4.4 FISHERIES AND AQUATIC BIOLOGY

4.4.1 INTRODUCTION TO FISHERIES AND AQUATIC BIOLOGY

This section of the EIR identifies the fisheries and other aquatic resources that could potentially be affected by the operation of Pacific Gas and Electric Company's hydroelectric generation facilities. This section also evaluates the impacts to these resources that may occur as the result of the proposed auction of assets. Potential project affects on invertebrates and amphibians is dicussed in the Terrestrial Biology section (Section 4.5).

Pacific Gas and Electric Company's hydroelectric generating system extends over a broad geographical area that encompasses portions of the Sacramento-San Joaquin River basin and the coastal drainage of the Eel River. This vast system includes 99 reservoirs and related facilities that influence environmental conditions in hundreds of miles of natural stream channels. Of the 97 freshwater fish species recorded for California's inland waters, 60 species (62 percent) occur in streams and reservoirs influenced by hydroelectric system operations. Table 4.4-1 summarizes the distribution of these fish species by regional bundle.

Of particular interest and importance is the distribution of chinook salmon and steelhead spawning and rearing habitat in relation to Pacific Gas and Electric Company's hydroelectric projects. All chinook salmon runs (i.e., fall, late fall, winter, spring) and steelhead runs (Central Valley ESU) are State and/or Federally listed as threatened, endangered or of special concern due to declining numbers. Figure 4.4-1 illustrates the occurrence of chinook salmon and steelhead spawning and rearing habitat in the Central Valley and the Eel River. Prior to the construction of the major dams in the Central Valley, an estimated 6,000 miles of spawning and rearing habitat was accessible to chinook salmon and steelhead. Currently, an estimated 95 percent of this habitat has been blocked by dams or other obstructions (U.S. Fish and Wildlife Service, 1998). Five Pacific Gas and Electric Company Projects have the potential to directly affect spawning and rearing habitat for these species. These projects are: Kilarc-Cow Creek, Battle Creek, DeSabla-Centerville, Narrows, and Potter Valley.

The environmental effects of hydroelectric projects on aquatic resources have been studied for decades and it is not the objective of this section to review the vast literature on this topic. For evaluation purposes it is convenient to separate the environmental effects of hydro projects on aquatic resources into two categories: (1) those effects associated with reservoirs; and (2) those effects associated with streams.

Reservoirs are created to store and/or divert water for use by the hydroelectric system. As artificial impoundments they differ from natural lakes in that the stored water can be readily manipulated on demand. For reservoirs, the most obvious result of water manipulation is a change in water surface elevation resulting in drawdown or filling. The timing, magnitude, frequency and duration of water level fluctuations in reservoirs are the most important factors affecting aquatic resources. Water level changes, in turn, influence the physical environment of the reservoir, including water quality and the availability of habitat. The quality of the physical environment, in turn, influences the dynamics of all biological resources in the reservoir. As described later in this section, the EIR focuses on evaluating how reservoir fluctuations impact the living space (i.e., volume of water) during the growing season for fish in Pacific Gas and Electric Company reservoirs, and for those reservoirs supporting warmwater sportfish, how fluctuations influence reproduction and the viability of fish populations.

The link between reservoirs and streams is direct and important. Reservoirs in many Pacific Gas and Electric Company hydroelectric projects have sufficient storage capacity to influence or control discharge downstream.

As with reservoir water level fluctuations, the timing, magnitude, frequency and duration of releases from reservoirs to streams affects the aquatic resources of the streams by influencing physical habitat and water quality. The physical and chemical environment of a stream influences, in turn, the dynamics of biological resources. As described later in this section, the EIR focuses on evaluating how reservoir releases impact the living space (i.e., physical habitat) of aquatic resources and the water quality to which those resources are exposed in streams influenced by Pacific Gas and Electric Company project operations.

During the scoping process of this EIR various issue areas were identified related to fishery and aquatic resources. Table 4.4-2 lists these issue areas and indicates if the issues are relevant to each of the 29 hydroelectric projects operated by Pacific Gas and Electric Company. These issues are discussed in the Environmental Setting and/or Impact Analysis, as is appropriate for each project.

4.4.2 System-Wide Regulatory Context

Pacific Gas and Electric Company's hydroelectric system stretches from the Pit River basin in Shasta County in the north to the Kern River basin in Kern County to the south, and from the crest of the Sierra Nevada in the Mokelumne River basin in Alpine County on the east to the Eel River basin in Mendocino County to the west. The aquatic resources of this vast region are managed by a variety of private (e.g., conservation organizations), local (e.g., county fish and game commissions), regional (e.g., CALFED), State (e.g., California Department of Fish and Game) and Federal (e.g., U.S. Fish and Wildlife Service) entities and agencies. Only a few of the government agencies, however, have regulatory authority over topics related to aquatic resources such as water quality. These agencies derive their respective mandates from an often diverse collection of statutes, legislative policies, executive branch directives, and implementation of regulations.

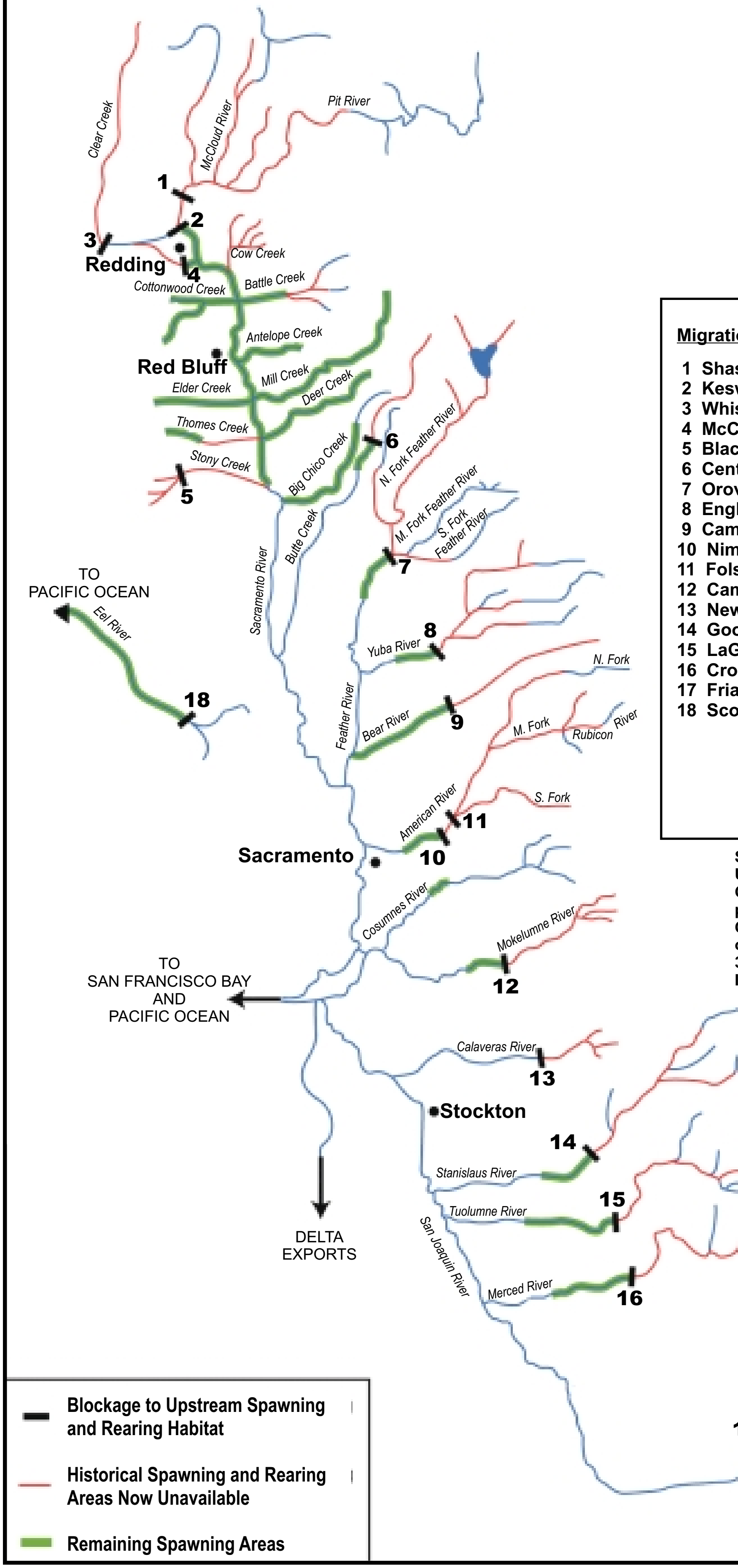
Twenty-six of Pacific Gas and Electric Company's hydroelectric projects are regulated through Federal licenses issued by the FERC. The FERC has broad authority over almost all aspects of hydroelectric projects. There are two exceptions related to aquatic resources where the State of California has regulatory authority. The first is compliance with the water quality certification

Hydrodivestiture EIR

Figure 4.4-1

Chinook Salmon and Steelhead Spawning and Rearing Habitat

Aspen
Environmental Group



Migration Barrier	Year Construction	Owner
1 Shasta Dam	1944	CVP[a]
2 Keswick Dam	1950	CVP
3 Whiskeytown Dam	1963	CVP
4 McCormick-Saetzer Dam	1903	CVP[b]
5 Black Butte Dam	1963	CVP
6 Centerville Dam	1900	Other[c]
7 Oroville Dam	1967	SWP[d]
8 Englebright Dam	1941	Other
9 Camp Far West Dam	1963	Other
10 Nimbus Dam	1955	CVP
11 Folsom dam	1958	CVP
12 Camanche Dam	1963	Other
13 New Hogan Dam	1964	CVP
14 Goodwin Dam	1912	Other
15 LaGrange Dam	1893	Other
16 Crocker-Huffman Dam	1988	Other
17 Friant Dam	1942	CVP
18 Scott Dam	1922	PG&E Co.

(a) Central Valley Project
(b) Dam removal expected by Dec. 2000
(c) Owner other than CVP or SWP
(d) State Water Project

Source:
USFWS (U.S. Fish and Wildlife Service). 1998. Central Valley Project improvement act tributary production enhancement report. Draft report to Congress on the feasibility, cost, and desirability of implementing measures pursuant to subsection 3406(e)(3) and (e)(6) of the Central Valley Project Improvement Act.

