, catch-and-release bass anglers likely produce carrion, a beneficial artifact of this recreational activity for eagles reported on Shasta Lake in northern California (Jackman and Hunt 2000).

One additional feature associated with the powerhouse, and a potential hazard to the eagles, is the transmission line right-of-way that extends north from the powerhouse, crosses the NFFR, and passes directly adjacent to the eagle nest on its path upslope. The resident eagle pair here appeared to be acutely aware of the conductor lines and the thinner overhead ground wires. On several occasions, eagles were observed making extra efforts to negotiate the wires on their way to the nest with prey or sticks. Typically, power lines pose the most danger to raptors when distracted by prey while hunting or during inclement weather (e.g., fog; APLIC 1994). Morning fog was commonly encountered at the site; however, the eagles appeared to wait for it to clear before moving. Also, no evidence was observed of the eagles hunting from the nest or other high perches that might put the power line between them and potential prey. Instead, the eagles chose shoreline perches located under the span of conductors when hunting in this area.

### E3.2.4 Bald Eagle Management Plan

#### E3.2.4.1 Area Description

The Lisensee's Poe Powerhouse is located in a steep canyon along the NFFR approximately 24 km north-northeast of Oroville, California, in Butte County. Upland vegetation consists of montane hardwood conifer, characterized by ponderosa pine (*Pinus ponderosa*), Douglas fir (*Pseudotsuga menziesii*), oak and live oak (*Quercus* spp.), manzanita (*Arctostaphylos* spp.), and madrone (*Arbutus menziesii*). Land ownership in the nest vicinity includes the Licensee, USFS (Plumas National Forest), State of California (Lake Oroville Recreation Area), and other private landowners. Land uses include hydroelectric power generation, timber production, residential homes, and recreation.

Hydrologically, NFFR water is diverted at Poe Dam, near Pulga, and routed by tunnel to Poe Powerhouse. The powerhouse is the last of a series of Licensee power facilities located along the NFFR drainage beginning at Mountain Meadows Reservoir and Lake Almanor. Directly upstream of Poe Powerhouse, the NFFR is riverine and flows are influenced by hydroelectric power production. Under the terms of the Project license, a minimum of 25 cfs must be released in the NFFR below Poe Dam, and a minimum of 50 cfs must be maintained at the USGS gaging station near Pulga. These flows are low enough to allow foot crossing above Poe Powerhouse during typical summer flows.

Flows increase substantially below Poe Powerhouse during operation, but are mediated by the Big Bend Reservoir, which is formed by the old Big Bend diversion dam. Built in 1910, this dam diverted water to the old Big Bend Powerhouse, now under Lake Oroville. Big Bend Dam acts as barrier to upstream movement of fish except when Lake Oroville is full or near full.

Large trees for nesting are in relatively short supply in the lower NFFR canyon. The active nest tree is a dominant, 56-m ponderosa pine with a DBH of 117 cm. The two alternate nest trees are large sawtimber (about 110 cm DBH) dominant ponderosa pines. Surrounding these nest trees, is a multi-layered canopy of mostly sapling and pole-sized California bay tree (*Umbellularia californica*), tanbark oak (*Lithocarpus densiflora*), big-leaf maple (*Acer macrophyllum*), Douglas fir, and California black oak (*Quercus kelloggii*), with a scattering of ponderosa pines and Douglas firs in the larger size classes.

Much of the timber stands near the existing nest territory were destroyed in the wildfire of November 2001. Fortunately the small stand of timber that supports the existing nest tree survived and the eagles continued to use this nest in both 2002 and 2003. The eagles successfully fledged one young from the nest in 2002, the first year following the fire, but failed during the incubation phase in 2003 (Table E3.2-6). There was no indication that the 2003 nesting failure was related to the effects of the 2001 wildfire.

### E3.2.4.2 Bald Eagle Productivity

The history of bald eagle breeding attempts at the Poe Powerhouse bald eagle territory is shown in Table E3.2-6. This site continues to be one of the most consistently successful and productive bald eagle territories in California. The earliest known nesting activity was reported in 1960; however, from 1960 to 1971, no information is available on productivity (CDFG file data). The three ponderosa pine nest trees are located in the draw west of Poe Powerhouse, across the NFFR. One is situated about 150 m upslope from the river adjacent to and southeast of a transmission line tower, and it is the nest currently used by the pair (Figure E3.2-1). A second nest tree is located about 50 m directly upslope from the current nest tree; this tree is dead and contains only a remnant nest. The eagles used this nest tree beginning in the late 1980s. The uppermost nest tree is located approximately 350 m west of, and upslope from, the other two. Bald eagles nested in this tree starting in the 1970s and, at one time, it contained two separate nests. Only remnant sticks presently remain.

**Table E3.2-6**
**Productivity Summary for the Poe Powerhouse Bald Eagle Territory**

| Year | Status | No. Young | Comments |
|---|---|---|---|
| 1970 | Status Unknown | - | Nesting activity suspected |
| 1971 | Successful | 1 | |
| 1972 | Successful | 1 | Female shot, male raised young |
| 1973 | Successful | 1 | |
| 1974 | Successful | 1 | |
| 1975 | Successful | 2 | |
| 1976 | Successful | 2 | |
| 1977 | Successful | 1 | |
| 1978 | Successful | 2 | |
| 1979 | Successful | 1 | |
| 1980 | Successful | 2 | |
| 1981 | Successful | 2 | |
| 1982 | Successful | 1 | |
| 1983 | Successful | 2 | |
| 1984 | Successful | 1 | |
| 1985 | Successful | 2 | |
| 1986 | Successful | 2 | |
| 1987 | Occupied Not Successful | 0 | Egg material collected after failure |
| 1988 | Successful | 2 | One of these 2 young translocated |
| 1989 | Successful | 2 | |
| 1990 | Successful | 1 | |
| 1991 | Successful | 2 | |
| 1992 | Successful | 1 | |
| 1993 | Successful | 1 | |
| 1994 | Successful | 2 | |
| 1995 | Successful | 1 | |
| 1996 | Occupied Not Successful | 0 | Incubated, failed |
| 1997 | Successful | 2 | |
| 1998 | Occupied Not Successful | 0 | Incubated, failed |
| 1999 | Successful | 2 | |
| 2000 | Successful | 1 | |
| 2001 | Successful | 2 | |
| 2002 | Successful | 1 | |
| 2003 | Occupied Not Successful | 0 | Incubated, failed |

Known years occupied: 33
Young produced: 44
Young/occupied year: 1.33

### E3.2.4.3 Bald Eagle Occurrence and Distribution

The known foraging home range of the Poe Powerhouse bald eagles includes several kilometers of the NFFR upstream of Poe Powerhouse, portions of the NFFR Arm, and probably the West Branch Arm of Lake Oroville, as well. During the mid-1980s, the pair utilized the NFFR Arm as far downstream as French Creek cove, approximately 8 km downstream of Poe Powerhouse (Pacific Gas and Electric Company 1988). Most sightings during this period were of eagles hunting pools in the riverine portion of the reservoir downstream of Big Bend Dam when Lake Oroville levels were low, or at lake inflow areas at French Creek and the main stem NFFR. In 2000, the eagles regularly soared off to apparently more distant destinations in the direction of the West Branch Arm and lower NFFR Arm of the lake.

Upstream of Poe Powerhouse, the adults have been seen perched along the river as far upstream as Bardees Bar (Pacific Gas and Electric Company 1988); however, recently, they seem to be concentrating hunting efforts in the portion of the reach extending about 4 km upstream of the powerhouse (Figure E3.2-1). While perching along the NFFR, the eagles preferred to hunt the shallow portions of pools, an aquatic habitat known to be important to river nesting bald eagles (Pacific Gas and Electric Company 1985; Hunt et al. 1992b). Occasionally, the Poe Powerhouse adults soared off in the direction of Concow Reservoir, located 6.5 km northwest of the nest site. Past use of this reservoir by adult bald eagles was reported by local residents (Pacific Gas and Electric Company 1988).

Winter surveys of the NFFR Arm of Lake Oroville up to Poe Powerhouse showed consistent use by low numbers of subadult and adult bald eagles, up to three total (Pacific Gas and Electric Company 1988). Adult bald eagles were regularly observed around the Poe Powerhouse vicinity during the recent research period and previous surveys by the USFS. These sitings indicate that the pair is resident year around, as is expected for bald eagles nesting along ice-free waters in California.

### E3.2.4.4 Bald Eagle Prey Studies

Information on the food habits of the Poe Powerhouse pair was collected in 1985-1987 (Pacific Gas and Electric Company 1988) and again in 1999-2000 (Section E3.2.3.2.3). The Poe Powerhouse bald eagles utilized a combination of native and introduced fish species from both reservoir (e.g., Lake Oroville) and NFFR riverine habitats. Commonly taken riverine prey species were Sacramento sucker (*Catostomus occidentalis*) and Sacramento pikeminnow (*Ptychocheilus grandis*). Prey fish species likely obtained from reservoir habitats included bass (*Micropterus* sp.), carp (*Cyprinus carpio*), and brown bullhead (*Ameiurus nebulosus*). A notable difference between the current analysis and that from the mid-1980s is the recent decrease in numbers of catfish taken by the pair. Catfish (e.g., brown bullhead) represented 38 percent of prey items from the 1980s compared to five percent in the recent collection. Another dissimilarity between the two periods is a recent increase in Centrarchid (i.e., bass) use. Bass represented over 25 percent of the 1999-2000 collection numbers, while centrarchids accounted for only eight percent of the 1985-1987 numbers. A similar situation occurred on Lake Shasta during this period when eagles there shifted from Sacramento blackfish (*Orthodon microlepidotus*; presumed extirpated) to bass (Jackman and Hunt 2000). Post-spawning mortality and fatalities from catch-and-release angling supplied an abundant source of bass carrion for eagles on Shasta Lake, a phenomenon likely also occurring on Lake Oroville, where carrion spotted bass (*Micropterus punctulatus*) were numerous in May 1999.

The NFFR contains the following prey-sized fish species in the lower reach from Poe Dam to Poe Powerhouse: rainbow trout (*Oncorhynchus mykiss*), Sacramento sucker, Sacramento pikeminnow, hardhead (*Mylopharadon conocephalus*), and smallmouth bass (*Micropterus dolomieui*). Recent surveys found Sacramento suckers to be the most numerous overall, followed by rainbow trout and Sacramento pikeminnow. Specifically in large pool habitats, adult suckers were heavily dominant, followed by pikeminnow and rainbow trout (Section E3.1.2). Suckers also dominated in run and pocket water habitats; however, rainbow trout were most abundant in riffles. Pikeminnow and suckers were accessible to eagles in these pools while feeding in shallows and swimming near the surface and around submerged rocks. Trout, with their upward visual orientation, are much more difficult for eagles to catch than benthic-feeding fish such as suckers (Haywood and Ohmart 1986). Portions of the NFFR have been treated to eliminate non-game fish and subsequently stocked with trout (1966, 1977); however, these efforts were ineffective (R. Flint, CDFG, pers. comm. in Pacific Gas and Electric Company 1988).

Fish populations in Big Bend Reservoir (Poe Afterbay) were recently sampled for the first time (Section E3.1.2). For adult size classes in an electrofishing sample, Sacramento suckers were by far the most abundant, followed by low numbers of adult Sacramento pikeminnow, rainbow trout, and smallmouth bass. Most of the suckers were found in the shallow run where the main NFFR channel enters the reservoir. The Poe Powerhouse eagles were observed capturing adult suckers at an exposed gravel bar downstream of the powerhouse on mornings when one or both units were shut down. Apparently, suckers moved into shallow water on this bar as they grazed on the reservoir bottom and thus became vulnerable to eagle strikes. Fish residing in Big Bend Reservoir have access to the NFFR. However, it is uncertain how much of a barrier that Big Bend Dam presents to upstream fish movements from Lake Oroville; this dam apparently acts as a barrier except when Lake Oroville is full or near full. An obsolete fish ladder adjacent to the diversion dam once allowed fish to migrate past.

Lake Oroville contains a wide variety of fish species. The lake fishery for prey-sized fish species in the NFFR Arm includes chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch)*, white sturgeon (*Acipenser transmontanus*), Sacramento pikeminnow, hardhead, carp, largemouth bass (*Micropterus salmoides*), smallmouth bass, spotted bass, redeye bass (*Micropterus coosae*), bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), white catfish (*Ictalurus catus*), brown bullhead, and channel catfish *(I. punctatus*) (R. Flint, CDFG, pers. comm. in Pacific Gas and Electric Company 1988). The Poe eagles can obtain bullheads from other nearby reservoirs, including Concow and Kunkle reservoirs, and farm ponds in the Table Mountain area (J. Snoden, CDFG, pers. comm. in Pacific Gas and Electric Company 1988). Large carp inhabit the clear waters of French Creek cove and also forage and bask at the surface in the NFFR Arm of Lake Oroville. During low lake levels, large suckers and cyprinids occurred near the surface and in the shallow water of pools below the Big Bend Dam; rainbow trout occuppied the swifter water below the dam.

### E3.2.4.5 Public Use and Human Interactions

- Many studies have documented the thresholds at which human activities elicit response from eagles (Stalmaster and Newman 1998; Knight and Knight 1984; Grubb et al. 1992; Steidl and Anthony 1996). These thresholds are useful in determining buffer zones to protect eagles from energy expenditures and nesting failures related to these disturbances. Eagles often tolerate or become habituated to existing human developments with predictable characteristics and activity levels. Such passive disturbance features in the Poe Powerhouse bald eagle territory include Poe Powerhouse and associated access roads, transmission power lines, and the Union Pacific Railroad tracks and access spur road. The Licensee's helicopter lands periodically at the powerhouse, but is ignored by the nesting eagles, as are the frequently passing trains. Other potential disturbances to the nesting eagles include: woodcutters and various unofficial activities on the road above the old nest; railroad maintenance activities (e.g., re-blasting tracks); and power line right-of-way vegetation maintenance activities. A 8-kph (5 mph) boat speed limit is enforced on the upper portion of the NFFR Arm of Lake Oroville which limits boating use to slow-moving fishing or houseboating in that portion of the eagles' territory.

### E3.2.4.6 Management Considerations

The bald eagle nesting territory management zone is described in Pacific Gas and Electric Company (1988). Most of this management zone is on the Licensee's land, with small portions of private land in the southwest and southeast portions of the polygon. The following management recommendations are based on the findings in this relicense application, the findings in support of the Licensee's 1988 management plan (Pacific Gas and Electric Company 1988), and a CDFG Bald Eagle Nesting Territory Management Plan (CDFG unpubl. report, no date):

1. Limit habitat alterations within the management zone to those that will enhance bald eagle nesting habitat and that pose no hazard to eagles (e.g., timber harvest would be allowed if under a silvicultural prescription to encourage long-term regeneration of large pines). Reduction of fuel loading is recommended in this nesting zone.

2. Apply seasonal restrictions to compatible habitat alterations in the management zone. Excepting emergencies, no such activity should be allowed in the management zone between January 1 and July 31. If a nesting attempt fails during a certain year, this restriction may be eased, but only after approval of the land or wildlife manager.

3. Discourage new recreational development or policy changes that would alter the current use of the nesting area by public users. No new permanent access roads should be allowed in the management zone.

4. Maintain use restrictions in the Poe Powerhouse bald eagle nesting habitat management zone. Current operation of the powerhouse is compatible with bald eagle nesting. Schedule non-emergency maintenance of power lines (e.g., vegetation removal or trimming operations) outside the bald eagle breeding season.

5. Managers should consider the effects of any proposed alterations to the operation or configuration of existing water facilities on the abundance of bald eagle prey species and availability of eagle foraging habitats from Poe Dam/Reservoir to Lake Oroville.

6. Review effects of 2001 wildfire on eagle habitat and consider needs of future eagle nesting habitat in the reforestation of the area.

### E3.2.5 Sensitive Wildlife Studies

#### E3.2.5.1 Methods

Surveys were conducted for the presence of the valley elderberry longhorn beetle by searching for elderberry (*Sambucus* sp.) in the riparian zone from Poe Powerhouse to Poe Dam in spring and summer 2000. In addition, Project botanists were consulted regarding locations of elderberry found during botanical surveys in the Poe Project area (C. Chainey-Davis, GANDA, Project botanist, pers. comm.). Valley elderberry longhorn beetle presence is documented when their characteristic oval exit holes (7-10 mm wide) are found on the bark of elderberry stems usually greater than 2.5 cm (1 in.) in diameter.

Surveys for peregrine falcons were conducted by visiting potential habitats during the 2000 breeding season either on foot or by vehicle or helicopter. Surveyors searched for adult and juvenile falcons, nest sites, and other evidence of breeding (e.g., whitewash) using binoculars and spotting scopes (Call 1978; Fuller and Mosher 1987). At potential nesting cliffs, surveyors watched for nesting activity for several hours to avoid missing nesting falcons, which are often inactive for long periods during portions of the breeding season (Cade et al. 1996).

Northern goshawk nests were sought by driving through appropriate forest habitats along the NFFR drainage, listening for unsolicited vocalizations, and periodically playing taped recordings of conspecific territorial calls to elicit a territorial response from breeding individuals (Fuller and Mosher 1987). The locations of calling stations are shown in Figure E3.2-2. Following the USFS protocol described in USFS (1992), tapes of adult alarm calls were used during surveys from mid-June through early July 2000. Survey locations were visited again in August during the post-fledging period, and a combination of juvenile begging calls (food solicitation or hunger screams) and alarm calls were played. Detection rates using broadcast surveys have been shown to be more effective at successful nests during the post-fledging period (Watson et al. 1999).

To survey for spotted owls in the NFFR canyon, the USFS protocol (USFS 1991) was followed along a survey route with pre-selected calling stations (Figure E3.2-2). Surveys were conducted after sunset on the nights of May 19, and June 15 and 28, 2000. The spot calling technique of playing a variety of spotted owl vocalizations was conducted at each station using a tape recorder connected to a loudspeaker. Call varieties included male and female location calls and contact calls. A standardized field tape produced by the Oregon Chapter of the Wildlife Society was used. Surveyors spent about 10 minutes calling at each station with approximately 15 seconds pause between vocalizations.

In late June 2000, suitable habitat was searched for willow flycatchers along Project area river reaches and reservoirs. Ground and helicopter surveys were used to locate areas appropriate for sampling. Stands of willow (*Salix* sp.) or other riparian brush were visited prior to 1000 hrs., and the area was monitored for unsolicited male willow flycatcher territorial calls. If no calls were heard, taped recordings of the male territorial calls were played in an attempt to solicit a response using the USFS, Pacific Southwest Region protocol (Craig et al. 1996).

To determine the presence of special status furbearers in the Project area, automated cameras placed at bait stations were utilized in two locations. Trailmaster brand automated camera systems consisting of an infrared transmitter, a receiver, and an automatic 35-mm camera were installed in trees adjacent to bait stations (Kucera and Barrett 1993). An animal inspecting the bait interrupts the pulsed, infrared beam and triggers the camera positioned on the bait station. The system is programmable and

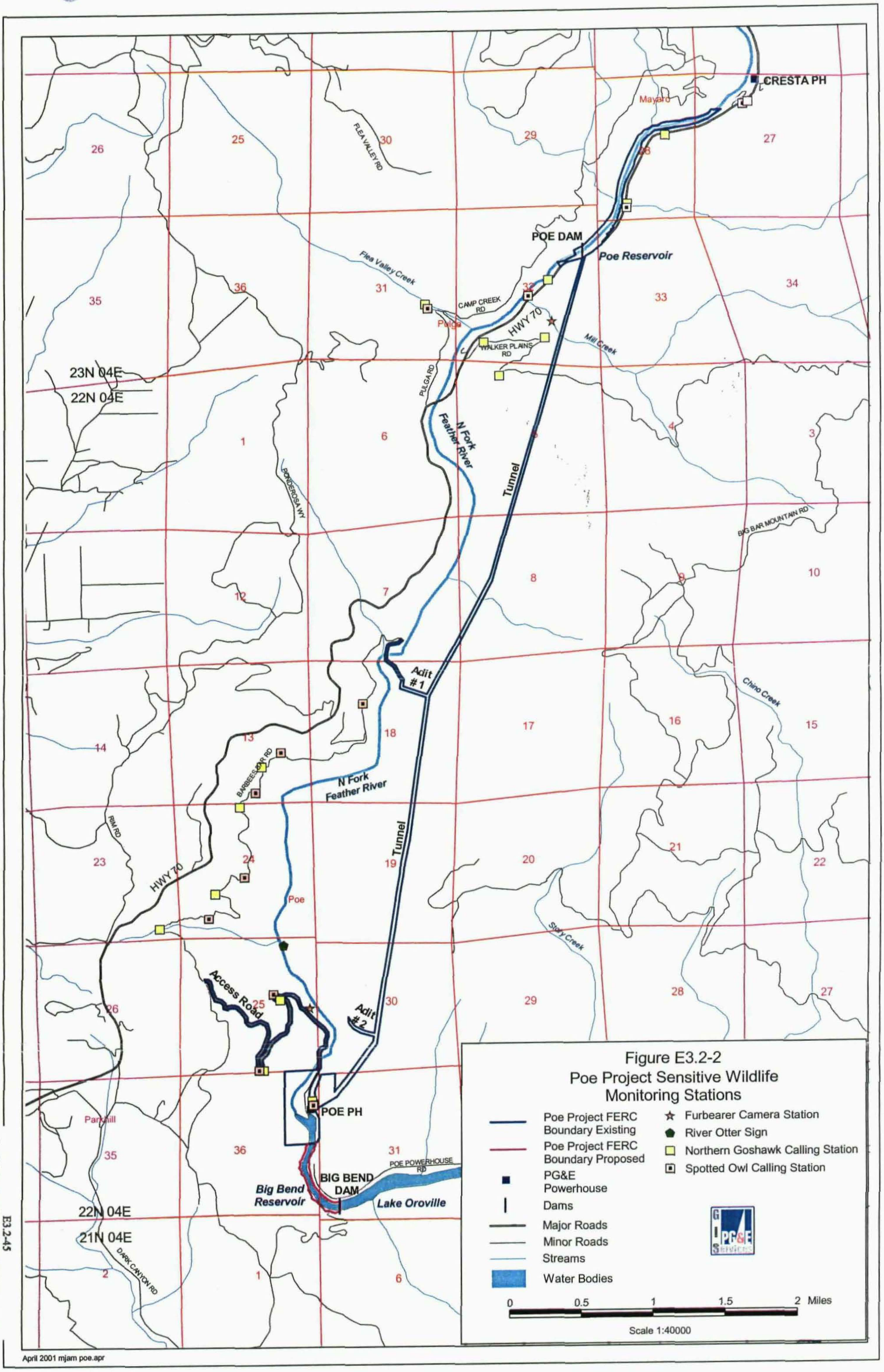


Figure E3.2-2
Poe Project Sensitive Wildlife Monitoring Stations

records the date and time a picture is taken. The stations were operated from mid-September 1999 through mid-March 2000. Bait was positioned 2 m off the ground to target Pacific fisher (Zeilinski and Kucera 1995). Whole fish and raw chicken parts wrapped in hardware cloth, to prevent consumption by visiting animals were used as bait, and the bait cages were doused with liquid fish fertilizer.