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Table 4.4-1 Distributional Checklist of the Fishes Potentially Affected By Pacific Gas and Electric Company's Hydroelectric System

Family Name Common Name (Scientific Name)	Native or Introduced Species[a]	Regional Bundle				
		Shasta	DeSabla	Drum	Motherlode	Kings Crane - Helms
Petromyzontidae (Lamprey Family)						
Pacific lamprey (*Lampetra tridentata*)	Native		X	X		
River lamprey (*Lampetra ayresi*)	Native			X		
Pacific brook lamprey (*Lampetra pacifica*)	Native			X		
Pit-Klamath brook lamprey (*Lampetra lethophaga*)	Native	X				
Kern Brook lamprey (*Lampetra hubbsi*)	Native				X	X
Acipenseridae (Sturgeon Family)						
White sturgeon (*Acipenser transmontanus*)						
Green sturgeon (*A. medirostris*)						
Clupeidae (Herring Family)						
Threadfin shad (*Dorosoma petenense*)	Introduced			X		
American shad (*Alosa sapidissima*)	Introduced			X		X
Osmeridae (Smelt Family)						
Wakasagi (*Hypomesus nipponensis*)	Introduced		X	X		
Salmonidae (Salmon and Trout Family)						
Coho salmon (*Oncorhynchus kisutch*)	Native			X		
Chinook salmon (*Oncorhynchus tshawytscha*)[b]	Native	SR, WR, FR, LFR	FR, SR	FR	FR	
Kokanee (*Oncorhynchus nerka kennerlyi*)	Introduced		X	X	X	X
Rainbow trout (*Oncorhynchus mykiss irideus*)	Native	X	X	X	X	X
Steelhead - Central Valley ESU[c] (*Oncorhynchus mykiss irideus)*	Native	X	X	X		
Eagle Lake trout *(Oncorhynchus mykiss aquilarum)*	Introduced			X		
McCloud River redband trout (*Oncorhynchus mykiss* ssp. 2)	Native	X				
Columbia River redband trout [Kamloops trout] *(Oncorhynchus mykiss gairdneri)*	Introduced			X		
Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*)	Introduced			X	X	
Brown trout (*Salmo trutta*)	Introduced	X	X	X	X	X
Brook trout (*Salvelinus fontinalis*)	Introduced	X	X	X	X	X
Lake trout (*Salvelinus namaycush*)	Introduced		X		X	
Cyrinidae (Minnow Family)						
California roach (*Hesperoleucus symmetricus symmetricus*)	Native	X	X	X	X	X
San Joaquin roach *(Hesperoleucus symmetricus* ssp. 1)	Native					X
Pit roach (*Hesperoleucas symmetricus mitrulus*)	Native	X				
Hitch (*Lavinia exilicauda*)	Native		X	X	X	X
Speckled dace (*Rhinichthys osculus*)	Native	X	X	X	X	
Tui chub (*Gila bicolor*)	Native	X	X	X	X	

Table 4.4-1 Distributional Checklist of the Fishes Potentially Affected By Pacific Gas and Electric Company's Hydroelectric System

Family Name Common Name (Scientific Name)	Native or Introduced Species[a]	Regional Bundle				
		Shasta	DeSabla	Drum	Motherlode	Kings Crane - Helms
Hardhead (*Mylopharodon conocephalus*)	Native	X	X	X	X	X
Sacramento pikeminnow (*Ptychocheilus grandis*)	Native	X	X	X	X	X
Carp (*Cyprinus carpio*)	Introduced	X	X	X	X	
Goldfish (*Carassius auratus*)	Introduced			X		X
Golden shiner (*Notemigonus crysoleucas*)	Introduced	X	X	X		X
Fathead minnow (*Pimephales promelas*)	Introduced			X	X	
Lahontan redside (*Richardsonius egregius*)	Introduced		X		X	
Catostomidae (Sucker Family)						
Sacramento sucker (*Catostomus occidentalis*)	Native	X	X	X		X
Tahoe sucker (*Catostomus tahoensis*)	Introduced		X	X	X	
Ictaluridae (Catfish Family)						
Brown bullhead (*Ictalurus nebulosus*)	Introduced	X	X	X	X	X
Black bullhead (*Ictalurus melas*)	Introduced	X		X		
Channel catfish (*Ictalurus punctatus*)	Introduced	X	X	X	X	X
White catfish (*Ictalurus catus*)	Introduced	X		X	X	X
Poeciliidae (Livebearer Family)						
Mosquitofish (*Gambusia affinis*)	Introduced	X		X		X
Gasterosteidae (Stickleback Family)						
Threespine stickleback (*Gasterosteus aculeatus*)	Native			X		X
Percichthyidae (Temperate Basses Family)						
Striped bass (*Morone saxatilis*)	Introduced			X		X
Centrarchidae (Sunfish Family)						
Sacramento perch (*Archoplites interruptus*)	Introduced		X			
Bluegill (*Lepomis macrochirus*)	Introduced	X	X	X	X	X
Green sunfish (*Lepomus cyanellus*)	Introduced	X	X	X	X	X
Warmouth (*Lepomus Lepomis gulosus*)	Introduced			X		X
Redear sunfish (*Lepomus microlephus*)	Introduced		X			
Pumpkinseed *(Lepomis gibbosus)*	Introduced			X		
Black crappie (*Pomoxis nigromaculatus*)	Introduced	X		X	X	X
White crappie (*Pomoxis annularis*)	Introduced					X
Largemouth bass (*Micropterus salmoides*)	Introduced	X	X	X	X	X
Smallmouth bass (*Micropterus dolomieui*)	Introduced	X	X	X		X
Spotted bass (*Micropterus punctulatus*)	Introduced			X		X
Redeye bass (*Micropterus coosae*)	Introduced				X	
Percidae (Perch Family)						
Bigscale logperch (*Percina macrolepida*)	Introduced			X		
Embiotocidae (Surfperch Family)						
Tule perch (*Hysterocarpus traski*)	Native	X	X			
Cottidae (Sculpin Family)						
Prickly sculpin (*Cottus asper*)	Native			X		X
Pit sculpin (*Cottus pitensis*)	Native	X				

Table 4.4-1 Distributional Checklist of the Fishes Potentially Affected By Pacific Gas and Electric Company's Hydroelectric System

Family Name Common Name (Scientific Name)	Native or Introduced Species[a]	Regional Bundle				
		Shasta	DeSabla	Drum	Motherlode	Kings Crane - Helms
Bigeye marbled sculpin (*Cottus klamathensis macrops*)	Native	X				
Rough sculpin (*Cottus asperrimus*)	Native	X				
Riffle sculpin (*Cottus gulosus*)	Native	X	X	X	X	
Total Fish Taxa	66	34	31	46	27	29

a California species occurring out of their native range are listed as "Introduced."
b SR = Spring-run
FR = Fall-run
LFR = Late fall-run
WR = Winter-run
c ESU = Evolutionarily Significant Unit

requirements of section 401 of the Federal Clean Water Act. The State Water Resources Control Board implements this regulatory program on behalf of the Federal government. Second, the California Fish and Game Commission sets State angling regulations. There are no regional or local agencies that have the authority to regulate any aspect of Federally licensed hydroelectric projects related to aquatic resources.

The foregoing discussion does not apply to the aquatic resources of the three unlicensed projects located in the DeSabla Regional Bundle (i.e., Hamilton Branch, Lime Saddle and Coal Canyon). There is no FERC regulation of these projects because they do not fall under the jurisdiction of the Federal Power Act. These three projects occupy private land and are subject to local, regional and State regulation, as may be applicable. The same is true for all private Pacific Gas and Electric Company lands that are not included within the boundaries of the FERC licenses. The aquatic resources of lakes and streams on these lands are primarily regulated by the California Fish and Game Commission with implementation responsibility through the California Department of Fish and Game. Aquatic habitat management of lands not within the boundaries of the FERC licenses may be overseen by Federal land management agencies (e.g., U.S. Forest Service) if the land is Federally controlled, or by private, local or State agencies if privately owned. When Federal lands are involved, the Federal land management agency is responsible for habitat management and the California Department of Fish and Game is responsible for management of the fish and wildlife populations (California Fish and Game Commission, Management and Utilization of Fish and Wildlife on Federal Lands, 1999).

Given this jurisdictional context, the following narratives provide a summary of statutes, policies, directives and associated regulations that have a direct bearing on the management of aquatic resources and their habitats at hydroelectric projects. The agencies responsible for implementation are identified.

Table 4.4-2 Summary of Aquatic Resource Issue Areas Relevant to each Pacific Gas and Electric Company Hydroelectric Project

Project Name and FERC License Number	Issue Area							
	Anadromous Fish Present?	Special Status Fish Present?	Minimum Instream Flow Requirement Problems?	Fish Passage or Screening Problems?	Ramping Rate Problems?	Wild Trout Designation?	Maintenance Stocking Practiced?	Water Quality Problems?
Shasta Regional Bundle								
Hat Creek Project (FERC 2661)	No	Yes	No	No	No	Yes	No	No
Pit 1 Project (FERC 2687)	No	Yes	Yes	No	Yes	No	Yes	Yes
Pit 3,4 and 5 Project (FERC 233)	No	Yes	No	No	No	No	Yes	No
McCloud-Pit Project (FERC 2106)	No	Yes	No	No	No	Yes	No	No
Kilarc-Cow Creek Project (FERC 606)	Yes	Yes	Yes	No	No	No	Yes	No
Battle Creek Project (FERC 1121)	Yes	Yes	Yes	Yes	No	No	No	No
Desabla Regional Bundle								
Upper North Fork Feather River Project (FERC 2105)	No	Yes	No	No	No	No	Yes	No
Bucks Creek Project (FERC 619)	No	No	No	No	Yes	No	Yes	No
Rock-Creek Cresta Project (FERC 1962)	No	Yes	Yes	No	No	No	Yes	Yes
Poe Project (FERC 2107)	No	Yes	No	No	No	No	No	No

Table 4.4-2 Summary of Aquatic Resource Issue Areas Relevant to each Pacific Gas and Electric Company Hydroelectric Project

Project Name and FERC License Number	Issue Area							
	Anadromous Fish Present?	Special Status Fish Present?	Minimum Instream Flow Requirement Problems?	Fish Passage or Screening Problems?	Ramping Rate Problems?	Wild Trout Designation?	Maintenance Stocking Practiced?	Water Quality Problems?
DeSabla-Centerville Project (FERC 803)	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Hamilton Branch Powerhouse (non FERC jurisdictional)	No	No	No	No	No	no	Yes	No
Lime Saddle Powerhouse (non FERC jurisdictional)	No	No	Yes	No	No	No	No	Yes
Coal Canyon Powerhouse (non FERC jurisdictional)	No	No	No	No	No	No	No	No
Drum Regional Bundle								
Drum-Spaulding Project (FERC 2310)	No	No	No	No	No	No	Yes	Yes
Narrows Project (FERC 1403)	Yes	Yes	No	No	No	No	Yes	No
Chili Bar Project (FERC 2155)	No	No	No	No	No	No	No	No
Potter Valley Project (FERC 77)	Yes	Yes	No	Yes	No	No	Yes	Yes
Motherlode Regional Bundle								
Mokelumne River Project (FERC 137)	No	Yes	Yes	No	No	No	Yes	Yes
Spring Gap-Stanislaus Project	No	Yes	Yes	No	No	No	Yes	No

Table 4.4-2 Summary of Aquatic Resource Issue Areas Relevant to each Pacific Gas and Electric Company Hydroelectric Project

Project Name and FERC License Number	Issue Area							
	Anadromous Fish Present?	Special Status Fish Present?	Minimum Instream Flow Requirement Problems?	Fish Passage or Screening Problems?	Ramping Rate Problems?	Wild Trout Designation?	Maintenance Stocking Practiced?	Water Quality Problems?
(FERC 2130)								
Phoenix Project (FERC 1061)	No	Yes	No	No	No	No	Yes	No
Merced Falls Project (FERC 2467)	No	Yes	No	No	No	Yes	Yes	No
Kings Crane-Helms Regional Bundle								
Crane Valley Project (FERC 1354)	No	Yes	Yes	Yes	No	No	Yes	Yes
Kerckhoff Project (FERC 96)	No	Yes	No	Yes	No	No	No	Yes
Helms Pumped Storage Project (FERC 2735)	No	No	No	Yes	No	No	Yes	No
Haas-Kings Project (FERC 1988)	No	Yes	No	Yes	Yes	No	Yes	Yes
Balch Project (FERC 175)	No	No	No	No	No	No	No	Yes
Tule River Project (FERC 1333)	No	Yes	No	Yes	No	No	Yes	Yes
Kern Canyon Project (FERC 178)	No	Yes	No	No	Yes	No	No	No

4.4.2.1 Federal Regulations and Policies

The following Federal regulations and policies are pertinent to the management of fish and aquatic resources at hydroelectric projects.

Federal Power Act of 1920, as amended (16 USC 791-828c)

This Federal statute created the Federal Power Commission, now known as the Federal Energy Regulatory Commission, or FERC. FERC is an independent regulatory commission within the U.S. Department of Energy. Congress gave FERC the authority to issue licenses for hydroelectric power projects located on waters under the jurisdiction of the United States and that were, in the judgment of the commission, best adapted to a comprehensive plan for improving or developing a waterway or waterways for, among other objectives, “the adequate protection, mitigation, and enhancement of fish and wildlife (including related spawning grounds and habitat)” (Federal Power Act, section 10(a)(1)). If a proposed project to be licensed is located in part or in whole on a Federal reservation (i.e., most Federal lands except national parks and monuments), then the license is subject to such terms and conditions as the secretary of the department under whose supervision the reservation falls deems necessary for the adequate protection of the reservation (Federal Power Act, section 4(e)).

These two sections of the Federal Power Act provide the primary statutory basis for conditioning FERC licenses for the protection, mitigation, and enhancement of aquatic resources. For example, for those hydroelectric projects located at least partially on lands administered by the U.S. Forest Service, the Secretary of Agriculture may condition the proposed licenses pursuant to section 4(e) with those terms and conditions necessary to protect the purposes of the reservation. This conditioning is in addition to any terms and conditions deemed appropriate by the FERC under its own authority. FERC cannot change or dismiss such 4(e) conditions.

For those State and Federal fish and wildlife agencies that do not have 4(e) authority, section 10(j) of the Federal Power Act provides a mechanism for their recommendations to be considered for inclusion as license conditions. The FERC has the final decision on the inclusion of such agency recommendations. State and Federal fish and wildlife agencies can advise the FERC on aquatic resource issues of concern to them through this process.

Endangered Species Act of 1973, as amended (16 USC 1531 et seq.)

The purposes of the ESA are: (1) to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved; and (2) to provide a program for the conservation of endangered and threatened species. Section 7 of the ESA states that all Federal departments and agencies shall, in consultation with and with the assistance of the Secretary of Interior or Commerce, ensure that any actions authorized, funded, or carried out by them do not jeopardize the continued existence of any listed species, or result in the destruction or adverse modification of habitat of listed species that is determined to be critical to the survival of the species. FERC is subject to the provisions of the ESA.

The Fish and Wildlife Service (U.S. Department of the Interior) is responsible for implementing the ESA for all species, except marine mammals and anadromous fishes (i.e., salmon and steelhead). The National Marine Fisheries Service (U.S. Department of Commerce) is responsible for implementation related to anadromous fishes. Several Pacific Gas and Electric Company hydroelectric projects have the potential to impact species listed under the ESA. The act prescribes a consultation process that would occur between the FERC and the Fish and Wildlife Service and/or the National Marine Fisheries Service, depending on the species of concern.

Clean Water Act, as Amended (33 USC 1251 et seq.)

The CWA is the principal statute governing pollution control and water quality of the nation's waterways. The objective of the CWA is to restore and maintain the chemical, physical and biological integrity of the nation's waters. The U.S. Environmental Protection Agency (USEPA) has been delegated the primary responsibility to implement the CWA. Certain responsibilities under the CWA that relate to hydroelectric project operations have been delegated by USEPA to the State of California. The more important provisions of the CWA related to the protection of aquatic resources are:

Water Quality Certification

Section 401 of the CWA requires certification from the State of California that a proposed water project is in compliance with established effluent limitations and water quality standards. During the relicensing of established projects, Pacific Gas and Electric Company is required to obtain a 401 certification from the State Water Resources Control Board. The licensee is subject to such terms and conditions, including but not limited to instream flow, as determined by the state to protect beneficial uses of water. FERC cannot change or dismiss such 401 certifications. Currently, out of 26 FERC-licensed hydroelectric projects operated by the Pacific Gas and Electric Company, only the Mokelumne River Project (FERC Project No. 137) has a water quality certification. The certification process is discussed more fully in the section of this EIR describing water resources.

National Pollution Discharge Elimination System (NPDES)

Section 402 of the CWA establishes conditions and permitting requirements for discharges of pollutants subject to the National Pollution Discharge Elimination System. Discharges from hydroelectric Project facilities, for example, the flushing of sediments from behind dams and the control of runoff from construction sites, are subject to the provisions of section 402. This program is under the jurisdiction of the USEPA, but the agency has delegated the implementation of the program to the State of California, State Water Resources Control Board. The State Board has, in turn, delegated the implementation of section 402 to the nine Regional Water Quality Control Boards located around the State.

Permits for Dredged or Fill Material

Section 404 of the CWA authorizes a separate permit program for the disposal of dredged or fill material in the nation's waters, to be administered by the Secretary of the Army, acting through the Chief of Engineers. The U.S. Army Corps of Engineers (USCOE) retains primary responsibility for permits to discharge dredged or fill material into waters of the United States. Local implementation of the program is handled at the USCOE district offices.

Fish and Wildlife Coordination Act (16 USC 661 et seq.)

The purpose of this act is to recognize the contribution of fish and wildlife resources to the nation. The goal is to ensure that fish and wildlife conservation receives equal consideration and is coordinated with other features of water resources development programs. The statute provides that whenever the waters of any stream or other body of water are proposed to be impounded, diverted, the channel deepened or otherwise controlled or modified, the responsible Federal agency shall consult with the Fish and Wildlife Service and/or the National Marine Fisheries Service, as appropriate. The consultation shall consider conservation of fish and wildlife resources with the view of preventing loss of and damages to such resources as well as providing for development and improvement in connection with water resources development. The comments of the California Department of Fish and Game are incorporated into the report forwarded to the responsible agency.

Reports and recommendations of the fish and wildlife agencies are to be included in any authorizing documents for construction or for modification of projects. Therefore, the FERC is required to consult during the hydroelectric project licensing process. The final decision to adopt fish and wildlife agency recommendations presented pursuant to the Coordination Act rests with the FERC. The Coordination Act is applicable to the relicensing of hydroelectric projects.

Magnuson Fishery Conservation and Management Act (16 USC 1801 et seq.)

The purpose of this act is to conserve and manage, among other resources, anadromous fishery resources of the United States. The act establishes eight Regional Fisheries Management Councils to prepare, monitor and revise fishery management plans, which will achieve and maintain the optimum yield from each fishery. In California, the Pacific Fisheries Management Council is responsible for achieving the objectives of the statute. The Secretary of Commerce has oversight authority. The statute was amended in 1996 to establish a new requirement to describe and identify "essential fish habitat" (EFH) in each fishery management plan. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." EFH has been established by the National Marine Fisheries Service (NMFS) for waters in California supporting anadromous fish. The act requires that all Federal agencies, including FERC, consult with NMFS on all actions, or proposed actions, permitted, funded or undertaken by the agency, that may adversely affect EFH. Adversely affect means any impact which reduces the quality and/or quantity of EFH. Comments from NMFS following consultation are advisory only;

however, a written explanation must be submitted to NMFS if the implementing Federal agency does not agree with NMFS's recommendations.

Fish and Wildlife Conservation Act of 1980 (16 USC 2901-2911)

This statute provides policy guidance to Federal agencies related to fish and wildlife resources. It declares that fish and wildlife are of ecological, educational, esthetic, cultural, recreational, economic and scientific value to the nation. The act acknowledges that historically, fish and wildlife conservation programs have focused on more recreationally and commercially important species within any particular ecosystem, without provisions for the conservation and management of non-game fish and wildlife. The purposes of this act are to encourage all Federal departments and agencies to utilize their statutory and administrative authority to the maximum extent practicable, consistent with each agency's statutory responsibilities, to conserve and promote conservation of non-game fish and wildlife and their habitats, and to provide financial and technical assistance to states to conduct inventories and conservation plans for non-game wildlife. This act applies to the FERC.