Camera bait stations were installed at the following sites: (1) in the NFFR canyon approximately 0.75 km upstream of the Poe Powerhouse bridge; and (2) on Mill Creek about 0.5 km upstream from its confluence with the NFFR (Figure E3.2-2). Each station was checked about every two weeks during the fall and winter, and film was changed as necessary. Entry to the vicinity of the Mill Creek station was through a California Department of Transportation maintenance yard, and therefore, the camera system was protected. The site upstream of the Poe Powerhouse bridge was perched above an overgrown logging road about 100 m over the NFFR. Unfortunately, vandals stole this system sometime between late January and early February 2000. All developed film prints were inspected carefully for animals, and all events were recorded on standardized forms.

Surveyors searched for river otters in the NFFR channel, including Poe Reservoir, during the course of other fieldwork throughout 2000. In addition, surveyors searched for otter sign during amphibian surveys between Poe Dam and Poe Powerhouse. Typical otter sign consists of haul-out areas and scat piles, often consisting of crayfish exoskeleton parts.

Surveys for special status bat species were conducted in 2000 at all Project facilities and throughout the Project vicinity. These surveys were conducted by Dr. Dixie Pierson, a recognized expert in bat distribution and ecology in California. Survey methods are described in Appendix E3.2-2.

### E3.2.5.2 Results

#### E3.2.5.2.1 Valley Elderberry Longhorn Beetle

The Valley elderberry longhorn beetle is associated with riparian systems containing its food plant, elderberry, in remnants of moist valley oak (*Quercus lobata*) woodlands in the lower Sacramento and upper San Joaquin valleys. Optimally, these forests consist of several canopy layers with dense undergrowth. Recent valley elderberry longhorn beetle collection sites in such areas typically contained cottonwood (*Populus fremontii*), sycamore (*Platanus racemosa*), and willow (*Salix* spp.) in the upper canopy with boxelder (*Acer negundo* ssp. *californicum*), Oregon ash (*Fraxinus latifolia*), and elderberry in the intermediate canopies. Urban and agricultural development has destroyed most of the historical valley riparian habitats, resulting in shrinking and fragmenting of the former range of the valley elderberry longhorn beetle (USFWS 1984).

Today, elderberry is also found growing in reclaimed and developed sites, such as urban parks and power-line corridors, which formerly were in riverine floodplains. Valley elderberry longhorn beetle larvae bore into stems of elderberry and feed on the pith. The adults emerge from exit holes in the stems during the spring to feed on elderberry flowers and eventually lay eggs on the bark, around June.

No elderberry plants were found growing in NFFR riparian habitats in the Poe Project area. One small elderberry bush was found along Bardees Bar Road in a moist, shaded draw (C. Chainey-Davis, GANDA, project botanist, pers. comm.); however, this plant was too small to host valley elderberry longhorn beetles. All recent Butte County valley elderberry longhorn beetle records were from sites in the Central Valley below 300 ft. elevation (CDFG 2000a). At higher elevations in the vicinity of the Project area, elderberry typically occurs as small plants in moist areas of dry slopes (C. Chainey-Davis, GANDA, project botanist, pers. comm.).

#### E3.2.5.2.2 Peregrine Falcon

The peregrine falcon was removed from the federal endangered species list in August 1999. Following a severe decline due largely to DDT contamination and a subsequent recovery after DDT was banned, the number of nesting peregrine falcons in California is now estimated at 150 pairs (B. Walton, U.C. Santa Cruz, Predatory Bird Research Group, pers. comm.). Peregrine falcons typically nest on large (>10 m or 30 ft.), vertical cliffs (Call 1978). Peregrine falcons primarily capture birds in a variety of habitats, usually near a water source, including wetlands, lakes, and rivers (Zeiner et al. 1990a).

No evidence of peregrine falcon breeding activity was found in the Project area. Potential nesting substrate occurred in the NFFR canyon from the Highway 70 bridge at Pulga downstream to Bardees Bar. Most of the rocky cliff habitat there was sub-optimal and appeared broken and non-vertical. The best cliff habitat occurred at Bardees Bar, though no peregrines were found there. One adult peregrine was observed flying down canyon over Poe Powerhouse in the direction of Lake Oroville in May 2000. The nearest known peregrine falcon breeding areas are located on the Highway 70 and Highway 162 bridges over Lake Oroville and at Bald Rock Dome, about 15 km southeast of Poe Powerhouse (J. Linthicum, UCSC, Predatory Bird Research Group, pers. comm.).

### E3.2.5.2.3 Northern Goshawk

Northern goshawk breeding habitat typically consists of moderately dense stands of mature coniferous or deciduous forest near meadows or other openings (Call 1978; Zeiner et al. 1990a). Accipiters (forest hawks) partition food on the basis of size and prey type: sharp-shinned hawks (*Accipter striatus*) capture small birds, Cooper's hawks *(Accipiter cooperi)* prey on equal proportions of medium-sized birds and small mammals, and goshawks forage on larger birds and mammals (Reynolds 1989). All accipiters are relatively late nesters, fledging young well into August (Call 1978). Breeding habitats for northern goshawks have been reduced by past timber harvest practices (Remsen 1978), or in the case of ponderosa pine habitats, converted to dense understory by fire suppression (Braun et al. 1996).

Most of the forest habitat in the NFFR canyon in the Project area appeared sub-optimal for northern goshawks. The most suitable conifer habitat was found on the slopes of the Mill Creek drainage southeast of the NFFR between the Highway 70 bridge at Pulga and Poe Dam. A 1999 fire burned the slopes of the northeast portion of the Project area above Poe Reservoir up to Cresta Powerhouse and beyond. No northern goshawks responded to broadcast calls at calling stations in the Project area. Several known goshawk breeding territories are located at higher elevations (>1,460 m, 4,800 ft.) north of the Project area, including one in Breakneck Canyon, approximately 13 km north-northwest of Poe Dam (CDFG 2000a).

### E3.2.5.2.4 California Spotted Owl

The northern subspecies of the spotted owl (*Strix occidentalis caurina*) is listed as a threatened species by the USFWS, while the California spotted owl subspecies (*S. o. occidentalis*) is classified as a federal Species of Concern, a California Species of Special Concern, and a Forest Service Sensitive species. The line separating the two subspecies is considered to be the Pit River in Shasta County, California: the California subspecies occurs in the southern Cascades and Sierra Nevada south of the Pit River, and the northern subspecies occurs to the north (Beck and Gould 1992). The official USFWS delineation for the threatened northern spotted owl subspecies, however, is the region north of Highway 299, although spotted owls in this general contact zone show little variation (B. Turner, District Biologist, USFS, Lassen National Forest, Hat Creek Ranger Dist., pers. comm.). Any spotted owls nesting in the vicinity of the Poe Project area would, therefore, be considered the California spotted owl subspecies.

In the Sierra Nevada Province, California spotted owls occur in a variety of habitats above 300 m (1,000 ft.) elevation, including three types found in the Project area: foothill riparian/hardwood forest; ponderosa pine/hardwood forest; and mixed conifer forest (Verner et al. 1992b). Nesting habitats typically have greater than 70 percent total canopy (all above 2 m), a mixture of tree sizes, at least two canopy layers, and some very large, old trees present in the stand (Verner et al. 1992a). While preferred conifer habitats usually contain large downed woody debris in the understory, this is apparently not a requirement of lower elevation habitats. One analysis of characteristics of lower elevation nesting habitats in the Sierra (i.e., foothill riparian/hardwood conifer) showed that most nests were in live hardwoods, typically black oak or live oak, that averaged 17 m tall with a mean DBH of 76 cm in about 90 percent total canopy cover and at a mean elevation of 790 m (Gutiérrez et al. 1992).

Habitat appeared suitable for California spotted owls in several portions of the Project area; however, stand characteristics were not measured to determine scale or suitability. Spotted owls are known to breed in this portion of the Sierra foothills (Verner et al. 1992a). No spotted owls were detected during surveys, and no owls responded to broadcast calls. On the evening of June 28, 2000, a juvenile western screech owl (*Otis kennicottii*) was observed standing in the road to Poe Powerhouse.

#### E3.2.5.2.5 Willow Flycatcher

Willow flycatchers (all subspecies) are designated an endangered species in California and are classified as a Sensitive Species by the USFS, Pacific Southwest Region (Craig et al. 1996; CDFG 2000b,c). The USFWS considers willow flycatchers in northern California (little willow flycatcher subspecies, *E.t. brewsteri*) as a Special Concern Species. Southern California populations (southwestern willow flycatcher subspecies, *E.t. extimus*) are listed as endangered by the USFWS. Populations east of the Sierra/Cascade crest are thought to be *E.t. adastus*, a Great Basin subspecies (Williams and Craig 2000).

Willow flycatchers are considered to be a rare-to-locally-uncommon summer resident in wet meadows and montane riparian habitats from 600 to 2,440 m (2,000-8,000 feet) elevation in California. They nest in dense and extensive willow thickets adjacent to wet meadows or other open wetlands, including willow-lined streams (Zeiner et al. 1990a; Craig et al. 1996). Shrub height of nesting habitat in central and southern California is typically greater than 2 m (6 ft.) high; willow flycatchers usually build nests from 0.6-3.0 m (2-10 ft.) off the ground. Foliage density (crown cover) in the lower vegetation layer is usually greater than 25%, with 75% and above optimal (Williams and Craig 2000). Willow flycatchers in Washington and Oregon occupy a broader range of habitats, including a wider range of shrub species and use of certain upland habitats. Surveyors in the Modoc National Forest of northeastern California found this species nesting in a shrub stratum of Prunus, Ribes, and Cercocarpus (Craig et al. 1996; Williams and Craig 2000). Two newly discovered populations of *E.t. brewsteri*, one southeast of McCloud, Siskiyou County with 72 flycatchers and the other in Warner Creek Valley, in northern Plumas County, with 42, greatly expanded the known population of this subspecies in California (Williams and Craig 2000).

Most breeding individuals arrive in nesting areas by mid-June; peak breeding occurs in June and early July. Willow flycatchers forage by hawking or gleaning insects from foliage in flight. Once common in suitable habitat throughout California, breeding populations have all but vanished from lower elevations, and they are now rare in mountainous regions (Serena 1982). The destruction and degradation of riparian habitats, including logging and dam construction that change wet meadow or stream hydrology, cattle grazing in willow thickets and direct disturbance to nests by browsing cows, and brown-headed cowbird (*Molothrus ater*) nest parasitism are all blamed for the decline of this species (Remsen 1978; Sogge et al. 1997; Williams and Craig 2000).

The only riparian shrub habitat patches of sufficient size to accommodate willow flycatchers in the Project area were located between the Flea Valley Creek confluence and Poe Dam. Three willow stands (all about 0.2 ha or 0.5 acre), some with small alder (*Alnus* sp.) and ash components, were surveyed there for willow flycatcher occurrence. No flycatchers were detected during surveys, and no flycatchers responded to broadcast calls.

**E3.2.5.2.6 Pacific Fisher**

Pacific fishers inhabit dense, medium-to-large tree stages of coniferous forests and riparian deciduous habitats in the Klamath, Cascade, and Sierra Nevada mountains (Zeiner et al. 1990b). Although data are lacking, Pacific fisher populations may be declining in northern California, possibly due to timber harvest practices that reduce size and structure of mature stands (Williams 1986).

The camera located at the station upstream of Poe Powerhouse recorded a total of 104 events (pictures) from September 14, 1999 to January 20, 2000 (Table E3.2-7), although most of these were biweekly test photos, misfires (e.g., from a frayed cable), or caused by interference from falling debris. Only two animal visits occurred at this station during the sampling period: a ringtail (*Bassariscus astutus*) and a black bear (*Ursus americanus*).

The bear removed the bait cage from retaining wire on the tree trunk and ate its contents. The bait cage and bait was replaced, but the bear did not return to this station.

The camera along Mill Creek recorded a total of 126 events from September 14, 1999 to March 10, 2000 (Table E3.2-7). A ringtail regularly visited this station throughout the sampling period. Less frequent visits of a black bear and cub were recorded (Figure E3.2-3), and single visits by a western spotted skunk (*Spilogale gracilis)*, raccoon (*Procyon rotor*), and gray fox (*Urocyon cinereoargenteus*) were also documented. There were no recorded visits by any special status furbearers at either of the bait stations.

### E3.2.5.2.7 River Otter

River otters are relatively uncommon residents of larger water bodies along river drainages mostly in the North Coast, Klamath, and Cascade Ranges and at scattered locations in the Sierra Nevada (Zeiner et al. 1990b). They feed primarily on fish and crayfish and often range far along river courses, up to 96 km (60 mi.) during a year.

No direct observations of river otters were made in the Project area. However, one haul-out/scent-marking area with characteristic scat piles consisting primarily of crayfish exoskeleton parts was found along the NFFR approximately 2 km upstream of Poe Powerhouse (Figure E3.2-2).

## Table E3.2-7

## Results from Two Furbearer Camera Stations Placed Near Poe Powerhouse and Along Mill Creek from September 14, 1999 to March 10, 2000

| Date | # Photos | TM Hits | Species (visits) | Comments |
|---|---|---|---|---|
| POE POWERHOUSE: | | | | |
| 09/14 – 10/14/99 | 18 | 42 | Ringtail (1)<br>Black Bear (1) | Bait cage removed by bear, replaced |
| 10/14 – 10/31/99 | 6 | 6 | none | All test photos, misfires |
| 10/31 – 11/23/99 | 25 | >100 | none | Test photos, many misfires – unknown cause |
| 11/23 – 12/7/99 | 5 | 6 | none | All test photos, misfires |
| 12/7 – 12/21/99 | 6 | 3 | none | All test photos, misfires |
| 12/21 – 1/10/00 | 24 | 10 | none | All test photos, misfires, camera cable chewed by rodent (repaired) |
| 1/10 – 1/20/00 | 20 | 3 | none | All test photos, misfires, camera cable chewed by rodent (replaced) |
| 1/20-2/8/00 | - | - | - | Camera system stolen |
| MILL CREEK: | | | | |
| 09/14 – 10/14/99 | 24 | 162 | Ringtail (1)<br>Spotted Skunk (1)<br>Black bear, cub (1) | Bears removed bait basket, bumped camera, bait not replaced (scent only). |
| 10/14 – 10/31/99 | 12 | 69 | Black bear, cub (2) | Bears bumped camera. |
| 10/31 – 11/23/99 | 4 | 4 | none | Replaced bait basket. |
| 11/23 – 12/7/99 | 25 | 103 | Ringtail (1) | Moved bait around in basket, camera date not working. |
| 12/7 – 12/21/99 | 12 | 25 | Ringtail (1)<br>Raccoon (1) | |
| 12/21 – 1/10/00 | 6 | 10 | Ringtail (1) | |
| 1/10 – 1/20/00 | 4 | 5 | Ringtail (1) | |
| 1/20-2/8/00 | 12 | 24 | Ringtail (2)<br>Gray Fox (1) | |
| 2/8 – 3/10/00 | 27 | 48 | Ringtail (3) | |

**Figure E3.2-3. Black bear and cub at Mill Creek camera/bait station, October 1999.**

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#### E3.2.5.2.8 Bats

The results of surveys for special status bat species are reported in Appendix E3.2-2.

### E3.2.6 Impacts of Existing Project

#### E3.2.6.1 Wildlife Resources

**Bald Eagle.** The Licensee has been following the guidelines established in the Poe Powerhouse Bald Eagle Management Plan since the time of its preparation (Pacific Gas and Electric Company 1988). The plan establishes guidelines for timber management, recreation, and hydroelectric power generation at the Project. The Licensee intends to continue following the recommendations of the plan as revised in this document throughout the remainder of the present and future license durations. By adhering to the plan's recommendations the Licensee ensures that continued operation of the present Project will have no adverse effects on the resident bald eagle population.

**Other Sensitive Species.** The Licensee recognizes that many of the special status species listed in Table E3.2-2 occur in the immediate Project vicinity. At present, there is no known impact on these species from the continued operation or maintenance of the Project. If future Project-related activities might affect habitat for these species, then the Licensee will conduct surveys and coordinate with interested resource agencies in plans for mitigating or protecting affected habitat or species.

### E3.2.7 Agency Recommended Measures

The agencies and NGOs did not provide specific recommendations for resource protection, mitigation, and enhancement measures through their comments on the Draft Application for New License. The primary recommendation advanced by the collective body of agencies and NGOs was to have the Licensee initiate a collaborative process through which all interested parties could have input into the development of such measures. As indicated in the following section, the Licensee has agreed to initiate a collaborative effort to address this recommendation.

### E3.2.8 Licensee Proposed Measures

**Minimum Streamflows.** Licensee proposes to maintain a continuous, year-round, minimum instream flow of 150 cfs in the NFFR, as measured at the Pulga gage (NF23). This proposed streamflow has been based on the balancing of numerous resource considerations, as discussed in the Project Resource Summary. Recognizing that there are uncertainties related to the actual responses of habitat characteristics (e.g., water temperature) and affected resources (e.g., fish, amphibians, macroinvertebrates, bald eagles, and riparian vegetation) to changes in streamflow, the Licensee proposes to monitor those responses.

**Recreation and Pulse Flows.** Licensee proposes no recreation or pulse flow releases due to the potential for impact on foothill yellow-legged frog (most importantly, egg masses, tadpoles, and metamorphs) and bald eagles (foraging habitat and forage fish species). Under current Project operations, high flow events occur in the Poe Reach of the NFFR on a periodic basis as a result of natural spills at Poe Dam during winter storms and the spring run-off period. These flow events will continue to provide ecological and recreational benefits.

**Ramping Rates.** Licensee proposes to implement the same ramping rate requirements as those recently developed for the upstream Rock Creek and Cresta dams under the Rock Creek-Cresta Relicensing Settlement Agreement to protect aquatic resources. During periods when ramping can be controlled at spill flows less than 3,000 cfs at Poe Dam, the initial ramping rates shown below are proposed. These rates would be followed as close as reasonably practicable given radial gate operating limitations. It is recognized that certain operating situations, such as a unit trip when incoming flows to Poe Reservoir cannot be controlled, would likely cause an exceedance of these rates. Revision to these rates could occur as the result of monitoring Rock Creek-Cresta flow impacts.

March, April, and May – 250 cfs/hr up-ramp and 150 cfs/hr down-ramp

June 1 – June 15 – 300 cfs/hr up-ramp and 150 cfs/hr down-ramp

Remainder of the year – 400 cfs/hr up-ramp and 150 cfs/hr down-ramp

**Bald Eagle Management Plan.** Licensee intends to continue to follow the recommendations of the Poe Powerhouse bald eagle management plan, including the revised recommendations as described in this document. The Licensee has updated essential habitat maps based on changes in eagle habitat since the development of the original plan. No additional measures are proposed for other wildlife species. However, should other activities occur at the Project that may affect sensitive wildlife species, the Licensee will conduct surveys for these species and coordinate with resource agencies on plans for the protection of affected resources.

**Collaborative Process for Developing Protection, Mitigation, and Enhancement Measures.** Licensee proposes to conduct a six-month collaborative process beginning in January 2004 and ending in July 2004. The goal of the collaborative is to reach agreement with all stakeholders willing to fully participate on appropriate protection, mitigation, and enhancement measures for the Project.