4.4.2.2 State Regulations and Policies

The following State regulations and policies are pertinent to the management of fish and aquatic resources at hydroelectric projects not regulated by the Federal Power Act and to Pacific Gas and Electric Company-owned lands outside the boundaries of their Federally licensed projects.

California Endangered Species Act (Fish and Game Code 2050 – 2116)

The CESA declares that deserving plant or animal species will be given protection by the State because they are of ecological, educational, historical, recreational, aesthetic, economic and scientific value to the people of California. The CESA established that it is State policy to conserve, protect, restore and enhance endangered species and their habitats.

The CESA is similar to the Federal ESA in many aspects, but not all. For example, the CESA does not protect invertebrates. The CESA only pertains to State-listed rare, threatened or endangered plant and wildlife species. CESA requires State agencies to consult with the California Department of Fish and Game when preparing CEQA documents in order to ensure that agency actions do not jeopardize listed species. A lead agency reviewing a proposed project within its jurisdiction must determine whether any State-listed rare, threatened, or endangered species may be present within project land and also determine whether the proposed project will have a significant impact on such species. The California Department of Fish and Game may implement endangered species protections by entering into management agreements with project owners.

The California Fish and Game Commission is assigned the responsibility to designate plant and animal species as rare, threatened or endangered. Under the CESA, the Department of Fish and Game has the responsibility for maintaining a list of rare, threatened and endangered species. The

Department of Fish and Game also maintains lists of Species of Special Concern that serve as "watch lists."

Pursuant to the requirements of the CESA, an agency reviewing a proposed project within its jurisdiction must determine whether any State-listed rare, threatened or endangered species may be present within the project boundary and also determine whether the proposed project will have a significant impact on such species.

Amended Statutes 1996 Chapter 825 et al. (Fish and Game Code 1600-1607)

Sections 1600 to 1607 of the Fish and Game Code apply only to private lands outside of the boundaries of licensed FERC hydroelectric projects. The statute gives the California Department of Fish and Game the authority to regulate activities that would alter the flow, bed, channel or bank of natural streams and lakes in which there is at any time an existing fish or wildlife resource or from which these resources derive benefit. Code sections provide for a consultation process during which the environmental issues are evaluated and a Streambed Alteration Agreement is issued that will avoid or reduce the potential environmental impacts to less than significant. The Streambed Alteration Agreement process is similar to a mini-CEQA process. These code sections are expected to be an important means of evaluating the environmental effects on aquatic resources if future land use changes occur on lands now owned by Pacific Gas and Electric Company.

Porter-Cologne Water Quality Control Act (Water Code 13000 – 14958)

This statute established the State Water Resources Control Board and the nine Regional Water Quality Control Boards as the principal State agencies having primary responsibility in coordinating and controlling water quality in California. The Regional Boards prepare and periodically update the Basin Plans (i.e., water quality control plans). Each plan establishes: 1) beneficial uses of water designated for each water body to be protected; 2) water quality standards for both surface and groundwater; and 3) actions necessary to maintain these standards in order to control sources of pollution to the State's waters. The development of water quality standards suitable for fish and aquatic resources is an important regulatory function of the State and regional boards. Enforcement of water quality standards is a parallel and equally important activity.

As noted previously, both the State board and regional boards under the auspices of USEPA have the responsibility of granting NPDES permits and implementing other provisons of the Federal Clean Water Act.

Z'Berg-Nejedly Forest Practice Act of 1973 (Title 14 California Code of Regulations Chapter 4)

This act mandates the California Department of Forestry and Fire Protection (CDF) to ensure that timber harvesting on California's non-Federal commercial forestlands will achieve maximum sustained timber productivity, protect soil resources and water quality, and safeguard, among other resources, fish and wildlife. Priority action areas for the forest practice program include improved coordination with the California Department of Fish and Game and the Regional Water Quality Control Boards at the State level, and with the National Marine Fisheries Service, Fish and Wildlife Service and USEPA at the Federal level. CDF is mandated to protect beneficial uses related to water quality and biological resources.

Article 6 of subchapters 4, 5, and 6 of the Forest Practice Rules provides regulatory guidance related to the protection of streams and lakes during timber harvesting operations. These rules have a direct influence on forestry impacts affecting fish and other aquatic resources. The Forest Practice Rules are an important regulatory tool should timber harvesting be conducted within the boundaries of FERC-licensed projects or on private watershed lands currently owned by the Pacific Gas and Electric Company.

Key Fish and Game Commission Policies Related to Fish and Aquatic Resources

The following policies related to aquatic resources have been formally adopted by the California Fish and Game Commission:

Commission Designated Wild Trout Waters

It is the policy of the Fish and Game Commission to designate certain State waters to be managed exclusively for wild trout.

Salmon

It is the policy of the Fish and Game Commission that salmon shall be managed to protect, restore and maintain the populations and genetic integrity of all identifiable stocks. Salmon streams shall be inventoried for quantity and quality of habitat, including instream flow requirements. Restoration plans shall identify habitats for restoration and acquisition and opportunities to protect or guarantee future instream flows. Existing salmon habitat shall not be diminished further without offsetting the impacts of the lost habitat. All available steps shall be taken to prevent loss of habitat, and the Department of Fish and Game shall oppose any development or project that will result in irreplaceable loss of fish. Artificial production shall not be considered as appropriate mitigation for loss of wild fish or their habitat.

Steelhead Rainbow Trout

It is the policy of the Fish and Game Commission that steelhead shall be managed to protect and maintain the populations and genetic integrity of all identifiable stocks. The remainder of this policy is similar to the policy for salmon.

Trout

It is the policy of the Fish and Game Commission that natural reproduction and rearing of trout will be encouraged to the greatest extent possible by protecting and improving habitat and by affording protection from disease, predators, and competing fish species. Artificial propagation and rearing of trout will be utilized only when necessary to augment natural production. Catchable-sized trout shall be stocked only in lakes, reservoirs and streams where natural reproduction and growth are inadequate to maintain populations capable of supporting fishing.

Warmwater Game Fish Stocking

It is the policy of the Fish and Game Commission that maintenance stocking of warmwater game fish is not recommended because satisfactory populations are usually sustained by natural reproduction. The policy describes the circumstances under which stocking is permitted.

Land Use Planning

This policy articulates the Fish and Game Commission's desire to have the California Department of Fish and Game coordinate closely with State, Federal and local planning agencies in the formulation and implementation of any plans which may impact fish and wildlife resources.

Management and Utilization of Fish and Wildlife on Federal Lands

It is the policy of the Fish and Game Commission that the Department of Fish and Game will manage and protect all fish and wildlife and threatened or endangered native plants on lands administered by the Federal government. This policy will not extend to the right of the Federal government to manage habitat and control access on its property. Management and protection of migratory fish and wildlife will be coordinated between the Department of Fish and Game and the Federal government on all lands under Federal jurisdiction.

Management and Utilization of Fish and Wildlife on Private Lands

It is the policy of the Fish and Game Commission that the owners or tenants of privately owned lands shall be actively encouraged to propagate, conserve and promote the wise use of fish and wildlife populations on their lands, consistent with other reasonable uses. This policy describes the procedures for setting up Private Lands Wildlife Habitat Enhancement and Management Areas with the California Department of Fish and Game.

Water

It is the policy of the Fish and Game Commission that the quantity and quality of the waters of California should be apportioned and maintained so as to produce and sustain the maximum numbers of fish and wildlife. The Department of Fish and Game is directed to review and comment on proposed water development projects, on applications for licenses or permits for water use, water development and on projects affecting aquatic habitat. It is also directed to recommend and seek the adoption of proposals necessary or appropriate for the protection and enhancement of fish and wildlife and their habitat, and to oppose the issuance of permits or licenses which have not prevented or adequately compensated for damage to fish and wildlife resources. Other directives to the Department of Fish and Game are specified.

4.4.2.3 Regional Regulations and Policies

CALFED

The California Water Policy Council and the Federal Ecosystem Directorate united in June 1994 to form CALFED. In June 1995, CALFED issued its Bay-Delta Program to develop a long-term, comprehensive solution to environmental issues in the Sacramento-San Joaquin Delta and San Francisco Bay. The CALFED program is an interagency effort with 15 participating State and Federal agencies, all with management and regulatory responsibilities in the Bay-Delta. These agencies provide policy direction and oversight for the process. The purpose of the program is to develop and implement a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta system.

The Framework Agreement for CALFED states that the State and Federal agencies will work together in three areas of Bay-Delta management:

- Water quality standards formulation;
- Coordination of State Water Project and Central Valley Project operations with regulatory requirements; and
- Long-term solutions to problems in the Bay-Delta estuary.

CALFED is interested in the effect of Pacific Gas and Electric Company's hydroelectric project operations on the aquatic resources of management concern to the restoration program of the Bay-Delta Program. Pacific Gas and Electric Company is participating with CALFED in the restoration of salmon and steelhead resources to Battle Creek (Shasta Regional Bundle) and Butte Creek (DeSabla Regional Bundle).

Central Valley Project Improvement Act (Public Law 102-575, Title 34)

The Central Valley Project Improvement Act (CVPIA) was signed into law by President Bush on October 30, 1992, and is designated as Title 34 of the Reclamation Projects Authorization and Adjustment. Subsection 3406(a) of the CVPIA amends the authorization of the Department of the Interior's Central Valley Project (CVP) to include fish and wildlife protection, restoration and mitigation as project purposes having equal priority with irrigation and domestic water uses and power generation. Subsection 3406(e) of the CVPIA requires that not later than five years after the date of enactment of the Act, the Secretary of the Interior shall provide Congress with specifically identified supporting investigations related to the restoration and enhancement of anadromous fishes affected by the CVP. Most of these investigations have been submitted. Pacific Gas and Electric Company operates several hydroelectric projects that directly influence anadromous fishery resources. Successful implementation of the CVPIA in concert with the activities of CALFED require the cooperation of the Pacific Gas and Electric Company in fishery restoration efforts (e.g., restoration efforts on Battle Creek and Butte Creek).