### E3.2.9 Anticipated Impacts of Continued Operation

Although no site specific data were collected on bald eagle foraging habitat availability in the NFFR below Poe Dam, increases in flow in the NNFR are likely to reduce foraging opportunities to bald eagles that presently spend about 30 percent of their time foraging in this area. Some small to moderate reduction in available foraging habitat is predicted based on present use of this area by foraging eagles, and studies from other areas that suggest such a reduction (e.g. Hunt et al. 1992. Foraging ecology of bald eagles on a regulated river. J. Raptor Research 26:243-256; Haywood and Omart 1986. Utilization of benthic-feeding fish by inland breeding bald eagles. Condor 88:35-42.). Monitoring of bald eagle nesting success will help ensure that proposed streamflow modifications do not adversely affect bald eagle nesting success.

Other than the above mentioned flow modification, following the recommendations of the Poe Powerhouse bald eagle management plan, as revised in this document, the Licensee will avoid any significant impacts to bald eagles nesting at the Project. No significant impacts to any other wildlife species are anticipated as a result of the continued operation of the Project.

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**FISH, WILDLIFE, AND BOTANICAL RESOURCES**

**Section E3.3**

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**BOTANICAL RESOURSES**

## E3.3 Botanical Resources

## E3.3.1 Existing Conditions

### E3.3.1.1 General Vegetation

The Poe Project vicinity is comprised of a mix of forest, woodland, chaparral, and grassland habitats. Six different plant communities are represented, each described here as a *series* based on the *Manual of California Vegetation* (Sawyer and Keeler-Wolf 1995). These series include canyon live oak, foothill pine-canyon live oak, mixed conifer, black oak, wedgeleaf ceanothus, and California annual grassland. Within the vicinity of the Project, these series commonly intergrade forming broad ecotones rather than sharp boundaries. Additional areas within the vicinity of the Project have been developed or disturbed. Each of these series is described below.

Canyon live oak series is characterized by widely spaced, broad-leaved trees to 20 meters in height. This series is dominated by canyon live oak (*Quercus chrysolepis*) with a shrub understory consisting of deer brush (*Ceanothus integerrimus*), poison oak (*Toxicodendron diversilobum*), toyon (*Heteromeles arbutifolia*), and whiteleaf manzanita (*Arctostaphylos viscida* ssp. *viscida*). Species common to the herbaceous understory of this series include blue wildrye (*Elymus glaucus* ssp. *glaucus*), coyote mint (*Monardella *odoratissima* ssp. *pallida*), and shaggy hawkweed (*Hieracium albiflorum*). This series is widespread throughout the vicinity of the Project, occurring on both granitic and metasedimentary soils.

Foothill pine-canyon live oak series is characterized by a moderately dense understory of evergreen sclerophyllous shrubs with an open canopy of foothill pine (*Pinus sabiniana*). In addition to foothill pine, dominant species within this series include canyon live oak, wedgeleaf ceanothus (*Ceanothus cuneatus* var. *cuneatus*), deer brush, birch leaf mountain mahogany (*Cercocarpus betuloides* var. *betuloides*), and poison oak. Within the vicinity of the Project, this series occurs on predominantly serpentine soils upstream of the Bardees Bar area.

Mixed conifer series is characterized by a moderately dense forest of coniferous evergreens dominated by ponderosa pine (*Pinus ponderosa*), Douglas fir (*Pseudotsuga menziesii* var. *menziesii*), and incense cedar (*Calocedrus decurrens*). Understory species common within openings in the forest canopy include deer brush, poison oak, and True's manzanita (*Arctostaphylos mewukka* ssp. *truei*). Within the vicinity of the Project, this series occurs on relatively gentle slopes away from the steep, rocky river canyon walls.

Black oak series is characterized by a moderately dense woodland dominated by black oak (*Quercus kelloggii*) with Douglas fir, ponderosa pine, and foothill pine as common associates. Species common to the shrub understory include poison oak, bracken fern (*Pteridium aquilinum* var. *pubescens*), birch leaf mountain mahogany, and deer brush.

Hedgehog dogtail (*Cynosurus echinatus*), blue wildrye, and hedge parsley (*Torilis arvensis*) dominate the herb layer. Small pockets of black oak occur throughout the vicinity of the Project, particularly on north-facing slopes.

Wedgeleaf ceanothus series is characterized by a dense chaparral to 3 meters in height dominated by wedgeleaf ceanothus. Other species common to this series include chamise (*Adenostoma fasciculatum*), greenleaf manzanita (*Arctostaphylos patula*), and yerba santa (*Eriodictyon californicum*). Within the vicinity of the Project, small pockets of wedgeleaf ceanothus occur on serpentine soils south of Poe Powerhouse.

California annual grassland series is characterized by a sparse to dense cover of annual, non-native grasses to one meter in height. Associated with the grasses are numerous species of annual and perennial herbs. Species characteristic of this series include ripgut brome (*Bromus diandrus*), soft chess (*Bromus hordeaceus*), wild oat (*Avena fatua*), slender oat (*Avena barbata*), and star thistle (*Centaurea solstitialis*). Within the vicinity of the Project, small areas of annual grassland occur as disturbed openings under transmission lines. Additional small areas of annual grassland are associated with serpentine soils.

All plant communities within the immediate vicinity of the Project were mapped using 1:12,000 scale color infrared aerial photographs acquired April 25, 1998 (Figure E3.3-1). Area of coverage included the NFFR from Cresta Powerhouse to Big Bend Dam.

### E3.3.1.2 Riparian Vegetation

**Mapping.** Riparian mapping was conducted from July through October 2000. Nine different plant communities were observed, each described here as a *series* based on the *Manual of California Vegetation* (Sawyer and Keeler-Wolf 1995). These series include torrent sedge, California brickellbush, arroyo willow, narrowleaf willow, Himalayan blackberry, foothill sycamore-arroyo willow, white alder (immature), white alder (mature), and Oregon ash. Each of these series is described below.

Torrent sedge series is characterized by perennial herbs growing at the water's edge. Torrent sedge (*Carex nudata*) is the dominant species within this series, although significant cover of shrubs, mostly willows, may be present as well. Within the vicinity of the Project, this series is dependent upon stable summer water levels.

California brickellbush series is characterized by a sparse vegetation cover of dry site herbs dominated by California brickellbush (*Brickellia californica*). Other species characteristic of this series include mugwort (*Artemisia douglasiana*), narrowleaf willow (*Salix exigua*), and white sweet clover (*Melilotus alba*). Within the vicinity of the Project, this series is generally found on gravel and cobble bars above the summer water's edge.

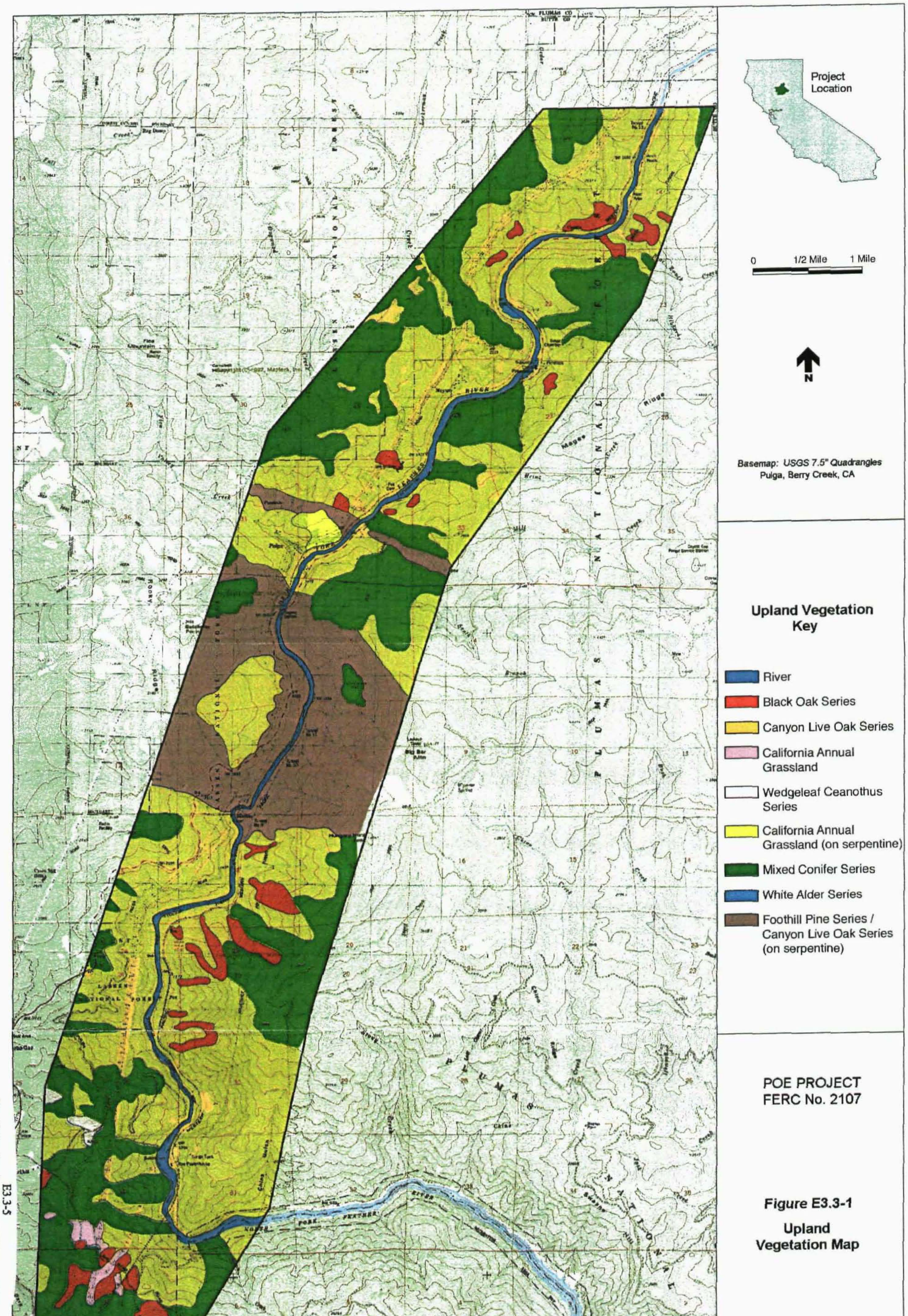


**Figure E3.3-1**
**Upland Vegetation Map**

Arroyo willow series is characterized by an open to dense streamside thicket dominated by a mixture of willows including arroyo willow (*Salix lasiolepis*), Pacific willow (*S. lucida* ssp. *lasiandra*), and narrowleaf willow. Within the vicinity of the Project, this series is commonly found on the water's edge and is subject to annual flooding.

Narrowleaf willow series is characterized by disturbed streamside sites dominated by narrowleaf willow. Other species characteristic of this series include torrent sedge and Himalayan blackberry (*Rubus discolor*). Within the vicinity of the Project, this series generally occurs on open sites on gravel and cobble bars.

Himalayan blackberry series is characterized by dense thickets of Himalayan blackberry with aerial cover values in excess of 80 percent. Other species common to this series include white alder (*Alnus rhombifolia*), narrowleaf willow, and California wild grape (*Vitis californica*). Within the vicinity of the Project, this series forms a nearly continuous band along the west shore of Poe Reservoir.

Foothill sycamore-arroyo willow series is characterized by an open woodland away from the active channel and at or above the ordinary high water mark. Dominant species include western sycamore (*Platanus racemosa*) and arroyo willow. Other species characteristic of this series include Fremont cottonwood (*Populus fremontii* ssp. *fremontii*), Himalayan blackberry, narrowleaf willow, and California button willow (*Cephalanthus occidentalis* var. *californicus*). Within the vicinity of the Project, this series is found away from the active channel, from Bardees Bar to Poe Powerhouse.

White alder series (immature) is characterized by a somewhat open thicket dominated by white alder seedlings and saplings. Associated species include arroyo willow, Fremont cottonwood, and Himalayan blackberry. Within the vicinity of the Project, this series occurs on somewhat unstable fluvial surfaces of gravel or cobble.

White alder series (mature) is characterized by streamside stands of mature white alder. Other species characteristic of this series include Oregon ash (*Fraxinus latifolia*), Himalayan blackberry, and mugwort. Within the vicinity of the Project, this series occurs in several areas along the shore of Poe Reservoir as a one-canopy wide stand of mature white alder.

Oregon ash series is characterized by open stands of mixed age Oregon ash occurring on higher, stable terraces. Associated species include Himalayan blackberry, mugwort, and California wild grape. Within the vicinity of the Project, two small stands of Oregon ash were mapped on higher, stable terraces between Pulga Bridge and Poe Dam.

All riparian areas were mapped using 1:2,000 scale color infrared digital aerial orthophotography acquired May 22, 2000 during instream flows of approximately 115 cfs. Area of coverage included the NFFR from Cresta Powerhouse to Big Bend Dam (Figure E3.3-2). Aerial cover values (in square meters) for each riparian vegetation series within the Project area are shown in Table E3.3-1.

**Table E3.3-1**
**Riparian Vegetation Series Aerial Cover Values (~115 cfs)**

| Riparian Vegetation Series | Aerial Cover ($m^2$) |
|---|---|
| Torrent sedge series (wetland herb) | 18,073 |
| California brickellbush series (dry herb) | 24,022 |
| Arroyo willow series | 52,587 |
| Narrowleaf willow series | 36,865 |
| Himalayan blackberry series | 24,481 |
| Foothill sycamore-arroyo willow series | 104,596 |
| White alder series, immature stands | 19,819 |
| White alder series, mature stands | 12,929 |
| Oregon ash series | 7,258 |
| Non-native grassland series | 3,240 |
| Ruderal | 29,428 |
| Bare ground | 290,434 |
| **Total** | 623,732 |

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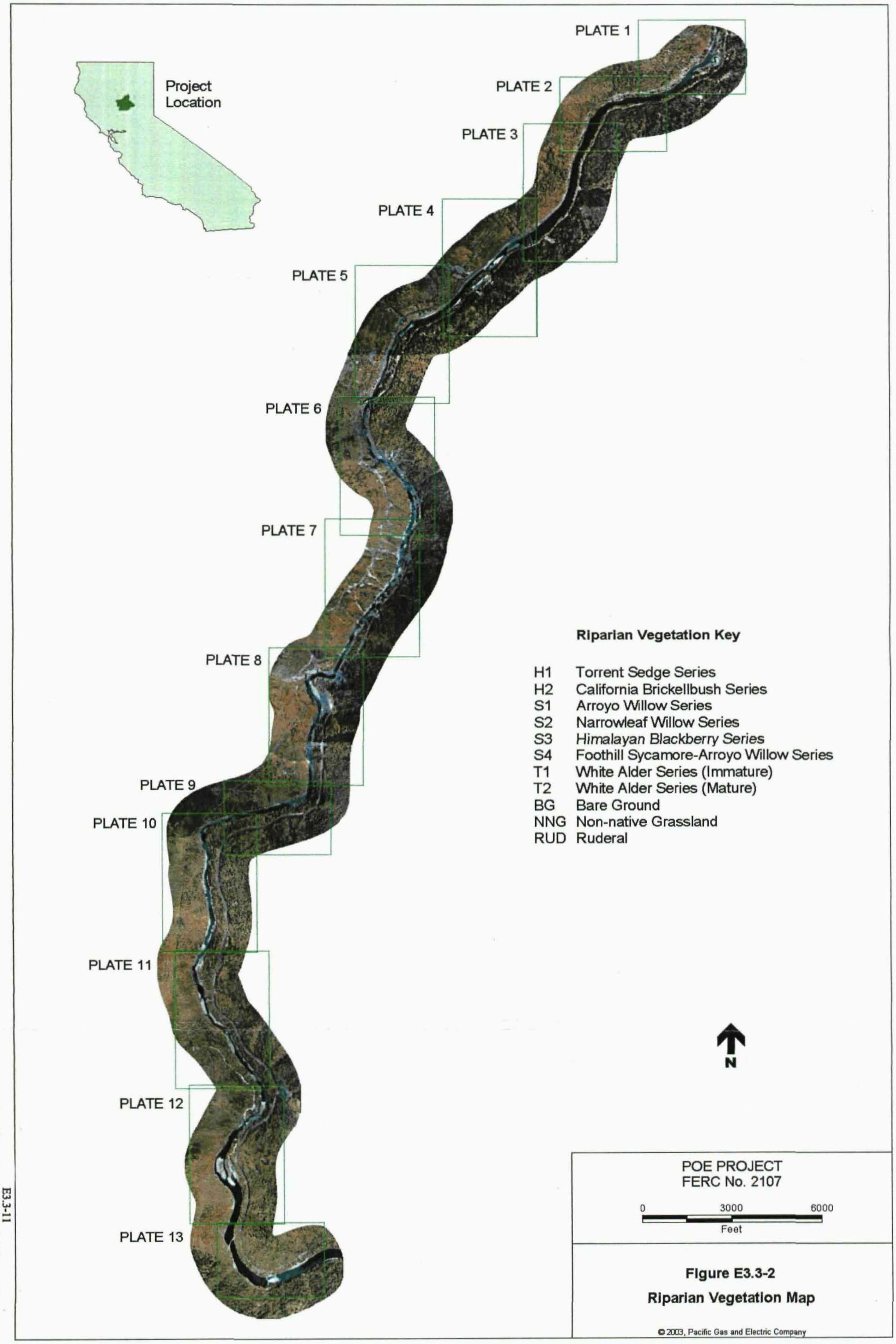


**Figure E3.3-2**
**Riparian Vegetation Map**

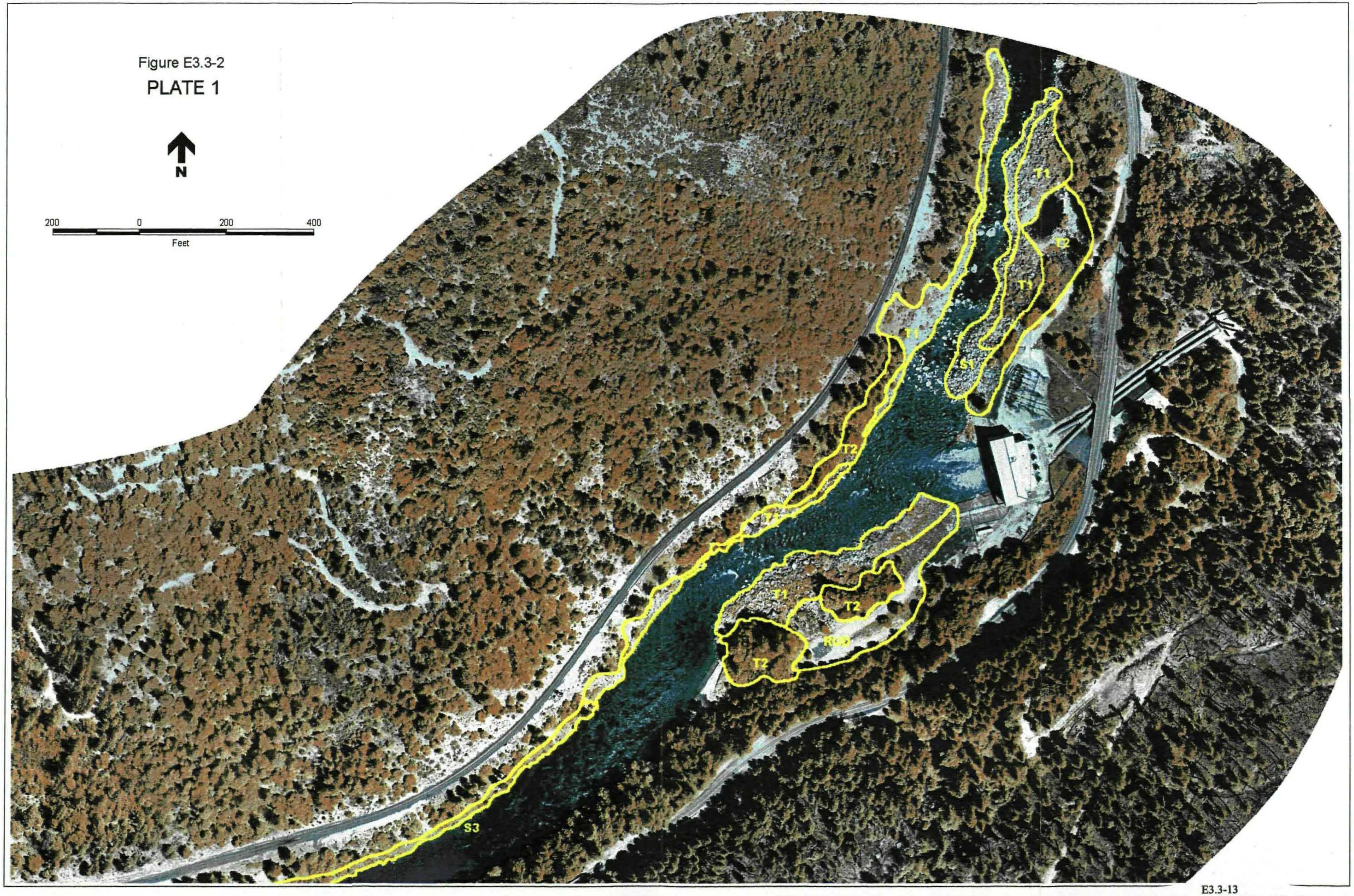


Figure E3.3-2

PLATE 1

Figure E3.3-2

PLATE 2

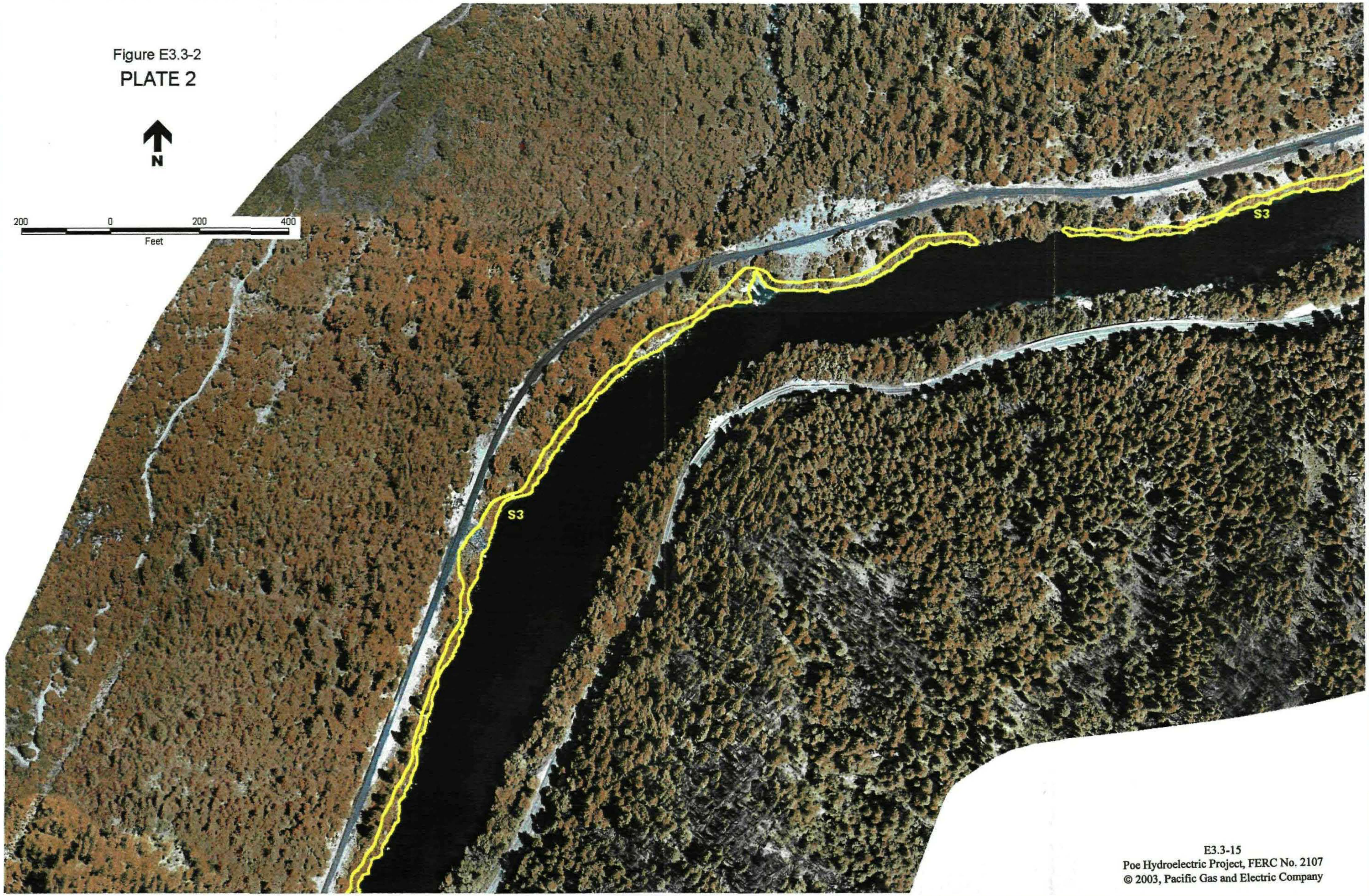



Figure E3.3-2
PLATE 3
N
200
0
200
400
Feet
S3
T1
RUD
RUD
RUD
S3
RUD
T2
BG
S2

Figure E3.3-2
PLATE 4

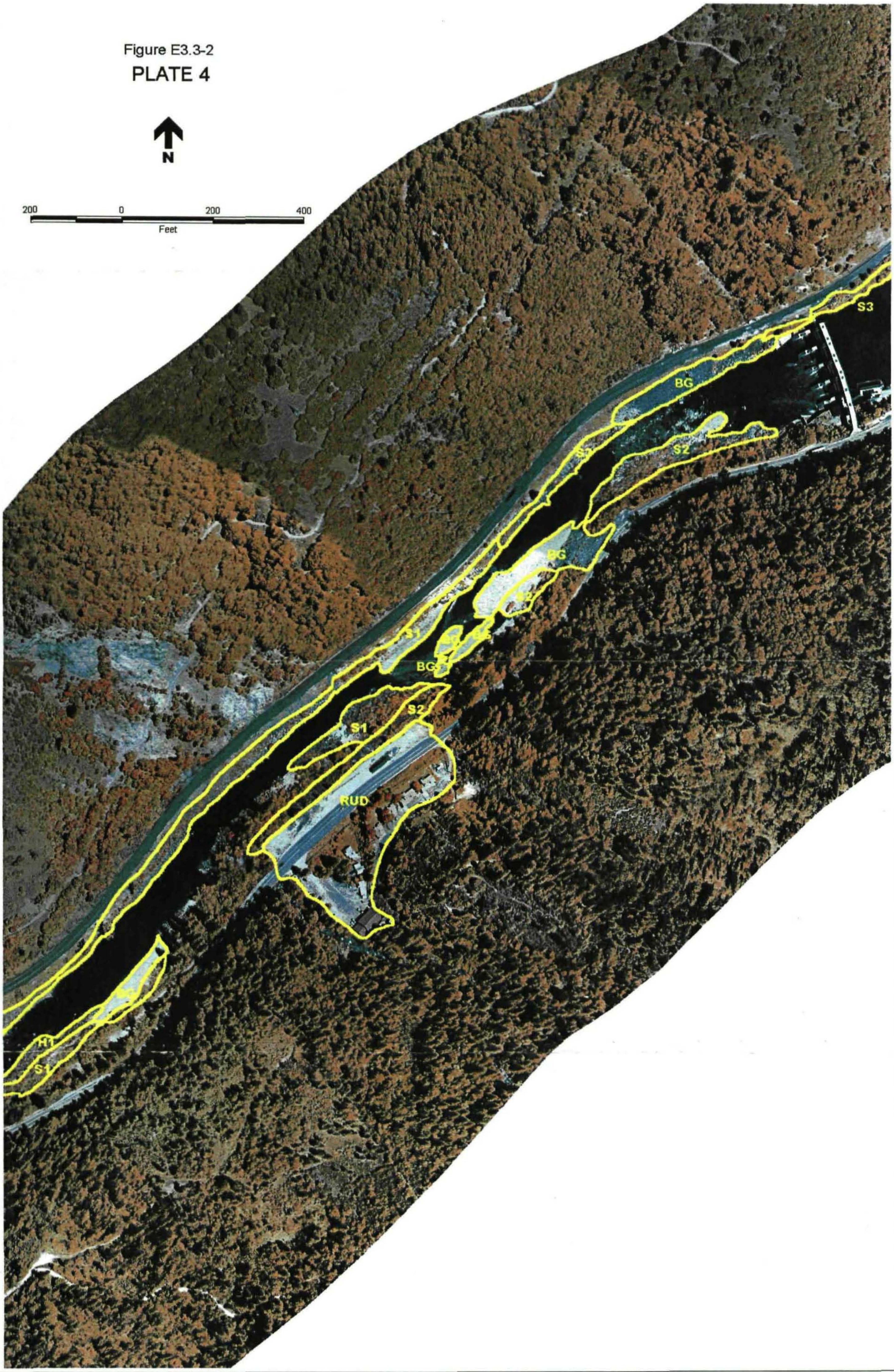
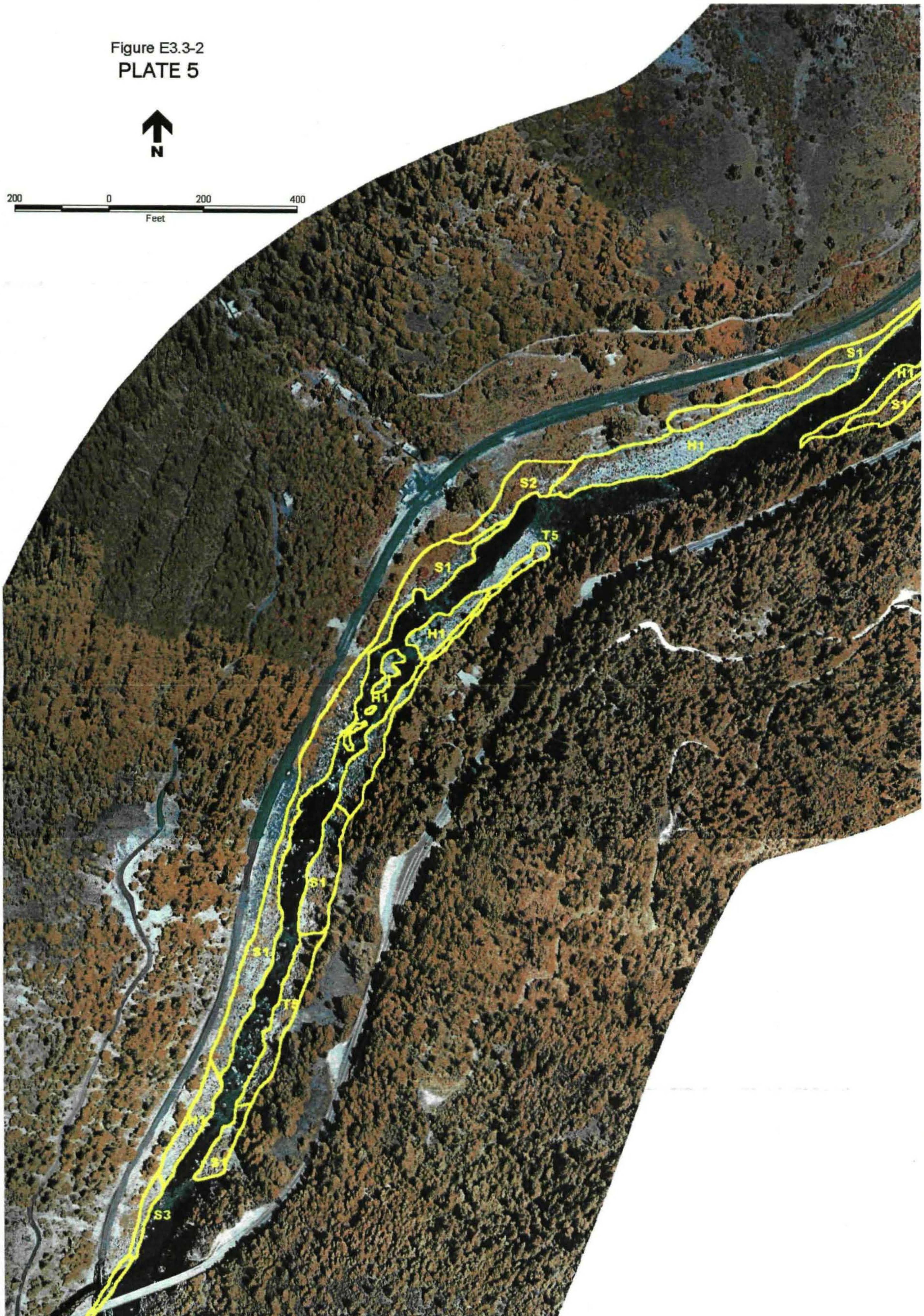


Figure E3.3-2
PLATE 5



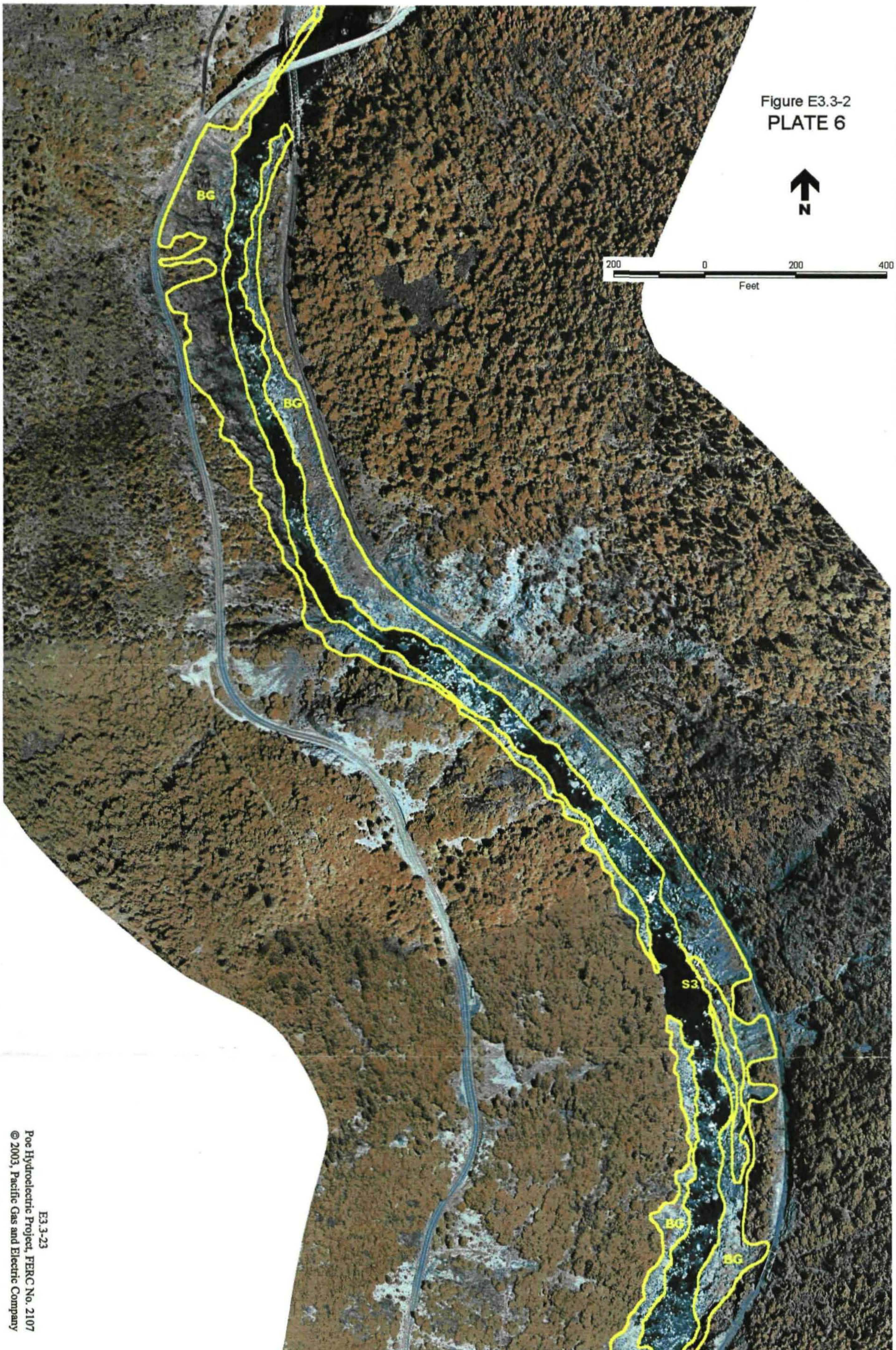



Figure E3.3-2
PLATE 6

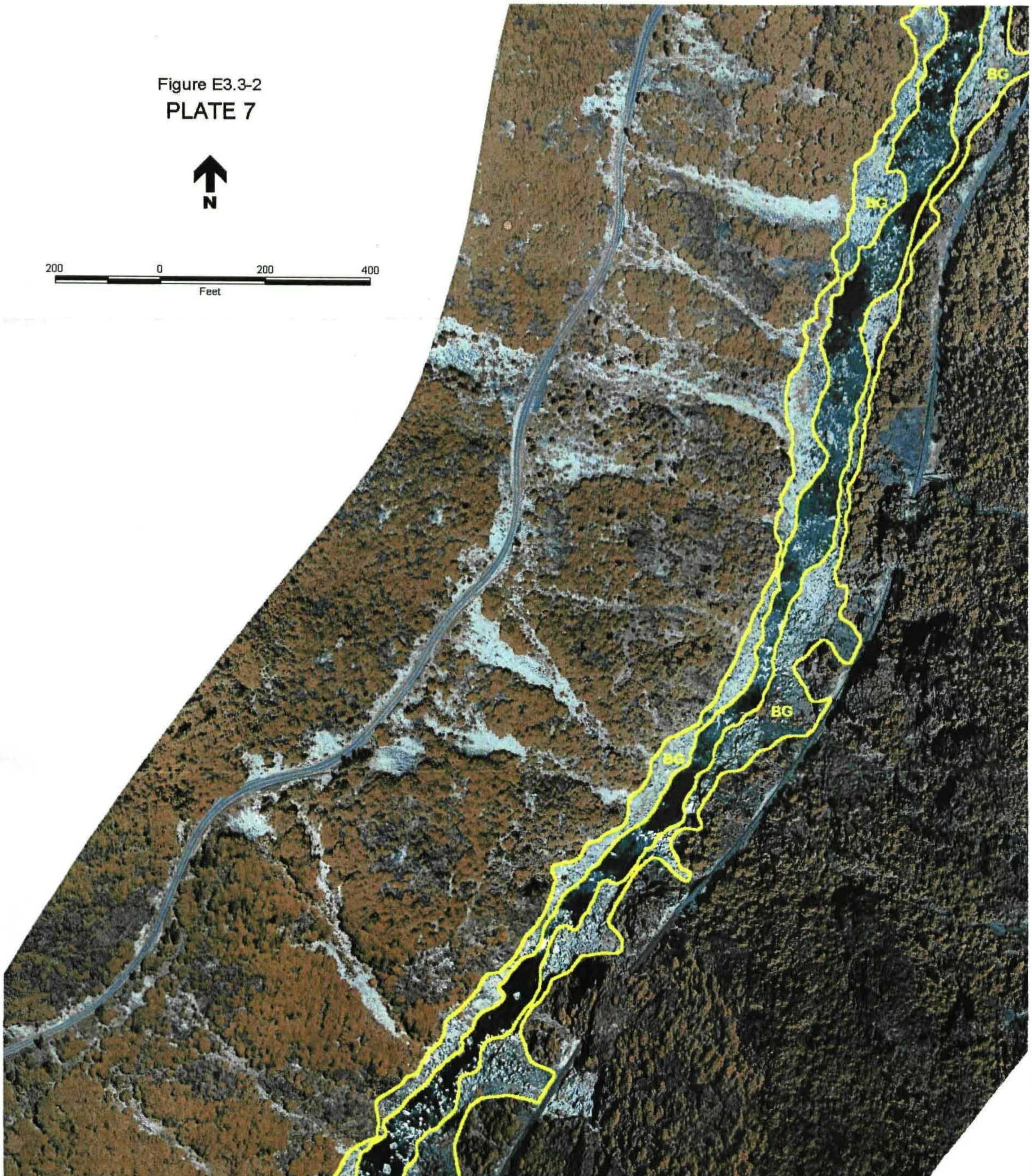


Figure E3.3-2
PLATE 7
N
200 0 200 400
Feet
BG
BG
BG
BG
BG
BG

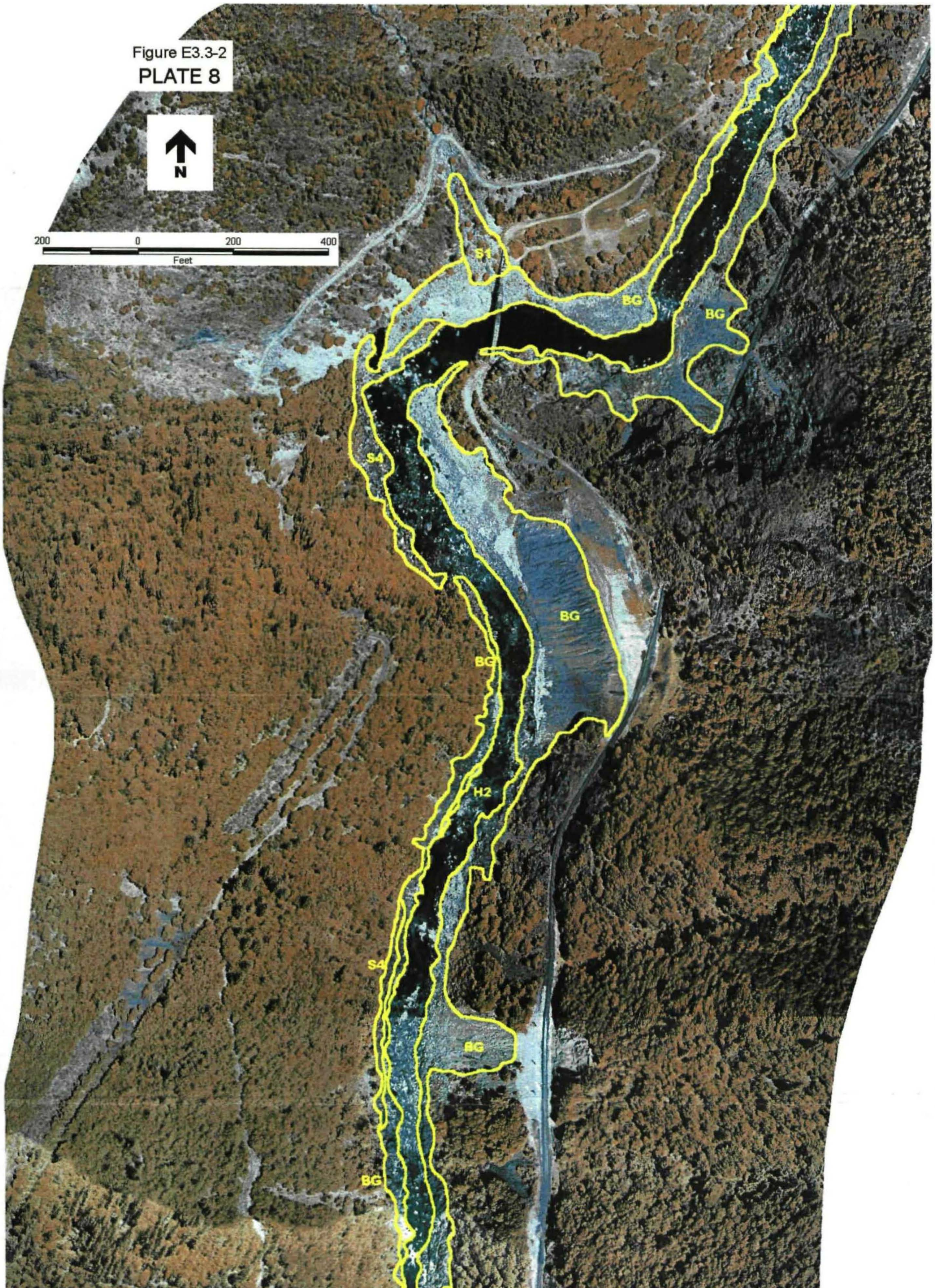


Figure E3.3-2
PLATE 8
N
200 0 200 400
Feet
S1
BG
BG
S4
BG
BG
H2
S4
BG
BG
T1
BG
BG