4.4.3 SYSTEM-WIDE SETTING

Pacific Gas and Electric Company's proposed transfer of ownership involves facilities and lands that support a broad variety of fisheries resources. There are three primary geographic subdivisions/bioregions that encompass Pacific Gas and Electric Company's hydroelectric system. Each is briefly described.

4.4.3.1 Northwestern California

Northwestern California is the northern-most bioregion in California and is characterized by having the most predictable climate in California. The region is further divided into sub-regions. The only sub-region that includes Pacific Gas and Electric Company hydroelectric projects is called the "North Coast Ranges." This sub-region is further divided into districts. The district that includes the Potter Valley Project (FERC 0077) of the Drum Regional Bundle is the "Inner North Coast Ranges." This district's predominant characteristic is low rainfall and hot and dry summers.

4.4.3.2 Cascade Range

The Cascade Range bioregion is of predominately volcanic origin. Cascade Range bioregion is also divided into sub-regions. The "High Cascade Range" sub-region includes all of the hydroelectric facilities in the DeSabla and Shasta Regional Bundles.

4.4.3.3 Sierra Nevada

The Sierra Nevada bioregion is geologically a primarily metamorphic region abutting the volcanic Cascade Range to the north and the Great Valley to the west. It is divided into three sub-regions. One of the sub-regions, "Sierra Nevada Foothills," encompasses the Drum (except for Potter Valley), Motherlode, and Kings/Crane Regional Bundles. This sub-region is a narrow strip of the western Sierra bounded by the Great Valley on the west and the Sierra Nevada crest on the east. This sub-region is further divided into three districts, two of which include Pacific Gas and Electric Company hydroelectric projects. These districts are termed the "Northern Sierra Nevada" and the "Central Sierra Nevada." The Motherlode and Drum Regional Bundles are located within the Northern Sierra Nevada district. The boundary between the northern and central districts is the Tuolumne-Calaveras county line. The Central Sierra Nevada district contains the Kings/Crane Regional Bundle.

The following sections describe the specific fish and other aquatic resources found within each of the regional bundles and specific hydroelectric projects.

4.4.4 REGIONAL AND LOCAL SETTING AND REGULATORY CONTEXT

4.4.4.1 Shasta Regional Bundle

This section addresses fisheries and aquatic resources at Pacific Gas and Electric Company's hydroelectric projects in the Shasta Watershed Region. Specifically, this section identifies the fisheries and aquatic resources associated with each Pacific Gas and Electric Company FERC Project, including special-status species and their habitats, describes natural and human factors that affect these resources, and discusses regulatory protection of the fishery resources (Table 4.4-3).

Regional Setting

Pacific Gas and Electric Company's hydroelectric projects are typically located in remote, rural areas that support a broad range of fishery resources. The existence and operation of hydroelectric facilities can have both adverse and beneficial impacts on these fishery resources. There are, however, a number of regulatory requirements designed to strike an appropriate balance between fishery conservation, energy production, and other competing uses.

Pacific Gas and Electric Company's hydroelectric facilities in the Shasta Region are located on rivers and streams in the Cascade Ranges region, which include Hat Creek, Fall River, Pit River, McCloud River, Kilarc Creek, Cow Creek, Battle Creek and other smaller miscellaneous tributaries, canals and diversion ditches. Fishery resources present in the Shasta Region include a diverse mixture of coldwater and warmwater species comprised of both native and nonnative species. Anadromous salmonid species are also present in Kilarc Creek, Cow Creek, and Battle Creek.

Regional Regulations and Policies

Applicable local plans for the Shasta Region are the Shasta County and Tehama County General Plans. Neither county currently has adopted ordinances specific to the protection of biological resources (i.e., tree preservation, protection of riparian areas, etc.). Portions of the Shasta Regional Bundle assets are located directly adjacent to Lassen National Forest and Shasta-Trinity National Forest lands. Project facilities adjacent to Lassen National Forest lands are specifically located near the Britton, Hat Creek, Logan, and Red Management Areas, as defined in the Lassen National Forest Plan. Project facilities and Watershed Lands associated with Bundle 2 (Pit 3, 4, and 5; McCloud-Pit) are located adjacent to Shasta-Trinity National Forest lands. The McCloud-Pit Project is next to the McCloud River Management Area and the Pit, 3, 4 and 5 Project is next to the Pit Management Area, as defined in the Shasta-Trinity National Forest Plan.

McCloud River Coordinated Resource Management Plan

Specific to the McCloud-Pit Project (FERC 2106) of Bundle 2, Pacific Gas and Electric Company is signatory to a Coordinated Resource Management Plan (CRMP), which provides measures to protect the McCloud River. Signatories to the plan agreed that the CRMP could be used as an acceptable alternative to designating McCloud River as a Wild and Scenic River.

The following sections discuss the specific types of fisheries and habitats found at each of Pacific Gas and Electric Company's FERC Project bundles in the Shasta Watershed Region, including special-status species potentially occurring at or in the vicinity of each facility.

Table 4.4-3 Distributional Checklist of the Fishes of the Shasta Regional Bundle by Pacific Gas and Electric Company Project

Family Name Common Name (*Scientific Name*)	Hat Creek (FERC 2661)	Pit 1 (FERC 2687)	Pit 3, 4 and 5 (FERC 0233)	McCloud-Pit (FERC 2106)	Kilarc-Cow Creek (FERC 0606)	Battle Creek (FERC 1121)
Petromyzontidae (Lamprey Family)						
Pit-Klamath brook lamprey (*Lampetra lethophaga*)	X	X	X	X		
Salmonidae (Salmon and Trout Family)						
Chinook salmon (*Oncorhynchus tshawytscha*)					FR, LFR[a]	SR, FR, LFR, WR[a]
Rainbow trout (*Oncorhynchus mykiss irideus*)	X	X	X	X	X	X
Steelhead - Central Valley ESU (*Oncorhynchus mykiss irideus)*						X
McCloud River redband trout (*Oncorhynchus mykiss* ssp. 2)				X		
Brown trout (*Salmo trutta*)	X	X	X	X	X	X
Brook trout (*Salvelinus fontinalis*)	X			X		X
Cyrinidae (Minnow Family)						
California roach (*Hesperoleucus symmetricus symmetricus*)						X
Pit roach (*Hesperoleucas symmetricus mitrulus*)			X	X		
Speckled dace (*Rhinichthys osculus*)	X		X	X	X	X
Tui chub (*Gila bicolor*)	X	X	X	X		
Hardhead (*Mylopharodon conocephalus*)		X	X	X		
Sacramento pikeminnow (*Ptychocheilus grandis*)	X	X	X	X		X
Carp (*Cyprinus carpio*)		X	X			
Golden shiner (*Notemigonus crysoleucas*)		X	X			
Catostomidae (Sucker Family)						
Sacramento sucker (*Catostomus occidentalis*)	X	X	X	X	X	X
Ictaluridae (Catfish Family)						
Brown bullhead (*Ictalurus nebulosus*)	X	X	X			

Table 4.4-3 Distributional Checklist of the Fishes of the Shasta Regional Bundle by Pacific Gas and Electric Company Project

Family Name Common Name (*Scientific Name*)	Hat Creek (FERC 2661)	Pit 1 (FERC 2687)	Pit 3, 4 and 5 (FERC 0233)	McCloud-Pit (FERC 2106)	Kilarc-Cow Creek (FERC 0606)	Battle Creek (FERC 1121)
Black bullhead (*Ictalurus melas*)		X	X			
Channel catfish (*Ictalurus punctatus*)		X	X			
Poeciliidae (Livebearer Family)						
Mosquitofish (*Gambusia affinis*)		X				
Centrarchidae (Sunfish Family)						
Bluegill (*Lepomis macrochirus*)		X	X			
Green sunfish (*Lepomus cyanellus*)		X	X	X		
Black crappie (*Pomoxis nigromaculatus*)		X	X			
White crappie (*Pomoxis annularis*)			X			
Largemouth bass *(Micropterus salmoides)*		X	X			
Smallmouth bass *(Micropterus dolomieui)*		X	X			
Embiotocidae (Surfperch Family)						
Tule perch *(Hysterocarpus traski)*		X	X	X		X
Cottidae (Sculpin Family)						
Prickly sculpin *(Cottus asper)*				X		
Pit sculpin *(Cottus pitensis)*	X	X	X	X		
Bigeye marbled sculpin *(Cottus klamathensis macrops)*	X	X	X	X		
Rough sculpin *(Cottus asperrimus)*	X	X	X			
Riffle sculpin *(Cottus gulosus)*				X	X	X
Total Fish Taxa	**12**	**22**	**24**	**17**	**7**	**14**

a FR = Fall-run
LFR = Late fall-run
WR = Winter-run
SR = Spring-run

Bundle 1: Hat Creek

Hat Creek 1 and 2 (FERC 2661)

The Hat Creek Project supports a variety of botanical, wildlife, and fisheries resources and habitats. The following sections describe the fisheries and aquatic resources, the sources and nature of potential impacts on fisheries and aquatic resources, and project-specific regulatory conditions related to these resources. A complete list of fish species found in the Hat Creek 1 and 2 Project vicinity is presented in Table 4.4-4.

Upper Hat Creek

Hat Creek begins as a small spring fed stream originating on the north side of Mount Lassen. Much of the annual flow in this upper reach is generated by snow pack runoff. The base flow increases greatly from natural springs located at Big Springs near Old Station on State Highway 44. The stream continues to flow north through coniferous forest primarily managed by the Lassen National Forest. Further downstream, Hat Creek enters a low gradient valley reach, Hat Creek Valley, which is dominated by privately owned parcels. Land use in this reach is comprised of rural residential home sites, cattle ranches, and vacation homes. Water is diverted from Hat Creek in this reach for hay production and cattle grazing. The Rising River flows into Hat Creek at the lower end of the valley and base flows increase substantially from this point downstream. Rising River is four miles long and originates from a spring fed lake. Rising River flow, combined with additional inflow from a series of cold volcanic springs, averages approximately 275 cfs.