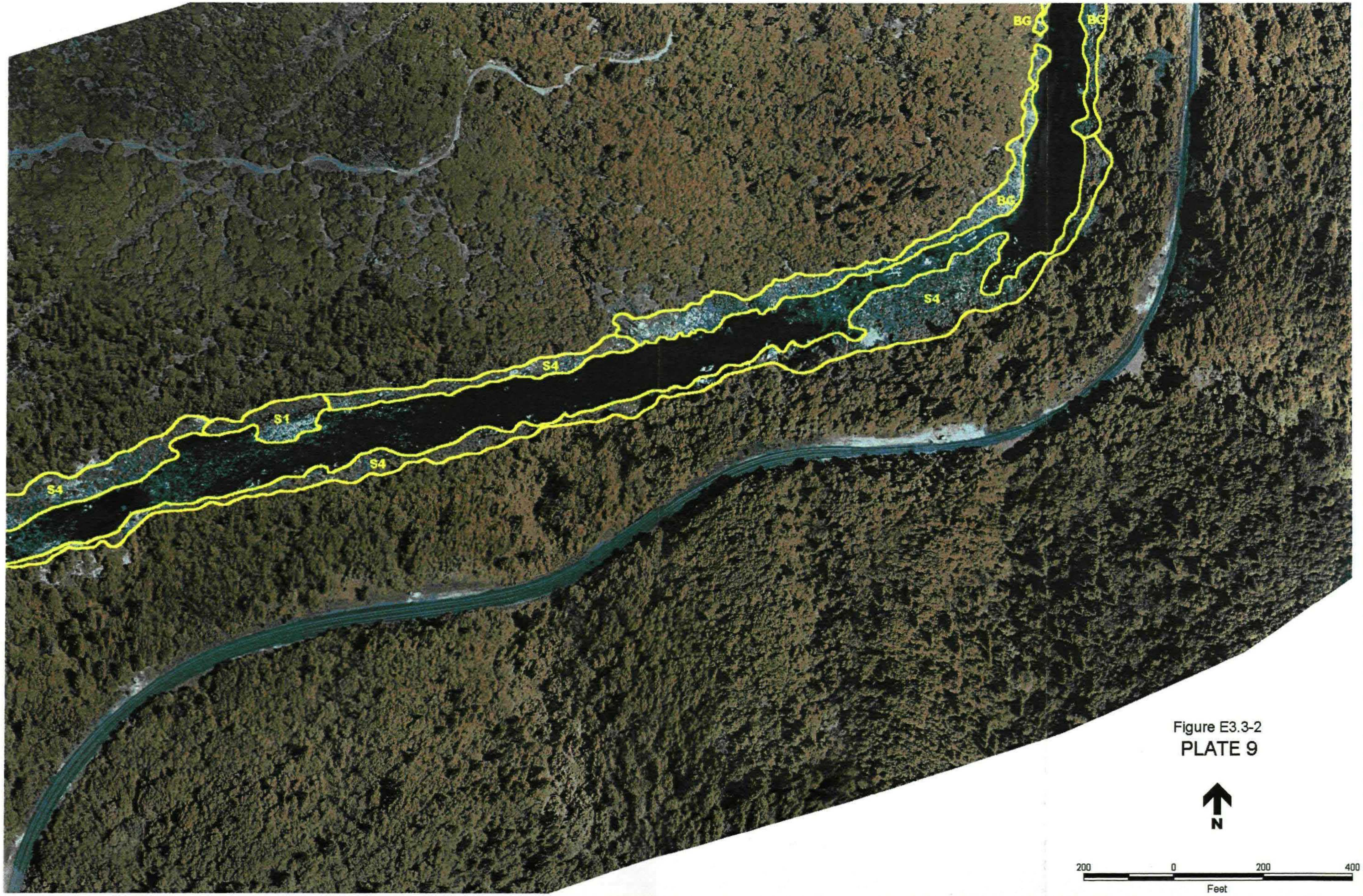



Figure E3.3-2
PLATE 9

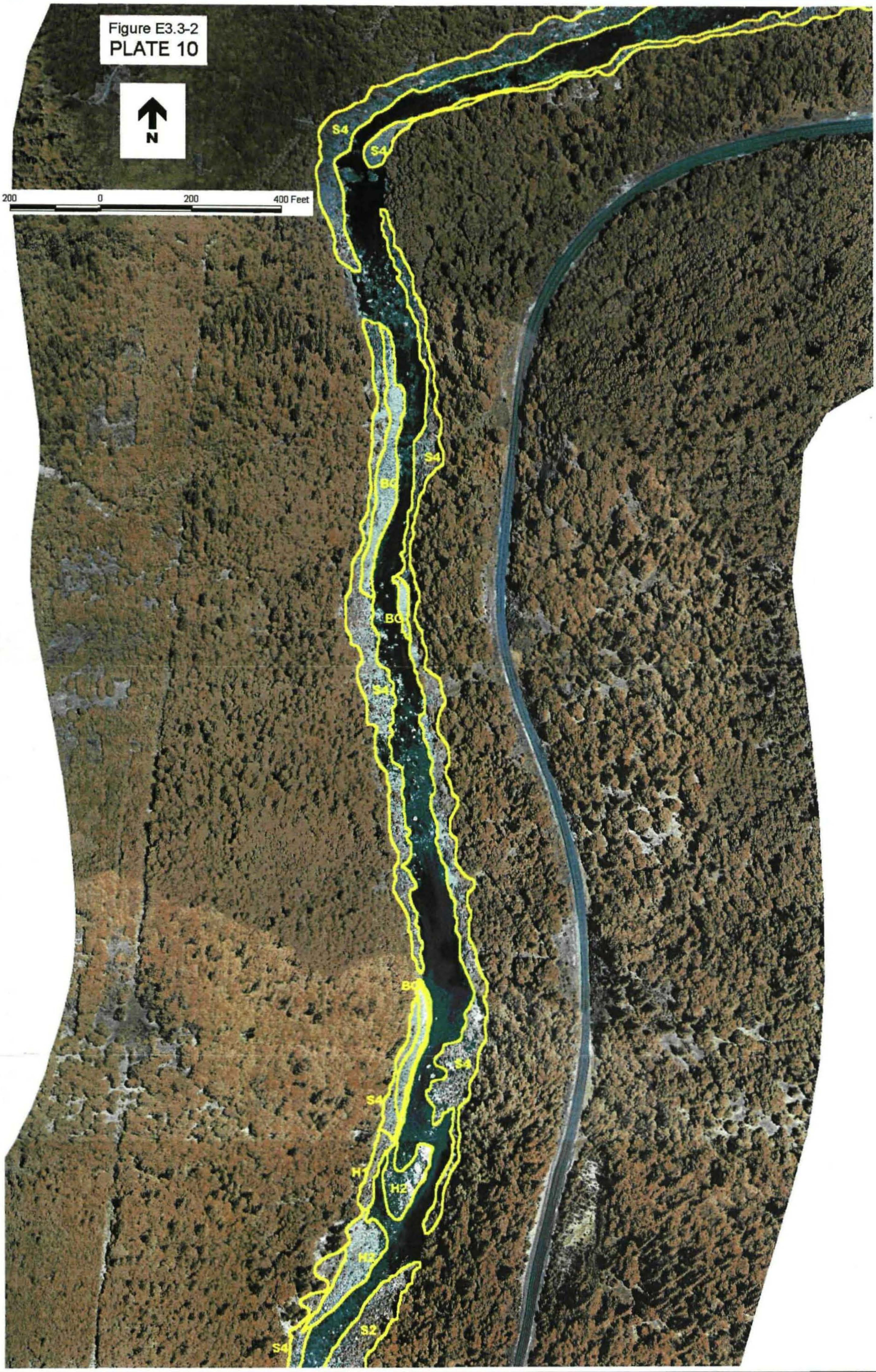


Figure E3.3-2
PLATE 10
N
200 0 200 400 Feet
S4
S4
S4
BC
BC
S4
BC
S4
S4
H1
H2
H2
S2
S4

Figure E3.3-2
PLATE 11

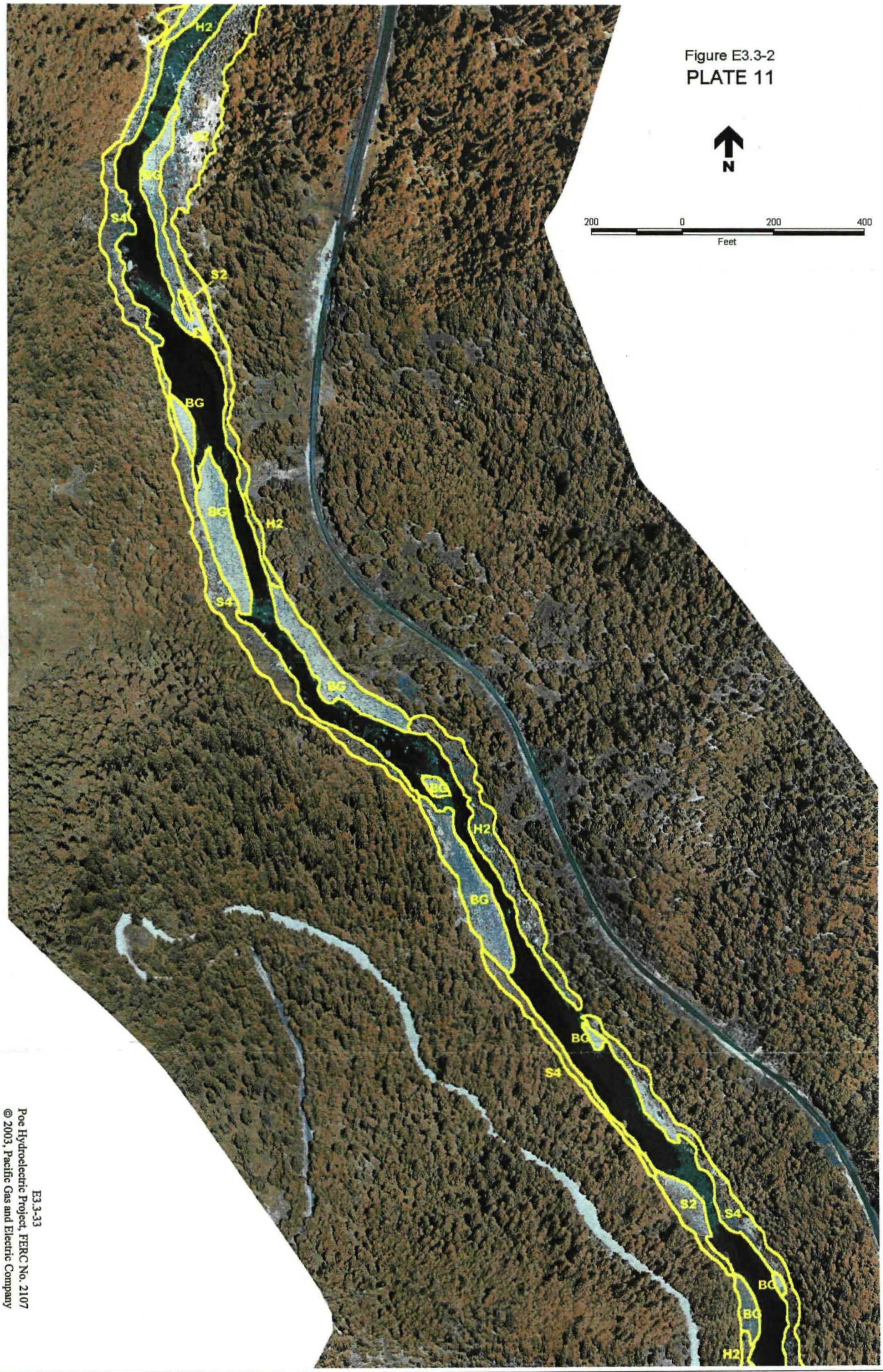



Figure E3.3-2
PLATE 12

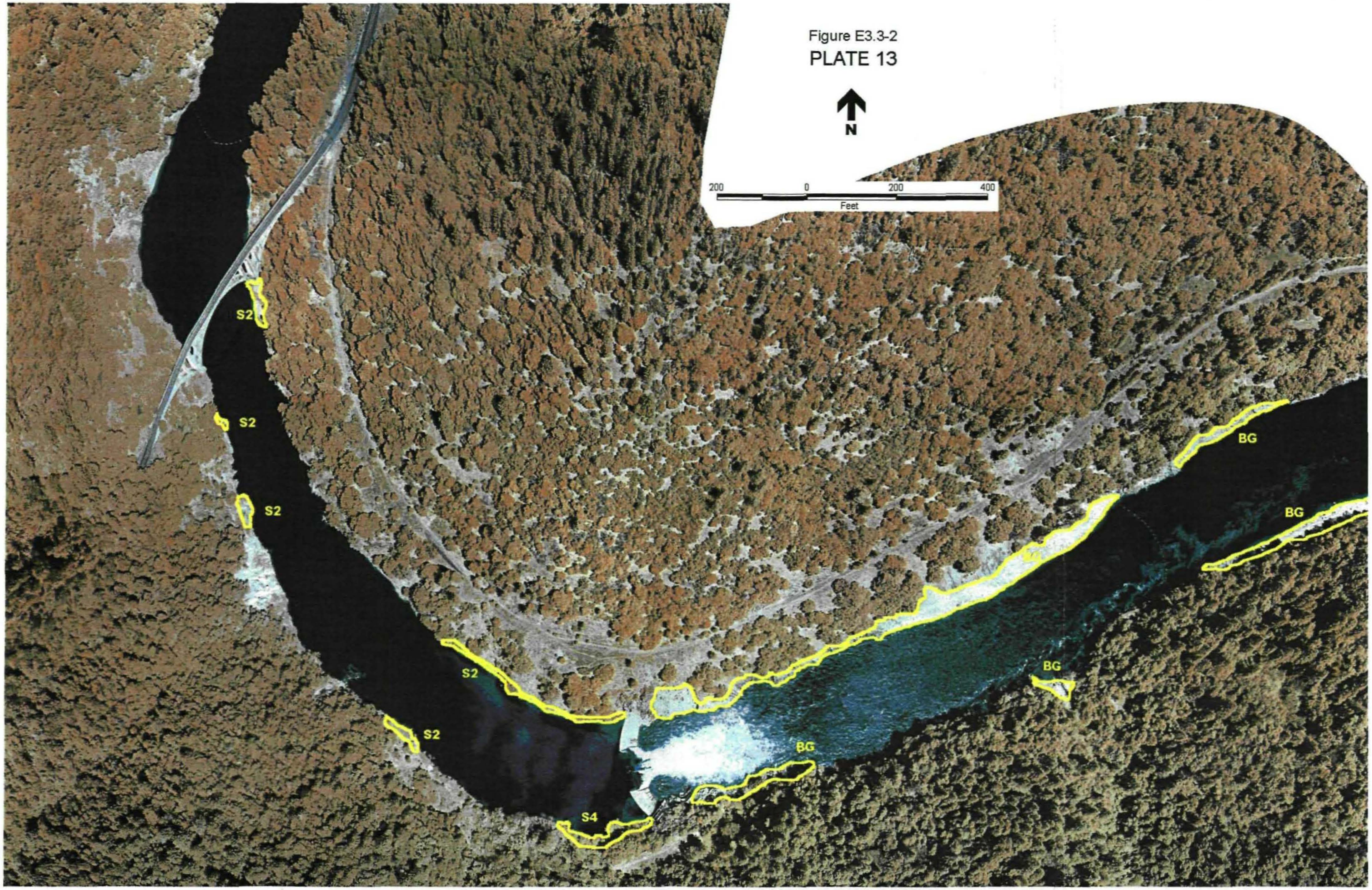


Figure E3.3-2
PLATE 13
N
200 0 200 400
Feet
S2
S2
S2
S2
S2
S4
BG
BG
BG
BG

**Historical Changes.** To assess historical changes to riparian vegetation on the Poe Project, current digital orthophotos were compared with historical aerial photographs taken in 1948, prior to construction of the Poe Project. This qualitative assessment resulted in the following general observations:

1) Increases in riparian extent were observed in areas that had been inundated prior to Project construction. These included bars exposed during reduced flows. It is estimated that more than 90% of the area currently populated by the torrent sedge series was inundated in 1948. Additional increases in riparian extent are attributed to lateral channel migration. The creation of a stable reservoir fringe has also permitted the establishment of a permanent band of riparian vegetation in areas once populated by upland vegetation.
2) Decreases in riparian extent were largely the result of the dewatering of overflow channels, oxbows, and gravel and cobble bars. Arroyo willow and narrowleaf willow series were most affected by these changes.
3) Relative stasis in riparian extent was observed along the outer margins of the riparian corridor where the effects of flooding are less severe. Foothill sycamore-arroyo willow and mature white alder were the dominant vegetation series in these areas.

**Flow Correlations.** In addition to the reference digital aerial orthophotography acquired during low flow conditions (approximately 115 cfs) on May 22, 2000, a second set of digital aerial orthophotography was acquired during high flow conditions (approximately 1,400 cfs) on May 21, 2000. Comparisons were made between the amounts of riparian vegetation present at low flow conditions verses that which would be lost due to inundation at high flow conditions. Table E3.3-2 lists the aerial extent (in square meters) of each riparian vegetation series that was inundated under high flow conditions. Approximately 14% of riparian vegetation currently present during low flow conditions would be inundated during high flow conditions. The amount of habitat conversion from upland to riparian that would occur due to a sustained high flow regime is unknown.

**Table E3.3-2**

**Net Loss of Riparian Vegetation at High Flow (~1400 cfs) vs. Low Flow (~115 cfs)**

| **Riparian Vegetation Series** | **Loss ($m^2$)** |
|---|---|
| Torrent sedge series (wetland herb) | 6,417 |
| California brickellbush series (dry herb) | 4,586 |
| Arroyo willow series | 6,309 |
| Narrowleaf willow series | 5,367 |
| Himalayan blackberry series | 219 |
| Foothill sycamore-arroyo willow series | 19,279 |
| White alder series, immature stands | 55 |
| White alder series, mature stands | 0 |
| Oregon ash series | 1,464 |
| Non-native grassland series | 92 |
| Ruderal | 0 |
| Bare ground | 44,368 |
| **Total** | 88,156 |

### E3.3.1.3 Special Status Plant Species

A literature review was conducted to determine what special status plant species potentially could occur within the Project area. Species lists reviewed included those published by the USFWS (2000), CDFG (2000), USFS (1998), and California Native Plant Society (1994, 2003). For the purposes of this review, special status plant species were defined as those plant species listed, proposed, or under review as rare, threatened, or endangered by the federal government or the State of California, those listed by the California Native Plant Society, and those listed as sensitive or of special interest by the USFS. A review of California Natural Diversity Data Base records revealed known occurrences of special status plant species within FERC Project boundaries near Poe Powerhouse and Bardees Bar.

Based on the literature review, a list of special status plant species that potentially could occur within the Project area was prepared (Table E3.3-3.) Following completion of the target species list, herbaria investigations were conducted to gather additional information on each target species. Where possible, known locations of target species near the Project area were visited. Field surveys were conducted to verify the possible presence of the 80 target species. The survey area included: 1) all areas within FERC Project boundaries, 2) access roads to Project facilities, and 3) water fluctuation zones within river reaches below project facilities. Survey protocol followed Nelson (1994). The entire survey area, including a 50-foot buffer zone, was surveyed May-June 1999 and March-August 2000.

## Table E3.3-3
## Special Status Plant Species Potentially Occurring in the Project Area

| Scientific Name | Common Name | Status[1] | Flowering Period |
|---|---|---|---|
| *Achnatherum stillmanii* | Stillman's needle grass | FSI | June-July |
| *Agrostis hendersonii* | Henderson's bent grass | FSI, 3 | April-May |
| *Allium jepsonii* | Jepson's onion | FS, 1B | June-July |
| *Allium sanbornii* var. *sanbornii* | Sanborn's onion | FSI, 4 | May-September |
| *Arabis constancei* | Contance's rock cress | FS, 1B | May-July |
| *Arenaria "grandiflora"* sp. *nov*. Clifton | Large-flowered sandwort | None | May-July |
| *Astragalus lentiformis* | Lens-pod milk-vetch | FS, 1B | May-June |
| *Astragalus pulsiferae* var. *pulsiferae* | Pulsifer's milk-vetch | FS, 1B | May-August |
| *Astragalus pulsiferae* var. *suksdorfii* | Suksdorf's milkvetch | FS, 1B | May-August |
| *Astragalus webberi* | Webber's milk-vetch | FS, 1B | May-July |
| *Balsamorhiza macrolepis* var. *macrolepis* | Big-scale balsamroot | FSI, 1B | April-June |
| *Botrychium ascendens* | Upswept moonwort | FS, 2 | July-August |
| *Botrychium crenulatum* | Scalloped moonwort | FS, 2 | June-July |
| *Botrychium lunaria* | Moonwort | FS, 1B | August |
| *Botrychium montanum* | Western goblin | FS, 2 | July-August |
| *Calycadenia oppositifolia* | Butte County calycadenia | FS, 1B | June-July |
| *Calystegia atriplicifolia* ssp. *buttensis* | Butte County morning-glory | FS, 1B | May-July |
| *Cardamine pachystigma* var. *dissectifolia* | Dissected-leaf toothwort | FSI, 3 | April-May |
| *Carex geyeri* | Geyer's sedge | FSI, 4 | May-July |
| *Carex gigas* | Siskiyou sedge | FSI, 4 | May-July |
| *Carex lasiocarpa* | Slender sedge | FSI, 2 | June-July |
| *Carex limosa* | Shore sedge | FSI, 2 | June-August |
| *Chamaesyce hooveri* | Hoover's spurge | FT, SE, FS, 1B | July |
| *Clarkia biloba* ssp. *brandegeae* | Brandegee's clarkia | FS, 1B | May-June |
| *Clarkia gracilis* ssp. *albicaulis* | White-stemmed clarkia | FS, 1B | June-July |
| *Clarkia mildrediae* var. *mildrediae* | Mildred's clarkia | FSI, 4 | June-July |
| *Clarkia mosquinii* var. *mosquinii* | Mosquin's clarkia | FS, 1B | June-July |
| *Clarkia mosquinii* var. *xerophila* | Enterprise clarkia | 1B | May-July |
| *Clarkia stellata* | Starry clarkia | FS | June-July |

**Table E3.3-3 (continued)**
**Special Status Plant Species Potentially Occurring in the Project Area**

| Scientific Name | Common Name | Status[1] | Flowering Period |
|---|---|---|---|
| *Corallorhiza trifida* | Northern coralroot | FSI, 2 | June-July |
| *Cupressus macnabiana* | MacNab cypress | FSI | N/A |
| *Cypripedium californicum* | California lady's-slipper | FSI, 4 | April-June |
| *Cypripedium fasciculatum* | Clustered lady's-slipper | FS, 4 | May-June |
| *Darlingtonia californica* | California pitcherplant | FSI, 4 | April-June |
| *Drosera anglica* | English sundew | FSI, 2 | July-August |
| *Drosera rotundifolia* | Round-leaved sundew | FSI | July-August |
| *Epilobium luteum* | Yellow willowherb | FSI, 2 | July-September |
| *Erigeron lassenianus* var. *deficiens* | Plumas rayless daisy | FSI | July-August |
| *Erigeron petrophilus* var. *sierrensis* | Northern Sierra daisy | FSI, 4 | July-August |
| *Fritillaria eastwoodiae* | Butte County fritillary | FS, 3 | March-April |
| *Fritillaria pluriflora* | Adobe lily | 1B | March-April |
| *Hackelia amethystina* | Amethyst stickweed | FSI, 4 | June-July |
| *Juncus leiospermus* var. *ahartii* | Ahart's rush | FS, 1B | March-May |
| *Lewisia cantelovii* | Cantelow's lewisia | FS, 1B | June-July |
| *Lewisia kelloggii* ssp. *hutchisonii* | Hutchison's lewisia | FSI, 3 | June-July |
| *Lilium humboldtii* ssp. *humboldtii* | Humboldt's lily | FSI, 4 | April-May |
| *Limnanthes floccosa* ssp. *californica* | Butte County meadowfoam | FE, SE, FS, 1B | March-May |
| *Lomatium roseanum* | Adobe lomatium | FSI | April-June |
| *Lupinus dalesiae* | Quincy lupine | FS, 1B | June-July |
| *Lycopus uniflorus* | Northern bugleweed | FSI, 4 | July-September |
| *Meesia bolanderi* | Moss | FW | Spring |
| *Meesia triquetra* | Moss | FW | Spring |
| *Meesia uliginosa* | Moss | FW | Spring |
| *Mimulus glaucescens* | Shield-bracted monkeyflower | FSI, 4 | April-July |
| *Mimulus laciniatus* | Cut-leaved monkeyflower | 4 | April-July |
| *Mimulus pygmaeus* | Egg Lake monkeyflower | FSI, 1B | May-June |
| *Monardella douglasii* ssp. *venosa* | Veiny monardella | 1B | May |
| *Monardella follettii* | Follett's monardella | FS, 1B | June |
| *Monardella stebbinsii* | Stebbins' monardella | FS, 1B | July-September |

## Table E3.3-3 (continued)
## Special Status Plant Species Potentially Occurring in the Project Area

| Scientific Name | Common Name | Status[1] | Flowering Period |
|---|---|---|---|
| *Mysosurus minimus* ssp. *apus* | Little mousetail | 3 | March-June |
| *Orcuttia pilosa* | Hairy Orcutt grass | FE, SE, FS, 1B | May-August |
| *Oreostemma elatum* | Plumas alpine-aster | FS, 1B | July-August |
| *Orthotrichum spjutti* | Lichen | FW | N/A |
| *Paronchia ahartii* | Ahart's whitlow-wort | 1B | March-June |
| *Penstemon personatus* | Closed-throated beardstongue | FS, 1B | June |
| *Perideridia bacigalupii* | Bacigalupi's yampah | FSI, 4 | June-August |
| *Rhyncospora alba* | White beaked-rush | FSI, 2 | July-August |
| *Rhynchospora capitellata* | Brownish beaked-rush | FSI, 2 | July-August |
| *Rupertia hallii* | Hall's rupertia | FS, 1B | July-August |
| *Rhynchospora californica* | California beaked-rush | 1B | May-July |
| *Sagittaria sanfordii* | Valley sagittaria | 1B | May-June |
| *Sanicula tracyi* | Tracy's sanicle | FS, 1B | May-July |
| *Scheuchzeria palustris* var. *americana* | American scheuchzeria | FS, 2 | July-August |
| *Sedum albomarginatum* | Feather River stonecrop | FS, 1B | July-September |
| *Senecio eurycephalus* var. *lewisrosei* | Cut-leaved ragwort | FS, 1B | May-August |
| *Sidalcea robusta* | Butte County sidalcea | 1B | April-June |
| *Silene occidentalis* ssp. *longistipitata* | Western campion | FS, 1B | July-August |
| *Stellaria obtusa* | Obtuse starwort | FSI, 4 | July |
| *Tuctoria greenei* | Greene's tuctoria | FE, ST, FS, 1B | May-July |
| *Vaccinium coccineum* | Suskiyou Mountains huckleberry | FS, 3 | June-August |

**Status[1]**

**U.S. Fish and Wildlife Service**
- FE Federally listed, endangered
- FT Federally listed, threatened

**U.S. Forest Service**
- FS Sensitive Species
- FSI Species of Special Interest
- FW Watch list

**California Department of Fish and Game**
- CE State listed, endangered
- CR State listed, rare

**California Native Plant Society**
- 1B Rare or endangered in California and elsewhere
- 2 Rare or endangered in California, more common elsewhere
- 3 Plants for which more information is needed
- 4 Plants of limited distribution

Forty-eight occurrences of twelve special status plant species were observed within the survey area. No state or federally listed threatened, endangered or candidate species were observed. Special status plant species observed within the survey area include:

**Jepson's onion** (*Allium jepsonii*). Jepson's onion is known only from Butte and Tuolumne counties at elevations ranging from 1,000 to 3,600 feet. Three populations of this species were observed on Bardees Bar Road just above the NFFR. These populations are threatened by invasive exotic species and road maintenance activities. An additional population was observed adjacent to the NFFR just south of the old Bardees Bar bridge.

**Butte County calycadenia** (*Calycadenia oppositifolia*). Butte County calycadenia is known only from Butte County at elevations ranging from 650 to 3,000 feet. Two populations of this species were observed in sunny, grassy openings and flats on serpentine soils near the Poe Powerhouse. Both populations had low cover and were threatened by yellow star thistle.

**Dissected-leaf toothwort** (*Cardamine pachystigma* var. *dissectifolia*). Dissected-leaf toothwort is known from Butte, Mendocino, Placer and Sonoma counties where it occurs at elevations ranging from 800 to 6,700 feet. One population consisting of only one individual was observed in a shaded serpentine drainage adjacent to Bardees Bar Road. Threats to this population include road maintenance activities.

**White-stemmed clarkia** (*Clarkia gracilis* ssp. *albicaulis*). White-stemmed clarkia is known only from Butte County, occurring at elevations ranging from 750 to 3,500 feet. Five populations of this species were observed along the edge of the Poe Powerhouse Road. One additional population was observed on the east side of Pulga Bridge. Threats to these populations include road maintenance activities and yellow star thistle.

**Mildred's clarkia** (*Clarkia mildredae* ssp. *mildredae*). Mildred's clarkia is known from Butte and Plumas counties at elevations ranging from 900 to 5,500 feet. Two populations of this species were observed just below the railroad tracks above Poe Reservoir. Also observed was one small population of the closely related golden-anthered clarkia (*C. mildredae* ssp. *lutescens*) near the Poe Powerhouse.

**Mosquin's clarkia** (*Clarkia mosquinii* ssp. *mosquinii*). Mosquin's clarkia is endemic to the Feather River drainage, occurring at elevations ranging from 975 to 3,750 feet. Three small populations of this species were observed along the Poe Powerhouse access road. Threats to these populations include road maintenance activities.

**Northern Sierra daisy** (*Erigeron petrophilus* var. *sierrensis*). Northern Sierra daisy is known from Butte, El Dorado, Nevada, Plumas, Sierra and Yuba counties at elevations of 1,700 to 4,700 feet. Four populations, ranging from 12 to 40 feet above the high water mark, were observed at the Poe Powerhouse, Bardees Bar, and east of the Pulga Bridge.

**Cantelow's lewisia** (*Lewisia cantelovii*). Cantelow's lewisia is known from Butte, Nevada, Plumas, Shasta and Sierra counties at elevations of 1,200 to 4,400 feet. Two populations were observed adjacent to Poe Reservoir. A third population was recorded east of the Pulga Bridge. Threats to this species include horticultural collecting and road and trail maintenance.

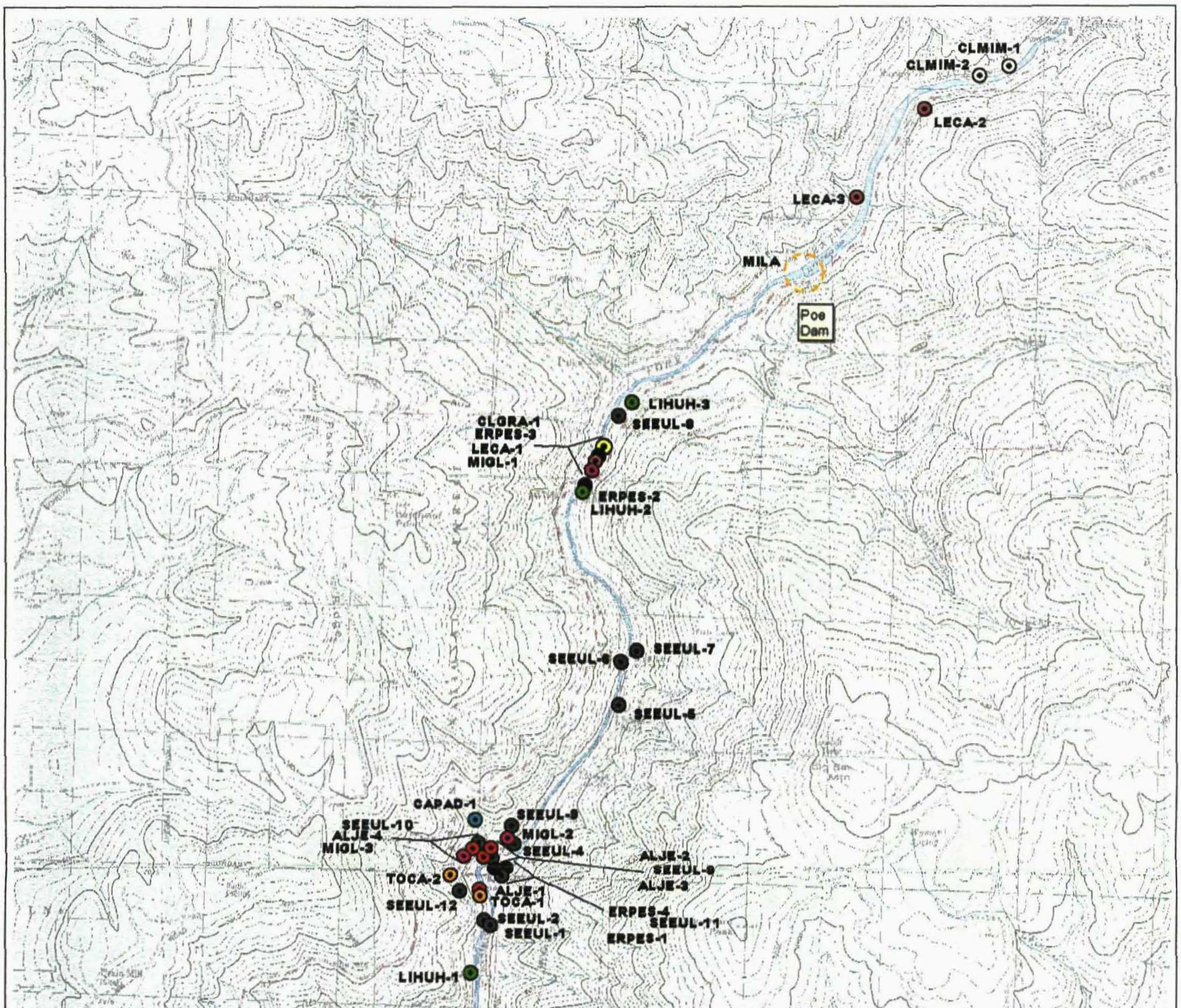
**Humboldt lily** (*Lilium humboldtii* ssp. *humboldtii*). Humboldt lily is relatively widespread occurring from Tehama to Tuolumne counties in the Sierra Nevada at elevations of 290 to 3,500 feet. Populations of this species were observed near Pulga Bridge and below Bardees Bar. Within the project Area, this species is threatened by Himalayan blackberry.

**Shield-bracted monkeyflower** (*Mimulus glaucescens*). Shield-bracted monkeyflower is known from Butte, Colusa, Lake, Nevada, Shasta and Tehama counties at elevations of 190 to 3,900 feet. Populations of this species were observed at Bardees Bar, Pulga Bridge and Poe Powerhouse.

**Cut-leaved ragwort** (*Senecio eurycephalus* var. *lewisrosei*). Cut-leaved ragwort is known from Butte and Plumas counties at elevations of 950 to 4,700 feet. Twelve populations of this species were observed within the Project Area, extending from Bardees Bar up river to Pulga Bridge. Several of these populations are threatened by road maintenance.

**California nutmeg** (*Torreya californica*). California nutmeg is widespread throughout California, but uncommon in the Project Area. Two populations of this species totaling three individuals were observed in the Bardees Bar area.

The locations of each of the 48 occurrences are shown in Figure E3.3-3. The coordinates and population size of each occurrence are provided in Table E3.3-4.




0 0.5 1
Miles

Basemap: USGS 7.5" Quadrangles
Pulga, Berry Creek, CA

POE PROJECT
FERC No. 2107

**Figure E3.3-3**
**Special Status Plant Locations**

N

Project Location

## Table E3.3-4
## Occurrences of Special Status Plant Species in the Project Area

| Code | Species | Number | Latitude | Longitude |
|---|---|---|---|---|
| ALJE-1 | *Allium jepsonii* | 150 | 39.76751 | -121.45851 |
| ALJE-2 | *Allium jepsonii* | 50 | 39.77040 | -121.45756 |
| ALJE-3 | *Allium jepsonii* | 50 | 39.76980 | -121.45823 |
| ALJE-4 | *Allium jepsonii* | 100 | 39.77033 | -121.45907 |
| CAOP-1 | *Calycadenia oppositifolia* | 50 | 39.73046 | -121.46666 |
| CAOP-2 | *Calycadenia oppositifolia* | 200 | 39.72874 | -121.46900 |
| CAPAD-1 | *Cardamine pachystigma* var. *dissectifolia* | 1 | 39.77233 | -121.45892 |
| CLGRA-1 | *Clarkia gracilis* ssp. *albicaulis* | 100 | 39.79769 | -121.44837 |
| CLGRA-2 | *Clarkia gracilis* ssp. *albicaulis* | 200 | 39.72840 | -121.46724 |
| CLGRA-3 | *Clarkia gracilis* ssp. *albicaulis* | 6 | 39.73393 | -121.47142 |
| CLGRA-4 | *Clarkia gracilis* ssp. *albicaulis* | 10 | 39.73242 | -121.47129 |
| CLGRA-5 | *Clarkia gracilis* ssp. *albicaulis* | 100 | 39.73084 | -121.46706 |
| CLGRA-6 | *Clarkia gracilis* ssp. *albicaulis* | 50 | 39.72912 | -121.46769 |
| CLMIL-1 | *Clarkia mildrediae* ssp. *lutescens* | 1 | 39.72482 | -121.46838 |
| CLMIM-1 | *Clarkia mildrediae* ssp. *mildrediae* | 10 | 39.82365 | -121.41384 |
| CLMIM-2 | *Clarkia mildrediae* ssp. *mildrediae* | 10 | 39.82297 | -121.41630 |
| CLMO-1 | *Clarkia mosquinii* | 50 | 39.73351 | -121.47728 |
| CLMO-2 | *Clarkia mosquinii* | 16 | 39.73222 | -121.47442 |
| CLMO-3 | *Clarkia mosquinii* | 3 | 39.72861 | -121.47581 |
| ERPES-1 | *Erigeron petrophilus* var. *sierrensis* | 50 | 39.76907 | -121.45628 |
| ERPES-2 | *Erigeron petrophilus* var. *sierrensis* | 10 | 39.79505 | -121.44999 |
| ERPES-3 | *Erigeron petrophilus* var. *sierrensis* | 100 | 39.79708 | -121.44877 |
| ERPES-4 | *Erigeron petrophilus* var. *sierrensis* | 50 | 39.76900 | -121.45726 |
| ERPES-5 | *Erigeron petrophilus* var. *sierrensis* | 20 | 39.72825 | -121.46765 |
| LECA-1 | *Lewisia cantelovii* | 500 | 39.79667 | -121.44904 |
| LECA-2 | *Lewisia cantelovii* | 100 | 39.82072 | -121.42106 |
| LECA-3 | *Lewisia cantelovii* | 20 | 39.81467 | -121.42685 |
| LIHUH-1 | *Lilium humboldtii* ssp. *humboldtii* | 10 | 39.76187 | -121.45913 |
| LIHUH-2 | *Lilium humboldtii* ssp. *humboldtii* | 10 | 39.79457 | -121.45013 |
| LIHUH-3 | *Lilium humboldtii* ssp. *humboldtii* | 10 | 39.80068 | -121.44600 |
| MIGL-1 | *Mimulus glaucescens* | 200 | 39.79603 | -121.44938 |
| MIGL-2 | *Mimulus glaucescens* | 100 | 39.77115 | -121.45612 |
| MIGL-3 | *Mimulus glaucescens* | 100 | 39.76983 | -121.45988 |
| MIGL-4 | *Mimulus glaucescens* | 20 | 39.72870 | -121.46773 |
| SEEUL-1 | *Senecio eurycephalus* var. *lewisrosei* | 3 | 39.76515 | -121.45752 |
| SEEUL-2 | *Senecio eurycephalus* var. *lewisrosei* | 5 | 39.76548 | -121.45803 |
| SEEUL-3 | *Senecio eurycephalus* var. *lewisrosei* | 10 | 39.76981 | -121.45746 |
| SEEUL-4 | *Senecio eurycephalus* var. *lewisrosei* | 25 | 39.77076 | -121.45552 |
| SEEUL-5 | *Senecio eurycephalus* var. *lewisrosei* | 3 | 39.78028 | -121.44673 |
| SEEUL-6 | *Senecio eurycephalus* var. *lewisrosei* | 15 | 39.78320 | -121.44660 |
| SEEUL-7 | *Senecio eurycephalus* var. *lewisrosei* | 5 | 39.78396 | -121.44523 |
| SEEUL-8 | *Senecio eurycephalus* var. *lewisrosei* | 25 | 39.79975 | -121.44709 |
| SEEUL-9 | *Senecio eurycephalus* var. *lewisrosei* | 50 | 39.77197 | -121.45575 |
| SEEUL-10 | *Senecio eurycephalus* var. *lewisrosei* | 50 | 39.77077 | -121.45865 |
| SEEUL-11 | *Senecio eurycephalus* var. *lewisrosei* | 10 | 39.76851 | -121.45659 |
| SEEUL-12 | *Senecio eurycephalus* var. *lewisrosei* | 3 | 39.76738 | -121.46022 |
| TOCA-1 | *Torreya californica* | 2 | 39.76710 | -121.45844 |
| TOCA-2 | *Torreya californica* | 1 | 39.76849 | -121.46102 |

### E3.3.1.4 Noxious Weeds

A literature review was conducted to determine what noxious weed species potentially could occur within the Project area. Sources reviewed included those published by the California Department of Food and Agriculture (2000), California Exotic Pest Council (2000), and USFS (1998). Surveys were conducted concurrently with those for special status plant species.