Upper Hat Creek, upstream of the Rising River, supports populations of wild rainbow trout (*Onchorhynchus mykiss*) and brown trout (*Salmo trutta*) throughout most of its length. Brook trout (*Salvelinus fontinalis*) also occur in the upper portions of the creek in the area of Lassen National Park. The CDFG annually stocks catchable sized rainbow trout along the upper creek near popular vacation areas, such as campgrounds along Highway 89. Occasionally, brown trout and brook trout may also be planted in this reach (PG&E Co., 1998e). Other fish species likely present include the Pit sculpin (*Cottus pitensis*), Sacramento pikeminnow (*Ptychocheilus grandis*), speckled dace (*Rhynichthys osculus*), tui chub (*Gila bicolor*), and Pit-Klamath brook lamprey (*Entosphenus lethophagus*).

FERC Project Boundary. Hat Creek enters the FERC License Project boundary several hundred meters downstream of the Rising River's confluence with Hat Creek. Stream gradients through this lower reach include three low gradient sections separated by two high gradient sections. These two high gradient reaches provide the energy for power production associated with the two Hat Creek powerhouses.

Cassel Pond, Hat Creek 1 Canal, and Hat Creek 1 Forebay

Hat Creek Dam 1, which is the first point of diversion for the Hat Creek 1 Powerhouse, forms Cassel Pond. Cassel Pond is a shallow water body (< 6 feet) with low water velocities that covers

Table 4.4-4 Shasta Regional Bundle – Hat Creek Project (FERC 2661) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Pit-Klamath brook lamprey	Rainbow trout	Brown trout	Brook trout	Speckled dace	Tui chub	Sacramento pikeminnow	Sacramento sucker	Brown bullhead	Pit sculpin	Bigeye marbled sculpin	Rough sculpin
Cassel Pond (Hat Creek 1 Diversion Dam)	None	X	X	X		X	X	X			X		
Hat Creek from Cassel Pond to Baum Lake	Year round: two cfs Proposal to increase minimum flow to eight cfs[b]	X	X	X	X	X	X	X			X	X	
Baum Lake (Hat Creek 2 Diversion Dam)	Generally held near maximum levels during recreation season[c]	X	X	X	X		X		X	X	X	X	X
Hat Creek from Baum Lake to tailrace of Hat Creek 2 Powerhouse	Year round: eight cfs[d]	X	X	X			X		X		X	X	X
Hat Creek from Hat Creek 2 Powerhouse tailrace to Lake Britton (Pit River)	Reach receives unimpaired flow of Hat Creek	X	X	X	X		X		X	X	X	X	X

a cfs = cubic feet/second

b PG&E Co. 1998. Application for New License, September 30.

c PG&E Co. and State of California. 1978. Agreement Relating to FERC Project 2661. April 14.

d PG&E Co. and State of California. 1978. Agreement Relating to FERC Project 2661. April 14. Ramping rates specified for changes in release from Hat Creek 2 Diversion Dam.

about 13 acres. Bottom substrates are primarily composed of sand and silt with abundant amounts of aquatic macrophytes including *Myriophyllum sibiricum, Zannichellia palustris,* and *Ranunculus aquatilus*. These aquatic macrophytes provide a rich environment for macro invertebrate production, which in turn provides a valuable source of food for the trout fishery. In addition, aquatic macrophytes provide trout and other fish species with a valuable source of cover to avoid potential predators.

The Hat Creek 1 Canal conveys water from Cassel Pond through an open canal to the Hat Creek 1 forebay. The canal is approximately 2,270 feet long and provides some habitat for aquatic macrophytes, invertebrates, and fish. The Hat Creek 1 forebay is a small impoundment, about 300 feet long and 30 to 120 feet wide. Water is released from the forebay to the penstock that leads to the Hat Creek 1 Powerhouse located at the upper end of Baum Lake. Cassel Pond, Hat Creek 1 Canal, and the Hat Creek 1 forebay contain wild rainbow and brown trout. In addition, catchable sized hatchery trout are commonly stocked in these waters to provide additional angling opportunities during the fishing season. A campground is located near Cassel Pond and is adjacent to the Hat Creek 1 canal. The canal provides some trout fishing opportunities for anglers visiting the area. Other species present in these waters include Pit-Klamath brook lamprey, Sacramento pikeminnow, speckled dace, and tui chub.

Hat Creek 1 Bypass Reach

The Hat Creek 1 bypass reach is located between the Hat Creek 1 dam and Baum Lake. The reach is approximately 1 mile in length and the current FERC license requires that a minimum bypass flow of 2 cfs be released below Hat Creek 1 dam. Small springs located along the reach contribute an additional 3 to 4 cfs to the 2 cfs minimum release flow. The stream gradient near the Hat Creek 1 powerhouse is low with moderate to steep gradients prevailing throughout the remainder of the bypass reach upstream. Regardless of the 2 cfs minimum release and spring-flow contributions that occur along the reach, in some of the higher gradient areas surface flows disappear and begin to flow underneath and between large boulders within the channel. These subsurface flow areas likely inhibit fish movement through these reaches. Riparian vegetation is comprised of willow and white alder species. In the steep gradient reaches, canopy cover is low (< 30 percent). The lower gradient sections contain more abundant numbers of alders, which provide greater canopy cover (> 80 percent) and shade to the stream.

Populations of Pit sculpin and wild rainbow trout are the most prevalent species found in this reach. Rainbow trout are more abundant in the lower section of the bypass reach, downstream of the subsurface flow section, than in the upper reaches of the reach. Rainbow trout spawn in the lower sections of the reach and young-of-the-year trout are commonly observed using this area in the spring. Bigeye marbled sculpin are present in the lower section of the reach and are likely migrants from Baum Lake. Other less common species include wild brown trout, Pit-Klamath brook lamprey, Sacramento pikeminnow, speckled dace, and tui chub. Sacramento pikeminnow, speckled dace, and tui chub have only been occasionally observed in the upper section just below the Hat

Creek 1 dam and are likely migrants from Cassel Pond. Incidental catches of brook trout and coho salmon have also been made in the lower section of the reach and these originate (escaped) from the Crystal Lake Fish Hatchery located at the bottom of the reach.

Baum Lake

Baum Lake is a relatively narrow, shallow reservoir with a surface area of 89 acres. The Hat Creek 1 powerhouse is positioned at the upper end of the reservoir and contributes nearly all of the flow through the reservoir. The upper section of the reservoir is long and narrow and resembles a slow moving river with slow water velocities. Rock Creek is a small spring fed stream that also contributes flow to the upper end of the reservoir. Approximately 20 cfs of the Rock Creek flow is diverted to the Crystal Lake Fish Hatchery located adjacent to Baum Lake, which is operated by the CDFG. Turtle Pond, a small spring located along the east side of the reservoir, contributes an additional 5 cfs of flow to the reservoir. Crystal Lake is a large spring fed water body located adjacent to Baum Lake along the western shore that contributes approximately another 100 cfs to the reservoir. Baum Lake is very productive and contains abundant macrophytes, which include *Elodea canadensis*, *Ranunculus aquatilus*, *Myriophyllum sibiricum*, *Potamogeton richardsonnii*, and *Zannichellia palustris*. The stable lake elevations and abundant growth of macrophytes provide a rich environment for production of aquatic invertebrates, which in turn provide for a productive trout fishery and a popular spot for anglers.

Baum Lake contains stable populations of wild rainbow trout. Catchable sized rainbow trout, brown trout, and brook trout from the Crystal Lake Fish Hatchery are also planted in the lake to provide additional angling opportunities. Four submerged springs located in Baum Lake near the inflow from Crystal Lake provide spawning habitat for trout. Other species present include Sacramento sucker, tui chub, bigeye marbled sculpin, Pit sculpin, rough sculpin, and brown bullhead (Pacific Gas and Electric Company 1998e).

Crystal Lake

Crystal Lake covers approximately 40 acres and is fed by springs located primarily along its south shore. The lake is shallow, with depths generally less than 10 feet, and also contains abundant submergent and emergent aquatic vegetation that provide important wetland habitats along the north and south shores. Substrates are primarily composed of sand, silt and organic material. Volcanic rock, ranging from gravel to bedrock, is present around the spring inflow areas and at the outflow into Baum Lake. A levee funnels outflow from Crystal Lake into a short stream that cascades into Baum Lake. At one time, a local landowner used the drop in elevation between Crystal Lake and Baum Lake to run a small powerhouse. This cascade was subsequently modified by Pacific Gas and Electric Company to allow fish access from Baum Lake to spawning areas present in Crystal Lake. The water supply in Crystal Lake contains a protozoan parasite (*Ceratomyxa shasta*) fatal to non-resistant (non-native) strains of rainbow trout. Consequently, only a small portion of flow from Crystal Lake is diverted (< 10 cfs) and utilized by the Crystal Lake Fish Hatchery to raise rainbow trout strains resistant to the *Ceratomyxa shasta* parasite. Although Crystal Lake contains valuable wetland habitats along much of its shoreline, the amount of weed beds within the lake is less than that available in Baum Lake. This factor, combined with the swampy nature of the shoreline and prohibition of boats, makes access to fishing areas around the lake more difficult and, therefore, less attractive to anglers.

Fish species present in Crystal Lake include rainbow trout, rough sculpin, bigeye marbled sculpin (*Cottus klamathensis*), and Pit-Klamath brook lamprey. Rainbow trout populations in Crystal Lake tend to have lower densities than those in Baum Lake. Submerged springs along the bottom of Crystal Lake and the outflow area of the lake provide valuable spawning habitat for trout. In the late 1960s, gravel introductions were made at strategic locations around the lake through the Trout Restoration Project to improve spawning habitat for wild trout. These areas are consistently used by rainbow trout and some brown trout during their respective spawning seasons.

Hat Creek 2 Flume

The Hat Creek 2 flume conveys water from Baum Lake to the Hat Creek 2 Powerhouse penstock. This concrete flume transports between 400 and 600 cfs, and is 4,520 feet long. High water velocities and the physical configuration of the flume provide only limited areas suitable for trout. Angling use in the flume is limited to the lower areas upstream of the trashracks above the penstock intake.

Hat Creek 2 Bypass Reach

The Hat Creek 2 bypass reach extends for approximately one mile downstream of the Hat Creek 2 dam at Baum Lake to the Hat Creek 2 Powerhouse outfall. Following negotiations between CDFG and Pacific Gas and Electric Company, a minimum flow release of 8 cfs has been maintained in this section since October of 1979. The increase in flow to 8 cfs was supported by findings of an instream flow study conducted jointly by Pacific Gas and Electric Company, CDFG and the USFWS in 1976. Sink holes within Baum Lake, which occurred historically and were plugged in 1957, re-opened in the late 1980s and currently provide an additional 20 to 30 cfs of flow accretion to the bypass reach at the Hat Creek #2 Springs, located a few hundred yards downstream of Hat Creek 2 dam.

The bypass reach contains riffle and run habitats with several pools located immediately downstream of the dam. Stream gradients through the bypass reach range from low to moderate with one high gradient reach located approximately one third of a mile downstream of the dam. Large volcanic boulders dominate the steep portion of the creek. These boulders form small falls and plunge pools. Upstream of the steep portion of the channel, substrates are comprised of small to large boulders with lesser amounts of cobble and gravel. Downstream of the steep portion, substrates are generally comprised of small boulders and large cobble with lesser amounts of gravel and sand. The Hat #2 Spring contributes some sand to the channel, which likely originated from the plugs constructed in Baum Lake in 1957. Riparian communities along this reach are similar to those described for the Hat Creek #1 bypass reach. In the higher gradient sections riparian canopy is generally less than 30 percent and in the lower gradient reaches riparian canopy is much greater (>70 percent) due to the abundance of white alder along the stream banks. Aquatic vegetation, *Elodea* sp. and *Ranunculus* sp., occurs along stream margins where slower water velocities are more prevalent.

Fish species present in the Hat Creek #2 bypass reach include rainbow trout, brown trout, bigeye marbled sculpin, Pit sculpin, Sacramento pikeminnow, tui chub, and Pit-Klamath brook lamprey. The most abundant species in the reach are rainbow trout and Pit sculpin with brown trout occurring in lower densities. The trout are primarily young-of-the-year. The lower and middle riffle sections of this reach contain suitable spawning and rearing for rainbow and brown trout but provide little habitat for adult trout. Adult trout from the Wild Trout Area migrate upstream into this reach during the fall and winter to spawn. Population sampling of the area conducted by CDFG verifies extensive use of this area by young-of-the-year rainbow trout. The Joerger Diversion Dam is a 4-feet high concrete rock structure located about in the middle of the bypass reach. This structure appears to form a barrier to spawning adult trout migrating upstream from the Wild Trout area (CDFG, 2000d). In contrast to the lower section, the section above the Joerger Diversion Dam consists of pool and run habitat more suitable to adult trout. Some adult trout use the pool upstream of Joerger Diversion Dam and may spawn in habitat upstream. Juvenile trout may also enter this reach from upstream reaches during spills over the Hat Creek 2 Dam at Baum Lake.

Wild Trout Area

The lower 3.5 miles of Hat Creek, downstream of the Hat Creek #2 Powerhouse, was designated as a "Wild Trout Stream" by the State Fish and Game Commission in 1972; this is one of the earliest such designations. Because of the Wild Trout Area designation, a management plan was written for the reach in 1975 and has since been updated and revised several times. The most recent plan was completed in 1999 (Deinstadt and Berry, 1999). Flows within the Wild Trout Area are provided by releases to the Hat Creek #2 bypass reach, the Hat Creek #2 Springs, and Hat Creek #2 Powerhouse releases. These sources provide a fairly stable flow regime, ranging between approximately 400 to 650 cfs.

The upstream section of the reach, just below the powerhouse, is characterized by a short, swift flowing riffle commonly referred to as the Powerhouse Riffle by CDFG and fishermen. Substrates in the riffle are comprised of cobble, gravel and sand. Gravel pockets within the riffle provide some suitable spawning habitat for trout. The channel is greater than 100 feet wide and riparian vegetation consists of mature alder, oak, and pine. A parking lot provides a popular access point for anglers and the Powerhouse Riffle receives heavy use by angers during the trout season. The FERC License Project boundary ends at the lower end of the Powerhouse Riffle.

The next 1.75 miles of the reach, downstream to the Highway 299 crossing, is a wide, slow-moving stream with a relatively deep channel that meanders through low rolling grasslands with scattered oak and conifer trees. The streambed consists of sand and silt substrates; however, the underlying diatomaceous layer is occasionally exposed within the stream channel. Sand and silt areas of the channel provide suitable locations for growth of aquatic vegetation. Abundant beds of *Elodea* sp. and *Myriophyllum* sp. are common throughout the reach and provide a good environment for aquatic macro-invertebrates and cover for trout.

Historic cattle grazing through this reach has prevented the establishment of healthy riparian stands along the stream channel. The exclusion of cattle from the stream channel in recent years has improved conditions for recovery of riparian vegetation along this reach, and willows are beginning to colonize along the stream channel. Angler use and muskrat burrows continue to cause bank stability problems in some areas.

For approximately the next mile downstream, the stream enters a section with a moderately steep gradient forming a long riffle. Bottom substrates in this reach consist of imbedded rubble with a thin layer of gravel covering a diatomaceous layer. Riparian vegetation consists of scattered pine, oak, and alder. The high water velocities of the reach limit the formation of important cover structures necessary for trout. To improve instream cover, boulders and woody debris have been experimentally placed in sections of the reach. Trout Unlimited and CDFG constructed a fish barrier at the bottom of the reach (0.1 mile upstream of Lake Britton) in 1968. The barrier, which is as an important component of the Trout Restoration Program, is designed to block migration of competing non-game species (Sacramento sucker, hardhead and tui chub) from Lake Britton to the Wild Trout Area upstream.

The Trout Restoration Project is a cooperative effort between Pacific Gas and Electric Company, Trout Unlimited, Humboldt State University Cooperative Fisheries Research Unit and CDFG. The Project began in 1968 and includes the following actions: 1) construction of a fish barrier upstream of Lake Britton to prevent upstream migration of Sacramento sucker and other non-game species that could potentially compete with desirable trout species; 2) eradication of the existing fish population from Baum Lake to the barrier with chemical treatments; 3) restocking of the reach with suitable strains of wild trout; 4) implementation of new fishing regulations to prevent over-harvest and stimulate creation of a trophy wild trout fishery; and 5) evaluation of the Project to assess its success and possible application to other California streams. The Trout Restoration Project has proven to be a great success since the initial actions were completed. More recent management objectives, described in subsequent Wild Trout Management Plans (Deinstadt & Berry, 1999), continue to maintain a quality wild trout fishery in the reach.

Other fish species present in the Wild Trout Area include Sacramento sucker, hardhead, tui chub, bigeye marbled sculpin, Pit sculpin, rough sculpin (*Cottus asperimus*), Sacramento pikeminnow, and Pit-Klamath brook lamprey.

Special-Status Fish Species

A query of the CNDDB for the Project, covering the area within the FERC Project boundary and a one-mile buffer around it, indicated presence of several special-status fish species (see Table 4.4-3). Rough sculpin, a State threatened species, and bigeye marbled sculpin, a State Species of Special Concern, were documented in the Project area during 1993 surveys. A second species, hardhead, a State Species of Special Concern and a Forest Service sensitive species, was also documented in the Project vicinity in 1992.

FERC License 2661

Issues related to habitat conditions for various fish species continue to be the basis for discussions with resource agencies. FERC's license articles address fisheries and other biological issues with regard to the Project. Specific license articles addressing fisheries issues include 15, 16, 32, and 33. FERC License Articles 15 and 16 address the conservation and development of fish and wildlife resources. FERC License Article 32 requires continuous minimum flows for fishery management purposes as agreed upon by Pacific Gas and Electric Company and CDFG. FERC License Article 33 requires consultation with USFWS and CDFG regarding protection of natural resources. Pacific Gas and Electric Company operates the project in compliance with these license conditions and regulatory requirements.

Pacific Gas and Electric Company and the resource agencies have established a task force to address fisheries problems associated with scheduled canal outages. Currently, Pacific Gas and Electric Company voluntarily provides biologists and work crews to assist, when necessary, in fish rescue operations conducted prior to scheduled canal outages.

Bundle 2: Pit River

The Pit River Bundle covers a large geographic area that includes the Fall River, McCloud River, and the Pit River from the confluence of the Fall River downstream to the Pit 7 afterbay. The main stem of the Pit River forms near the town of Alturas in Northern California. From there, it flows westward, past the town of Fall River Mills, and ultimately to Lake Shasta on the Sacramento River. Lake Shasta is operated by the U.S. Bureau of Reclamation as the keystone of the Central Valley Project. Pit River flows upstream of the Fall River are derived primarily from rainfall and snowmelt. Agricultural water diversions in this portion reduce flows in the Pit River substantially during the summer growing season. The Fall River is the largest tributary to the Pit River and enters the Pit River approximately one mile south of the town of Fall River Mills. Hat Creek (Bundle 1) enters the Pit River at Lake Britton. Other larger tributary streams in the basin include Burney Creek, Rock Creek, Nelson Creek, and Kosk Creek.

The Bundle incorporates three existing FERC licenses, which are Pit 1 (FERC 2687), Pit 3, 4, and 5 (FERC 0233), and McCloud-Pit (FERC 2106). Both lacustrine (lake) and riverine (river) habitats associated with the Pit River FERC Projects support a variety of warm and coldwater fish species.

The following sections describe the fisheries and aquatic habitats, including special-status fish species associated with each FERC project license included in Bundle 2.

Pit 1 (FERC 2687)

The Pit 1 Project is situated on the Pit River and the Fall River (a tributary to the Pit River) in Shasta County. The Pit River originates on the western slopes of the Warner Mountains near Alturas, in Modoc County. It flows southwesterly through Big Valley, Fall River Valley, Lake Britton, the Pit River Canyon, and eventually, into Lake Shasta on the Sacramento River, a distance of approximately 150 miles. Major tributaries to the Pit River include Fall River, Hat Creek, and Burney Creek.

Fall River originates from numerous large springs and spring-fed tributaries, including Spring Creek, Lava Creek, and the Tule River. The only regularly flowing surface tributary to Fall River is Bear Creek. The Tule River is a major tributary with spring-fed sources that include Little Tule River, Ja-She Creek, and Big Lake. The Fall River flows in a southwesterly direction for approximately 40 miles before merging with Pit River.