Thirty-six occurrences of five noxious weed species were documented within the Project Area. No California Department of Food and Agriculture (CDFA) A-rated pest plants were observed. Noxious weed species observed within the survey area include:

**Barbed goatgrass** (*Aegilops triuncialis*). Barbed goatgrass is listed by CDFA as a B-rated species. One large population of this species was observed at the base of Bardees Bar Road.

**Yellow star thistle** (*Centaurea solstitialis*). Yellow star thistle is listed by CDFA as a C-rated species. Fourteen medium to large populations of this species were observed along the NFFR corridor, with the largest number of occurrences recorded in the Poe Powerhouse vicinity.

**Klamathweed** (*Hypericum perforatum*). Klamathweed is listed by CDFA as a C-rated species. Twelve medium size populations of this species were observed within the Project Area between Pulga Bridge and Poe Powerhouse.

**Himalayan blackberry** (*Rubus discolor*). Himalayan blackberry is not currently listed by CDFA. This species forms a nearly continuous band along the west shore of Poe Reservoir. Two additional populations were observed just upstream of Pulga Bridge.

**Bouncing bet** (*Saponaria officinalis*). Bouncing bet is listed by CDFA as a C-rated species. This species forms a nearly continuous band of plants along both sides of NFFR from Pulga Bridge to Poe Powerhouse. The source of this infestation is likely the large, vigorous colonies of bouncing bet growing on sandy spoil piles just north of the town of Belden.

The locations of each of the 36 occurrences are shown in Figure E3.3-4. The coordinates and population size of each occurrence are provided in Table E3.3-5. Table 3.3-6 contains a list of all plant species observed during all Poe Project botanical surveys.

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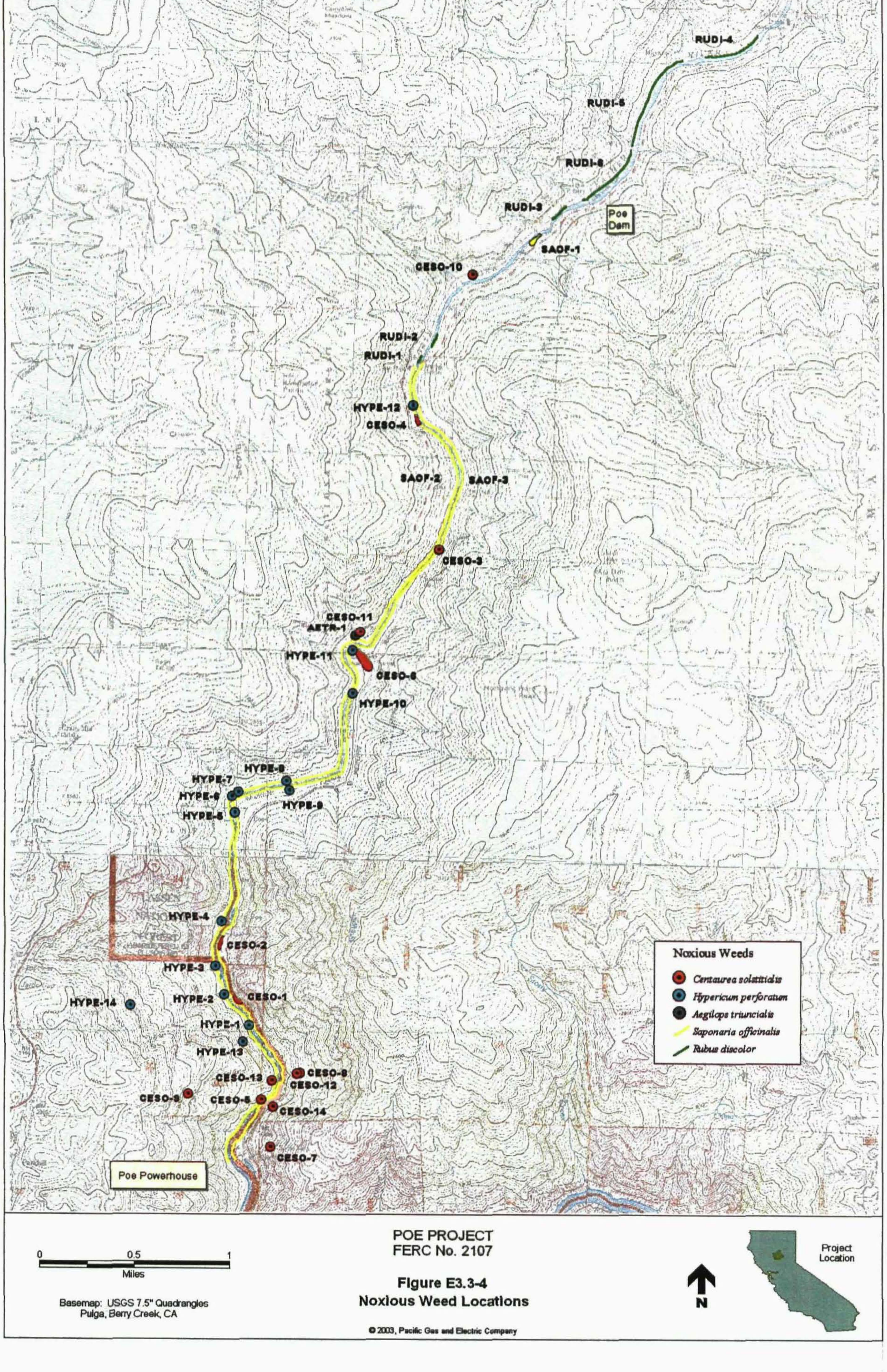
RUDI-4
RUDI-5
RUDI-6
RUDI-3
Poe Dam
SAOF-1
CESO-10
RUDI-2
RUDI-1
HYPE-12
CESO-4
SAOF-2
SAOF-3
CESO-3
CESO-11
AETR-1
HYPE-11
CESO-6
HYPE-10
HYPE-8
HYPE-7
HYPE-6
HYPE-9
HYPE-5
HYPE-4
CESO-2
HYPE-3
HYPE-14
HYPE-2
CESO-1
HYPE-1
HYPE-13
CESO-13
CESO-8
CESO-12
CESO-9
CESO-5
CESO-14
CESO-7
Poe Powerhouse
Noxious Weeds
Centaurea solstitialis
Hypericum perforatum
Aegilops triuncialis
Saponaria officinalis
Rubus discolor
0 0.5 1
Miles
Basemap: USGS 7.5" Quadrangles
Pulga, Berry Creek, CA
POE PROJECT
FERC No. 2107
Figure E3.3-4
Noxious Weed Locations
© 2003, Pacific Gas and Electric Company
N
Project Location

## Table E3.3-5
## Occurrences of Noxious Weeds in the Project Area

| Code | Species | Number | Latitude | Longitude |
|---|---|---|---|---|
| AETR-1 | *Aegilops triuncialis* | >500 | 39.77017 | -121.45748 |
| CESO-1 | *Centaurea solstitialis* | 200-500 | 39.73734 | -121.47027 |
| CESO-2 | *Centaurea solstitialis* | 200-500 | 39.74242 | -121.47238 |
| CESO-3 | *Centaurea solstitialis* | 50-100 | 39.77811 | -121.44806 |
| CESO-4 | *Centaurea solstitialis* | 200-500 | 39.78977 | -121.45072 |
| CESO-5 | *Centaurea solstitialis* | >500 | 39.72823 | -121.46741 |
| CESO-6 | *Centaurea solstitialis* | 100-200 | 39.76803 | -121.45652 |
| CESO-7 | *Centaurea solstitialis* | 10-50 | 39.72400 | -121.46622 |
| CESO-8 | *Centaurea solstitialis* | 10-50 | 39.73068 | -121.46303 |
| CESO-9 | *Centaurea solstitialis* | 50-100 | 39.72864 | -121.47585 |
| CESO-10 | *Centaurea solstitialis* | 50-100 | 39.80285 | -121.44461 |
| CESO-11 | *Centaurea solstitialis* | 100-200 | 39.77052 | -121.45694 |
| CESO-12 | *Centaurea solstitialis* | 100-200 | 39.73063 | -121.46338 |
| CESO-13 | *Centaurea solstitialis* | 50-100 | 39.72997 | -121.46622 |
| CESO-14 | *Centaurea solstitialis* | 50-100 | 39.72759 | -121.46602 |
| HYPE-1 | *Hypericum perforatum* | 10-50 | 39.74428 | -121.47235 |
| HYPE-2 | *Hypericum perforatum* | 10-50 | 39.73775 | -121.47186 |
| HYPE-3 | *Hypericum perforatum* | 10-50 | 39.74028 | -121.47289 |
| HYPE-4 | *Hypericum perforatum* | 50-100 | 39.74428 | -121.47235 |
| HYPE-5 | *Hypericum perforatum* | 10-50 | 39.75407 | -121.47099 |
| HYPE-6 | *Hypericum perforatum* | 50-100 | 39.75555 | -121.47136 |
| HYPE-7 | *Hypericum perforatum* | 50-100 | 39.75593 | -121.47061 |
| HYPE-8 | *Hypericum perforatum* | 50-100 | 39.75701 | -121.46510 |
| HYPE-9 | *Hypericum perforatum* | 10-50 | 39.75613 | -121.46477 |
| HYPE-10 | *Hypericum perforatum* | 10-50 | 39.76497 | -121.45773 |
| HYPE-11 | *Hypericum perforatum* | 50-100 | 39.76881 | -121.45781 |
| HYPE-12 | *Hypericum perforatum* | 10-50 | 39.79102 | -121.45127 |
| RUDI-1 | *Rubus discolor* | Continuous | 39.79561 | -121.45150 |
| RUDI-2 | *Rubus discolor* | Continuous | 39.79732 | -121.45029 |
| RUDI-3 | *Rubus discolor* | Continuous | 39.80852 | -121.43624 |
| RUDI-4 | *Rubus discolor* | Continuous | 39.82342 | -121.41579 |
| RUDI-5 | *Rubus discolor* | Continuous | 39.81912 | -121.42618 |
| RUDI-6 | *Rubus discolor* | Continuous | 39.81150 | -121.43029 |
| SAOF-1 | *Saponaria officinalis* | Continuous | 39.80578 | -121.43871 |
| SAOF-2 | *Saponaria officinalis* | Continuous | 39.76106 | -121.46061 |
| SAOF-3 | *Saponaria officinalis* | Continuous | 39.76091 | -121.45916 |

**Table E3.3-6**
**Plant Species Observed Within the Project Area**

| SCIENTIFIC NAME | COMMON NAME |
|---|---|
| **FERNS AND FERN ALLIES** | |
| **Blechnaceae** | **Deer Fern Family** |
| *Woodwardia fimbricata* | Giant Chain Fern |
| **Dennstaedtiaceae** | **Bracken Family** |
| *Pteridium aquilinum* var. *pubescens* | Bracken Fern |
| **Dryopteridaceae** | **Wood Fern Family** |
| *Dryopteris arguta* | Wood Fern |
| *Polystichum imbricans* ssp. *imbricans* | Narrow Leaf Sword Fern |
| **Equisetaceae** | **Horsetail Family** |
| *Equisetum arvense* | Common Horsetail |
| *Equisetum hyemale* ssp. *affine* | Western Scouring Rush |
| **Polypodiaceae** | **Polypody Family** |
| *Polypodium calirhiza* | Intermediate Polypody |
| **Pteridaceae** | **Brake Family** |
| *Aspidotis densa* | Indian's Dream |
| *Pellaea andromedifolia* | Coffee Fern |
| *Pellaea mucronata* var. *mucronata* | Bird's Foot Fern |
| *Pentagramma pallida* | Pallis Fern |
| *Pentagramma triangularis* ssp. *semipallida* | Silverback Fern |
| *Pentagramma triangularis* ssp. *triangiularis* | Goldenback Fern |
| **Selaginellaceae** | **Spike Moss Family** |
| *Selaginella hansenii* | Hansen's Spike Moss |
| **GYMNOSPERMS** | |
| **Cupressaceae** | **Cypress Family** |
| *Calocedrus decurrens* | Incense Cedar |
| **Pinaceae** | **Pine Family** |
| *Abies concolor* | White Fir |
| *Pinus lambertiana* | Sugar Pine |
| *Pinus ponderosa* | Ponderosa Pine |
| *Pinus sabiniana* | Foothill Pine |
| *Pseudotsuga menziesii* var. *menziesii* | Douglas Fir |

| SCIENTIFIC NAME | COMMON NAME |
|---|---|
| **Taxaceae** | **Yew Family** |
| *Torreya californica* | California Nutmeg |

## ANGIOSPERMS - DICOTS

| SCIENTIFIC NAME | COMMON NAME |
|---|---|
| **Aceraceae** | **Maple Family** |
| *Acer macrophyllum* | Big Leaf Maple |
| **Amaranthaceae** | **Amaranth Family** |
| *Amaranthus albus* | Tumbleweed |
| *Amaranthus powellii* | Green Amaranth |
| **Anacardiaceae** | **Sumac Family** |
| *Toxicodendron diversilobum* | Poison Oak |
| **Apiaceae** | **Carrot Family** |
| *Cicuta douglasii* | Water Hemlock |
| *Daucus pusillus* | American Wild Carrot |
| *Lomatium marginatum* var. *marginatum* | Hertweg's Lomatium |
| *Lomatium urticulatum* | Bladder Lomatium |
| *Osmorhiza chilensis* | Mountain Sweetroot |
| *Osmorhiza occidentalis* | Western Sweetroot |
| *Perideridia* sp. | Yampah |
| *Sanicula bipinnata* | Poison Sanicle |
| *Sanicula bipinnatifida* | Purple Sanicle |
| *Sanicula crassicaulis* | Foothill Sanicle |
| *Tauschia hartwegii* | Hartweg's Tauschia |
| *Torilis arvensis* | Hedge Parsley |
| **Apocynaceae** | **Dogbane Family** |
| *Apocynum androsaemifolium* | Bitter Dogbane |
| *Apocynum cannibinum* | Indian Hemp |
| *Vinca major* | Periwinkle |
| **Araliaceae** | **Ginseng Family** |
| *Aralia californica* | Elk Clover |
| **Aristolochiaceae** | **Pipevine Family** |
| *Aristolochia californica* | California pipevine |
| *Asarum hartwegii* | Hartweg's Wild Ginger |
| **Asclepiadaceae** | **Milkweed Family** |
| *Asclepias cordifolia* | Purple Milkweed |

| SCIENTIFIC NAME | COMMON NAME |
|---|---|
| **Asteraceae** | **Sunflower Family** |
| *Achillea millefolium* | Yarrow |
| *Adenocaulon bicolor* | American Trail Plant |
| *Agoseris grandiflora* | Large Flowered Agoseris |
| *Artemisia douglasiana* | Mugwort |
| *Artemisia dracunculus* | Tarragon |
| *Baccharis pilularis* | Coyote Brush |
| *Brickellia californica* | California Brickellia |
| *Calycadenia oppositifolia* | Butte County calycadenia |
| *Calycadenia truncata* | Rosin Weed |
| *Carduus pycnocephalus* | Italian Thistle |
| *Centaurea solstitialis* | Yellow Star Thistle |
| *Cichorium intybus* | Chicory |
| *Cirsium occidentale* var. *candidissimum* | Snowy Thistle |
| *Cirsium vulgare* | Bull Thistle |
| *Erigeron petrophilus* var. *sierrensis* | Northern Sierra Daisy |
| *Eriophyllum lanatum* var. *grandiflorum* | Woolly Sunflower |
| *Filago californica* | California Herba Impia |
| *Gnaphalium canescens* | Cudweed |
| *Grindelia hirsutula* var. *davyi* | Foothill Gum Plant |
| *Helianthella californica* var. *nevadensis* | California Helianthella |
| *Hieracium albiflorum* | Shaggy Hawkweed |
| *Hypochaeris glabra* | Smooth Cat's Ear |
| *Hypochaeris radiata* | Spotted Cat's Ear |
| *Lagophylla glandulosa* | Glandular Hareleaf |
| *Lessingia nemaclada* | Slender Stemmed Lessingia |
| *Madia elegans* ssp. *vernalis* | Common Madia |
| *Malacothrix floccifera* | Woolly Malacothrix |
| *Senecio eurycephalus* var. *lewisrosei* | Cut Leaved Ragwort |
| *Senecio integerrimus* var. *major* | Mountain Butterweed |
| *Solidago californica* | California Goldenrod |
| *Sonchus oleraceus* | Common Sow Thistle |
| *Xanthium strumarium* | Cocklebur |
| **Berberidaceae** | **Barberry Family** |
| *Berberis aquifolium* var. *dictyota* | Jepson's Barberry |
| **Betulaceae** | **Birch Family** |
| *Alnus rhombifolia* | White Alder |
| *Corylus cornuta* ssp. *californica* | California Hazelnut |
| **Boraginaceae** | **Borage Family** |
| *Cryptantha flaccida* | Weak Stemmed Cryptantha |
| *Cynoglossum grande* | Grand Hound's Tongue |

| SCIENTIFIC NAME | COMMON NAME |
|---|---|
| **Brassicaceae** | **Mustard Family** |
| *Barbarea orthocerus* | American Winter Cress |
| *Brassica nigra* | Black Mustard |
| *Cardamine oligosperma* | Western Bitter Cress |
| *Cardamine* sp. | Toothwort |
| *Cardamine pachystigma* var. *dissectifolia* | Dissected Leaf Toothwort |
| *Cardamine pachystigma* var. *pachystigma* | Rock Toothwort |
| *Carderia pubescens* | Hairy White Top |
| *Draba verna* | Spring Draba |
| *Lepidium campestre* | Field Peppergrass |
| *Rorippa nasturtium-aquaticum* | Water Cress |
| *Sisymbrium altissimum* | Tumble Mustard |
| *Streptanthus polygaloides* | Milkwort Jewelflower |
| *Streptanthus tortuosus* var. *tortuosus* | Mountain Jewelflower |
| *Thysanocarpus curvipes* | Lacepod |
| **Calycanthaceae** | **Calycanthus Family** |
| *Calycanthus occidentalis* | Western Spicebush |
| **Caprifoliaceae** | **Honeysuckle Family** |
| *Lonicera hispidula* var. *vacillans* | Hairy Honeysuckle |
| *Lonicera interrupta* | Chaparral Honeysuckle |
| *Sambucus mexicana* | Blue Elderberry |
| **Caryophyllaceae** | **Pink Family** |
| *Cerastium arvense* | Field Chickweed |
| *Cerastium glomeratum* | Mouse Ear Chickweed |
| *Minuartia douglasii* | Sandwort |
| *Petrorhagia dubia* | Wild Carnation |
| *Saponaria officinalis* | Bouncing Bet |
| *Scleranthus annuus* ssp. *annuus* | Knawel |
| *Silene californica* | California Catchfly |
| **Convolvulaceae** | **Morning Glory Family** |
| *Calystegia malacophylla* ssp. *malacophylla* | Sierra Morning Glory |
| *Calystegia occidentalis* ssp. *occidentalis* | Western Morning Glory |
| **Cornaceae** | **Dogwood Family** |
| *Cornus sessilis* | Black Fruited Dogwood |
| **Crassulacerae** | **Stonecrop Family** |
| *Crassula connata* | Pygmyweed |
| *Dudleya cymosa* var. *cymosa* | Canyon Dudleya |
| *Sedum spathulifolium* | Yellow Stonecrop |

| SCIENTIFIC NAME | COMMON NAME |
|---|---|
| **Cucurbitaceae** | **Gourd Family** |
| *Marah watsonii* | Watson's Manroot |
| **Cuscutaceae** | **Dodder Family** |
| *Cuscuta subinclusa* | Canyon Dodder |
| **Datiscaceae** | **Datisca Family** |
| *Datisca glomerata* | Durango Root |
| **Ericaceae** | **Heath Family** |
| *Arbutus menziesii* | Madrone |
| *Arctostaphylos mewukka* ssp. *truei* | True's Manzanita |
| *Arctostaphylos patula* | Greenleaf Manzanita |
| *Arctostaphylos viscida* ssp. *viscida* | Whiteleaf Manzanita |
| *Rhododendron occidentale* | Western Azalea |
| **Fabaceae** | **Pea Family** |
| *Albizia julibrissin* | Silk Tree |
| *Cercis occidentalis* | Western Redbud |
| *Genista monspessulana* | French Broom |
| *Hoita macrostachya* | Leather Root |
| *Lathyrus latifolius* | Everlasting Pea |
| *Lathyrus nevadensis* var. *nevadensis* | Sierra Nevada Pea |
| *Lathyrus sulphureus* | Shrub Pea |
| *Lotus argophyllus* var. *fremontii* | Silver Leaf Lotus |
| *Lotus corniculatus* | Bird's Foot Trefoil |
| *Lotus humistratus* | Hill Lotus |
| *Lotus micranthus* | Miniature Lotus |
| *Lotus oblongifolius* var. *oblongifolius* | Narrow Leaf Lotus |
| *Lotus purshianus* | Spanish Lotus |
| *Lupinus albifrons* var. *albifrons* | Silver Bush Lupine |
| *Lupinus bicolor* | Miniature Lupine |
| *Lupinus microcarpus* var. *densiflorus* | White Whorled Lupine |
| *Lupinus nanus* | Sky Lupine |
| *Melilotus alba* | White Sweetclover |
| *Trifolium dubium* | Little Shamrock |
| *Trifolium hirtum* | Rose Clover |
| *Trifolium variegatum* | White tipped Clover |
| *Trifolium willdenovii* | Toncat Clover |
| *Vicia americana* var. *americana* | American Vetch |
| *Vicia sativa* ssp. *sativa* | Common Vetch |
| *Vicia villosa* ssp. *varia* | Winter Vetch |
| **Fagaceae** | **Beech Family** |
| *Lithocarpus densiflorus* var. *densiflorus* | Tanbark Oak |
| *Quercus chrysolepis* | Canyon Live Oak |

| SCIENTIFIC NAME | COMMON NAME |
|---|---|
| **Fagaceae** (cont.) | |
| *Quercus douglasii* | Blue Oak |
| *Quercus kelloggii* | California Black Oak |
| *Quercus lobata* | Valley Oak |
| *Quercus weslizenii* var. *weslizenii* | Interior Live Oak |
| **Garryaceae** | **Silk Tassel Family** |
| *Garrya congdonii* | Congdon's Silk Tassel |
| *Garrya fremontii* | Fremont's Silk Tassel |
| **Gentianaceae** | **Gentian Family** |
| *Swertia albicaulis* var. *nitida* | White Stemmed Swertia |
| **Geraniaceae** | **Geranium Family** |
| *Erodium cicutarium* | Red Stem Filaree |
| *Geranium molle* | Dove Foot Geranium |
| **Grossulariaceae** | **Gooseberry Family** |
| *Ribes roezlii* var. *roezlii* | Sierra Gooseberry |
| **Hippocastanacea** | **Buckeye Family** |
| *Aesculus californica* | California Buckeye |
| **Hydrophyllaceae** | **Waterleaf Family** |
| *Draperia systyla* | Draperia |
| *Eriodictyon californicum* | Yerba Santa |
| *Nemophila heterophylla* | Variable Leaved Nemophila |
| *Nemophila menziesii* ssp. *menziesii* | Baby Blue Eyes |
| *Phacelia corymbosa* | Serpentine Phacelia |
| *Phacelia imbricata* | Imbricate Phacelia |
| **Hypericaceae** | **St. John's Wort Family** |
| *Hypericum concinnum* | Gold Wire |
| *Hypericum perforatum* | Klamathweed |
| **Lamiaceae** | **Mint Family** |
| *Lycopus americanus* | Cut leaf Bugleweed |
| *Mentha arvensis* | Field Mint |
| *Monardella odoratissima* ssp. *pallida* | Coyote Mint |
| *Monardella sheltonii* | Shelton's Coyote Mint |
| *Prunella vulgaris* var. *vulgaris* | Common Self Heal |
| *Salvia sonomensis* | Creeping Sage |
| *Scutellaria californica* | California Scullcap |
| *Scutellaria siphocampyloides* | Grey Leaf Scullcap |
| *Stachys ajugoides* var. *rigida* | Rigid Hedge Nettle |

| SCIENTIFIC NAME | COMMON NAME |
|---|---|
| **Lauraceae** | **Laural Family** |
| *Umbellularia californica* | California Bay |
| | |
| **Malvaceae** | **Mallow Family** |
| *Sidalcea malvaeflora* ssp. *asprella* | Checkermallow |
| | |
| **Oleaceae** | **Olive Family** |
| *Fraxinus latifolia* | Oregon Ash |
| | |
| **Onagraceae** | **Evening Primrose Family** |
| *Clarkia concinna* | Red Ribbons |
| *Clarkia gracilis* ssp. *albicaulis* | White Stem Clarkia |
| *Clarkia mildrediae* ssp. *lutescens* | Golden Anthered Clarkia |
| *Clarkia mildrediae* ssp. *mildrediae* | Mildred's Clarkia |
| *Clarkia mosquinii* ssp. *mosquinii* | Mosquin's Clarkia |
| *Clarkia purpurea* ssp. *quadrivulnera* | Purple Clarkia |
| *Clarkia rhomboidea* | Rhomboid Clarkia |
| *Clarkia unguiculoata* | Woodland Clarkia |
| *Epilobium brachycarpum* | Autumn Willowherb |
| *Epilobium ciliatum* ssp. *ciliatum* | Hairy Willowherb |
| *Epilobium minutum* | Chaparral Willowherb |
| *Oenothera elata* ssp. *hirsutissima* | Evening Primrose |
| | |
| **Papaveraceae** | **Poppy Family** |
| *Dendromecon rigida* | Bush Poppy |
| *Dicentra formosa* | Bleeding Heart |
| *Eschscholzia californica* | California Poppy |
| | |
| **Philadelphaceae** | **Mock Orange Family** |
| *Phyladelphus lewisii* | Wild Mock Orange |
| | |
| **Plantaginaceae** | **Plantain Family** |
| *Plantago erecta* | Dwarf Plantain |
| *Plantago lanceolata* | English Plantain |
| | |
| **Platanaceae** | **Sycamore Family** |
| *Plantanus racemosa* | Western Sycamore |
| | |
| **Polemoniaceae** | **Phlox Family** |
| *Allophyllum divaricatum* | Purple False Gilia |
| *Collomia heterophylla* | Collomia |
| *Gilia capitata* ssp. *pedemontana* | Blue Headed Gilia |
| *Linanthus ciliatus* | Whisker Brush |

| SCIENTIFIC NAME | COMMON NAME |
|---|---|
| **Polygalaceae** | **Milkwort Family** |
| *Polygala cornuta* var. *cornuta* | Sierra Milkwort |
| | |
| **Polygonaceae** | **Buckwheat Family** |
| *Eriogonum nudum* var. *oblongiflium* | Pink Spineflower |
| *Eriogonum ursinum* | Bear Valley Buckwheat |
| *Polygonum arenastrum* | Common Smartweed |
| *Polygonum lapathifolium* | Willow Weed |
| *Polygonum persicaria* | Lady's Thumb |
| *Rumex acetocella* | Sheep Sorrel |
| *Rumex crispus* | Curly Dock |
| | |
| **Portulacaceae** | **Purslane Family** |
| *Claytonia parviflora* ssp. *parviflora* | Narrow Leaf Miner's Lettuce |
| *Lewisia cantelovii* | Cantelow's Lewisia |
| *Montia parviflora* | Showy Rock Montia |
| | |
| **Primulaceae** | **Primrose Family** |
| *Dodecatheon hendersonii* | Sailor Caps |
| *Trientalis latifolia* | Pacific Starflower |
| | |
| **Ranunculaceae** | **Crowfoot Family** |
| *Aquilegia formosa* | Red Columbine |
| *Clematis lasiantha* | Pipestems |
| *Delphinium gracilentum* | Slender Larkspur |
| *Delphinium patens* ssp. *patens* | Spreading Larkspur |
| *Ranunculus occidentalis* | Western Buttercup |
| *Thalictrum fendleri* var. *fendleri* | Fendler's Meadow Rue |
| | |
| **Rhamnaceae** | **Buckthorn Family** |
| *Ceanothus cuneatus* var. *cuneatus* | Buck Brush |
| *Ceanothus integerrimus* | Deer Brush |
| *Ceanothus lemmonii* | Lemmon's Ceanothus |
| *Rhamnus ilicifolia* | Holly Leaf Redberry |
| *Rhamnus rubra* | Sierra Coffeeberry |
| *Rhamnus tomentella* | Hoary Coffeebery |
| | |
| **Roseaceae** | **Rose Family** |
| *Adenostoma fasciculatum* | Chamise |
| *Cerocarpus betuloides* var. *betuloides* | Birch Leaf Mountain Mahogany |
| *Chamaebatia foliolosa* | Mountain Misery |
| *Fragaria vesca* | Wood Strawberry |
| *Heteromeles arbutifolia* | Toyon |
| *Potentilla glanulosa* ssp. *glandulosa* | Sticky Cinquefoil |
| *Rosa gymnocarpa* | Wood Rose |
| *Rubus discolor* | Himalayan Blackberry |

| SCIENTIFIC NAME | COMMON NAME |
|---|---|
| **Roseaceae** (cont.) | |
| *Rubus laciniatus* | Cut Leaved Blackberry |
| *Rubus leucodermis* | Blackcap Raspberry |
| *Rubus parviflorus* | Thimbleberry |
| *Sanguisorba occidentalis* | Western Burnet |
| **Rubiaceae** | **Madder Family** |
| *Cephalanthus occidentalis* var. *californicus* | California Button Willow |
| *Galium aparine* | Goose Grass |
| *Galium bolanderi* | Bolander's Bedstraw |
| *Galium porrigens* var. *tenue* | Climbing Bedstraw |
| **Salicaceae** | **Willow Family** |
| *Populus fremontii* ssp. *fremontii* | Fremont Cottonwood |
| *Salix exigua* | Narrowleaf Willow |
| *Salix laevigata* | Red Willow |
| *Salix lasiolepis* | Arroyo Willow |
| *Salix lucida* ssp. *lasiandra* | Shining Willow |
| **Saxifragaceae** | **Saxifrage Family** |
| *Heuchera micrantha* | Crevice Alumroot |
| *Lithophragma heterophyllum* | Woodland Star |
| *Saxifraga californica* | California Saxifrage |
| **Scrophulariaceae** | **Figwort Family** |
| *Antirrhinum vexillo-calyculatum* ssp. *intermedium* | Wiry Snapdragon |
| *Castilleja applegatei* ssp. *pinetorum* | Applegate's Paintbrush |
| *Castilleja pruinosa* | Frosty Paintbrush |
| *Collonsia sparsiflora* | Few Flowered Collinsia |
| *Collinsia tinctoria* | Sticky Chinese Houses |
| *Cordylanthus tenuis* ssp. *tenuis* | Slender Bird's Beak |
| *Digitalis purpurea* | Foxglove |
| *Keckiella breviflora* | Gaping Keckellia |
| *Keckiella lemmonii* | Lemmon's Keckellia |
| *Mimulus aurantiacus* | Bush Monkeyflower |
| *Mimulus cardinalis* | Crimson Monkeyflower |
| *Mimulus glaucescens* | Shield Bracted Monkeyflower |
| *Mimulus guttatus* | Common Monkeyflower |
| *Mimulus kelloggii* | Kellogg's Monkeyflower |
| *Pedicularis densiflora* | Indian Warrior |
| *Penstemon azureus* var. *azureus* | Azure Penstemon |
| *Scrophularia californica* ssp. *californica* | California Figwort |
| *Verbascum blattaria* | Moth Mullein |
| *Verbascum thapsus* | Common Mullein |
| *Veronica americana* | American Brooklime |

| SCIENTIFIC NAME | COMMON NAME |
|---|---|
| **Solanaceae** | **Nightshade Family** |
| *Solanum parishii* | Parish's Nightshade |
| **Urticaceae** | **Nettle Family** |
| *Urtica dioica* ssp. *holosericea* | Hoary Nettle |
| **Verbenaceae** | **Vervain Family** |
| *Verbena lasiostachys* var. *scabrida* | Western Vervain |
| **Viscaceae** | **Mistletoe Family** |
| *Arceuthobium occidentale* | Foothill Pine Dwarf Mistletoe |
| *Phoradendron villosum* | Oak Mistletoe |
| **Vitaceae** | **Grape Family** |
| *Vitis californica* | California Wild Grape |

## ANGIOSPERMS - MONOCOTS

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|---|---|
| **Cyperaceae** | **Sedge Family** |
| *Carex bolanderi* | Bolander's Sedge |
| *Carex densa* | Dense Sedge |
| *Carex feta* | Green Sheathed Sedge |
| *Carex multicaulis* | Many Stemmed Sedge |
| *Carex nudata* | Torrent Sedge |
| *Carex subfusca* | Rusty Sedge |
| *Cyperus eragrostis* | Tall Flatsedge |
| *Eleocharis obtusa* var. *obtusa* | Obtuse Spikerush |
| **Iridaceae** | **Iris Family** |
| *Iris macrosiphon* | Long Tubed Iris |
| *Sisyrinchium bellum* | Blue Eyed Grass |
| **Juncaceae** | **Rush Family** |
| *Juncus balticus* | Baltic Rush |
| *Juncus bufonius* var. *bufonius* | Toad Rush |
| *Juncus effusus* var. *pacificus* | Bog Rush |
| *Juncus oxymeris* | Pointed Rush |
| *Juncus patens* | Spreading Rush |
| *Juncus tenuis* | Slender Rush |
| *Luzula comosa* | Hairy Wood Rush |
| **Liliaceae** | **Lily Family** |
| *Allium amplectens* | Paper Onion |
| *Allium jepsonii* | Jepson's Onion |
| *Allium peninsulare* var. *peninsulare* | Mexican Onion |
| *Brodiaea elegans* ssp. *elegans* | Harvest Brodiaea |

| SCIENTIFIC NAME | COMMON NAME |
|---|---|
| **Liliaceae** (cont.) | |
| *Calochortus albus* | White Globe Lily |
| *Calochortus monophyllus* | Yellow Star Tulip |
| *Calochortus tolmei* | Pussy Ears |
| *Chlorogalum pomeridianum* var. *pomeridianum* | Wavy Leaf Soap Plant |
| *Dichelostemma capitatum* ssp. *capitatum* | Blue Dicks |
| *Dichelostemma multiflorum* | Wild Hyacinth |
| *Dichelostemma volubile* | Twining Brodiaea |
| *Erythronium multiscapoideum* | Sierra Fawn Lily |
| *Fritillaria recurva* | Scarlet Fritillary |
| *Lilium humboldtii* ssp. *humboldtii* | Humboldt Lily |
| *Triteleia bridgesii* | Bridge's Triteleia |
| **Orchidaceae** | **Orchid Family** |
| *Piperia elongata* | Dense Flowered Rein Orchid |
| **Poaceae** | **Grass Family** |
| *Achnatherum lemmonii* | Lemmon's Needlegrass |
| *Aegilops triuncialis* | Barbed Goatgrass |
| *Aira caryophyllea* | Silver European Hairgrass |
| *Avena barbata* | Slender Wild Oat |
| *Avena fatua* | Wild Oat |
| *Brachypodium distachyon* | False Brome |
| *Briza maxima* | Quaking Grass |
| *Bromus carinatus* var. *carniatus* | California Brome |
| *Bromus diandrus* | Ripgut Grass |
| *Bromus hordeaceus* | Soft Chess |
| *Bromus madritensis* ssp. *rubens* | Red Brome |
| *Bromus tectorum* | Cheat Grass |
| *Cynodon dactylon* | Bermuda Grass |
| *Cynosurus echinatus* | Hedgehog Dogtail |
| *Dactylis glomerata* | Orchard Grass |
| *Deschampsia elongata* | Slender Hairgrass |
| *Elymus elymoides* ssp. *elymoides* | Squirreltail |
| *Elymus glaucus* ssp. *glaucus* | Blue Wildrye |
| *Festuca arundinacea* | Tall Fescue |
| *Festuca californica* | California Fescue |
| *Festuca occidentalis* | Western Fescue |
| *Holcus lanatus* | Common Velvet Grass |
| *Koeleria phleoides* | Koeleria |
| *Melica californica* | California Melic |
| *Melica torreyana* | Torrey's Onion Grass |
| *Panicum acuminatum* var. *acuminatum* | Western Panicgrass |
| *Poa secunda* ssp. *secunda* | One Sided Bluegrass |
| *Vulpia microstachys* var. *microstachys* | Three Week Fescue |
| *Vulpia myuros* | Rattail Fescue |

### E3.3.2 Impacts of Existing Project

Poe Project operations and facilities do not significantly impact the existing canyon live oak, foothill pine-canyon live oak, mixed conifer, black oak, wedgeleaf ceanothus, and California annual grassland habitats present within the vicinity of the Project. Existing flows in the Poe Reach of the NFFR appear sufficient to support the existing riparian habitats that occur there.

### E3.3.3 Agency Recommended Measures

The agencies and NGOs did not provide specific recommendations for resource protection, mitigation, and enhancement measures through their comments on the Draft Application for New License. The primary recommendation advanced by the collective body of agencies and NGOs was to have the Licensee initiate a collaborative process through which all interested parties could have input into the development of such measures. As indicated in the following section, the Licensee has agreed to initiate a collaborative effort to address this recommendation.

### E3.3.4 Licensee Proposed Measures

**Minimum Streamflows.** Licensee proposes to maintain a continuous, year-round, minimum instream flow of 150 cfs in the NFFR, as measured at the Pulga gage (NF23). This proposed streamflow has been based on the balancing of numerous resource considerations, as discussed in the Project Resource Summary. Recognizing that there are uncertainties related to the actual responses of habitat characteristics (e.g., water temperature) and affected resources (e.g., riparian vegetation, bald eagles, fish, amphibians, and macroinvertebrates) to changes in streamflow, the Licensee proposes to monitor those responses.

**Recreation and Pulse Flows.** Licensee proposes no recreation or pulse flow releases due to the potential for impact on riparian vegetation as well as other affected resources (e.g., foothill yellow-legged frog, bald eagle). Under current Project operations, high flow events occur in the Poe Reach of the NFFR on a periodic basis as a result of natural spills at Poe Dam during winter storms and the spring run-off period. These flow events will continue to provide ecological and recreational benefits.

**Ramping Rates.** Licensee proposes to implement the same ramping rate requirements as those recently developed for the upstream Rock Creek and Cresta dams under the Rock Creek-Cresta Relicensing Settlement Agreement to protect aquatic resources. During periods when ramping can be controlled at spill flows less than 3,000 cfs at Poe Dam, the initial ramping rates shown below are proposed. These rates would be followed as close as reasonably practicable given radial gate operating limitations. It is recognized that certain operating situations, such as a unit trip when incoming flows to Poe Reservoir cannot be controlled, would likely cause an exceedance of these rates. Revision to these rates could occur as the result of monitoring Rock Creek-Cresta flow impacts.

March, April, and May – 250 cfs/hr up-ramp and 150 cfs/hr down-ramp.

June 1 – June 15 – 300 cfs/hr up-ramp and 150 cfs/hr down-ramp.

Remainder of the year – 400 cfs/hr up-ramp and 150 cfs/hr down-ramp.

**Collaborative Process for Developing Protection, Mitigation, and Enhancement Measures.** Licensee proposes to conduct a six-month collaborative process beginning in January 2004 and ending in July 2004. The goal of the collaborative is to reach agreement with all stakeholders willing to fully participate on appropriate protection, mitigation, and enhancement measures for the Project.

### E3.3.5 Anticipated Impacts of Continued Operation

The proposed minimum flow of 150 cfs would result in a small decrease in the amount of substrate suitable for riparian vegetation. Torrent sedge would be the most affected of the riparian vegetation series present along the Poe Reach of the NFFR. Portions of islands and shoreline that currently support this series would be inundated.

### E3.3.6 References for Botanical Resources


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**Report E3**

**FISH, WILDLIFE, AND BOTANICAL RESOURCES**

**Section E3.4**

**AGENCY CONSULTATION**

## E3.4 Agency Consultation

The following is a list of agency consultation letters for the August 2003 Draft Application for New License. Copies of the letters and Licensee's replies to the comments are in Appendix E5-1.

| DATE | |
|---|---|
| 7.1.02 | Notification of Intent to file Application for New License. |
| 8.21.03 | Transmittal of August 2003 Draft Application for New License. |
| 11-7-03 | National Park Service comments on the Draft Application for New License. |
| 11-19-03 | California State Water Resources Control Board comments on the Draft Application for New License. |
| 11-21-03 | California Department of Fish and Game comments on the Draft Application for New License. |
| 11-21-03 | National Marine Fisheries Service comments on the Draft Application for New License. |
| 11-21-03 | U. S. Forest Service comments on the Draft Application for New License. |