All the storage and diversion facilities of the Pit 1 Project are located on the Fall River, but the Pit 1 Powerhouse is located on the Pit River, 6.7 miles downstream of the confluence of Fall and Pit rivers. The drainage area of the Fall River utilized by the Pit 1 Project is approximately 600 square miles.

Aquatic Habitats

Pit 1 Project land supports a variety of fish species, aquatic resources, and habitats. Major water bodies located in the vicinity of the Pit 1 Project include both lacustrine (lake) and riverine (river) habitats. Big Lake, Horr Pond, Pit 1 Forebay, and Fall River Pond are the primary lacustrine water bodies. Fall River, Tule River, Little Tule River, and an 11.2-mile reach of the Pit River from the confluence of the Fall River downstream to Lake Britton comprise the major riverine habitats that are affected by the operation of the Pit 1 Project.

Big Lake, Horr Pond, Tule River, and the Little Tule River. Big Lake is located approximately 14.5 miles to the northeast of the Pit 1 Diversion Dam. The lake is essentially a wide shallow section of the Tule River and receives its only inflow from precipitation and a series of springs located along its north shore. The lake has an average depth of about 6 feet with a maximum depth of 10 to 11 feet and covers a surface area of approximately 750 acres. The south shoreline consists of a peat levee and lava rock forms the remaining shorelines. The lake bottom is primarily comprised of decomposed vegetation and peat. Shoreline vegetation includes bands of emergent tules and cattails on the east, north, and west sides of the lake, which grades to an area of conifer and oak woodland. The south shore is comprised primarily of pasturelands with sparse bands of tules and cattails. Flow from Big Lake travels west and enters directly into Horr Pond.

Horr Pond was created in 1962 when a levee on the north side of the Tule River failed and flooded an area previously reclaimed in the early 1900s. The lake has a surface area of about 170 acres and is 1 to 3 feet deep. Bottom substrates are comprised of organic material with scattered earthen clumps. There are no springs in Horr Pond and the entire inflow to the pond comes from Big Lake.

The Tule River originates at the springs located in Big Lake, and in reality both Big Lake and Horr Pond are part of the Tule River. Downstream of Horr Pond, the Tule River ranges in width from 200 to 1,500 feet and depths range from 4 to 5 feet along the shoreline and thalweg depths range between 10 and 15 feet. The river is confined by levees that were constructed as part of a reclamation project in the early 1900s. The channel has a gentle slope creating a very slow moving run for its entire length. Flows in the Tule River are estimated to range from 550 to 1,000 cfs. Emergent vegetation is primarily comprised of tules and cattails along the northern shoreline. Cattle grazing along the southern shore, which has since been eliminated, has reduced the abundance of emergent vegetation present there. Exclusionary fencing was constructed along the southern shoreline in 1991 and 1992, excluding cattle from access to the southern shoreline. Sparse stands of willow (*Salex* sp.) provide the only source of woody riparian vegetation along the river. Tule River enters Fall River approximately 9.5 miles upstream from the Pit 1 Diversion Dam on the lower section of Fall River.

The Little Tule River begins from spring-fed Lava Creek and Eastman Lake to the north of Tule River. Little Tule River flows in a southerly direction for approximately 3.2 miles where it joins the Tule River approximately one and a half miles upstream from its confluence with Fall River. The Little Tule River ranges in width from about 150 to 400 feet and is generally shallow close to shore with depths increasing to about 8 to 10 feet in the thalweg. Substrates are primarily comprised of fine sediment and decaying organic matter. Large beds of aquatic vegetation (*Elodea* sp.) form within the channel during the spring. Emergent vegetation (tules and cattails) is abundant along the eastern shoreline and is less common along the western shoreline. The lower section of the river is confined between levees constructed in the early 1900s. A few scattered clumps of willows provide the only woody riparian vegetation along the riverbanks.

Fall River. The Fall River drains a 612 square mile area of volcanic plateau. Fall River is approximately 21.3 miles in length, originates at Thousand Springs (elevation 3,320 feet) to the north, and joins the Pit River just south of the small community of Fall River Mills (elevation 3,302 feet). Thousand Springs is comprised of a series of springs that surface in lava beds located northeast of the town of Dana. Flows are relatively stable throughout the year due to the stream's spring flow origins. Summer flows in the upper reach are generally around 450 cfs.

Bear Creek enters Fall River just downstream of Thousand Springs and contributes the only significant surface flow to the upper river section. Bear Creek is commonly intermittent during the summer; however, during the winter and spring seasons, it can contribute significant high flow to Fall River during heavy rainfall and snow melt periods.

Spring Creek joins Fall River 5.2 miles downstream from Thousand Springs and contributes additional cold spring-fed flow to the river at this point. Mid-summer water temperatures in the upper reach provide excellent conditions for trout and generally range from the low to mid 50s °F. The confluence of Spring Creek marks the general boundary between the upper and lower sections of Fall River. In the upper section (5.2 miles), the river flows through a ponderosa pine forest interspersed with a few wide lower gradient meadows. Riparian vegetation is minimal and is comprised of willow, alder, and pine.

In the lower reach (lower 16 miles) downstream of the confluence of Spring Creek, the river meanders through valley grasslands, which are extensively used for agricultural production and cattle grazing. The river has a gentle slope, less than 1 foot per mile, and can be described as a slow moving meandering river. The width of the river in this reach increases to about 300 feet. Depths range from approximately 2 feet in shallower sections to over 20 feet in the deeper pools. Bottom substrates are comprised of clay hardpan, diatomaceous earth, silt, sand, lava cobbles, and decaying organic matter (Tetra Tech, Inc., 1998). Submerged aquatic macrophytes, *Elodea nuttallii, E. canadensis, Myriophyllum sibiricum, Zannichellia palustris, and Ranunculus aquatilis,* form weed beds sporadically distributed throughout the channel (NSR 1997). These aquatic weed beds have historically provided good substrates for aquatic invertebrate production as well as provide valuable cover for trout and other fish species. In recent years, large contributions of sand have entered the system and are currently moving through the lower reaches of the river. Increased quantities of sand are believed to be a factor in recent declines in the abundance of submerged vegetation within the river. Where exclusionary fencing has been installed, or in land areas where cattle ranching does not occur, extensive bands of emergent vegetation and riparian plant species occur along the river banks. In areas where cattle grazing still occurs, and exclusionary fencing has not been installed, riparian and emergent vegetation has been eliminated from river margins. Common emergent plant species present in the river include *Sparganium emersum, Juncus effuses*, and *Scirpus acutus*. Riparian plant species present include willow, ash, alder, and cottonwood.

Contributions from Spring Creek and the Tule River generally provide an additional 1,200 cfs to the 450 cfs flow contribution from upper Fall River. Fall River base flows near the Pit 1 Diversion Dam generally range between 1,100 and 2,000 cfs (FERC 1998). Since construction of the Pit 1 Project in 1922, nearly all of the flow in the Fall River has been diverted through the Pit 1 Tunnel, which begins at the Pit 1 Diversion Dam and ends at the penstocks leading to the Pit 1 Powerhouse. As a result, flows in the lower-most one mile of Fall River, between the Pit 1 Dam and its confluence with the Pit River, has been severely reduced and is limited to seepage flow and occasional winter spills. Because of the low gradient in the lower reaches of the river, operation of the Pit 1 Diversion Dam can affect water surface elevations in Fall River for a considerable distance upstream. Therefore, water surface elevations in the lower Fall River are controlled at the Pit 1 Diversion Dam to simulate natural seasonal river elevations and deliver water to the Pit 1 Forebay. The Pit 1 Forebay Dam, downstream of the Pit 1 Diversion Dam, serves as a small storage reservoir and diversion point for water deliveries into the Pit 1 Tunnel and Pit 1 Powerhouse.

Pit 1 Forebay. The Pit 1 Forebay Dam is located on the Fall River approximately one mile upstream from the confluence of the Fall River with the Pit River. The Pit 1 Diversion Dam provides flow to the Pit 1 Forebay Dam and is located near the Pit 1 Diversion Tunnel approximately 1.6 miles upstream of the Pit 1 Forebay Dam. Water surface elevations in the Pit 1 Forebay fluctuate up to three feet daily as water diversions are sent through the Pit 1 Tunnel. Under normal project peaking operations the forebay attains maximum water depth between 8 and 10 AM, and is then drawn down through the day as water is diverted through the Pit 1 Tunnel until minimum depth is reached at about 10 PM each night. The forebay has a maximum water storage capacity of 3,212 acre-feet with a usable storage capacity of 1,159 acre-feet. Water depths in the forebay are generally shallow with a maximum depth of 10 feet. The surface area is approximately 222 acres. Bottom substrates are comprised of mud and silt with one small area of boulders present along the northwest shoreline. Extensive beds of aquatic macrophytes, including *Elodea* sp. and *Ceratophyllum* sp., are common along the west shore and other shallow areas along the shoreline. By the late summer, aquatic vegetation beds dominate the water column and extend into the water body from shore for about 30 feet. Shoreline vegetation is comprised of chaparral, sage, and grasslands along the north and east sides of the forebay. Emergent vegetation and a few scattered willow shrubs are common along the south and west sides of the forebay.

Fall River Pond. The Fall River Pond is located downstream (0.7 miles) of the Pit 1 Forebay Dam in the town of Fall River Mills. A small diversion weir creates Fall River Pond and is not part of the Pit 1 Project facilities. The diversion weir serves to divert water to a private ranch located south of town (Knoch's Ranch). When requested by the water right holder, up to 27 cfs is released below the Pit 1 Forebay Dam to the diversion weir where it is diverted for agricultural purposes. The pond is shallow with depths ranging from 5 to 7 feet and has a general width of 200 feet. Extensive beds of aquatic vegetation (*Elodea* sp., *Ceratophyllum* sp., *Myriophyllum* sp., and *Ranunculus* sp.) and large floating mats of vegetation and algae form in the pond each summer. Emergent vegetation (cattails and tules) is common along the shoreline from just downstream of the Pit 1 Forebay Dam to the Highway 299 bridge in the town of Fall River Mills. High water temperatures, excessive growth of aquatic macrophytes and algae, and elevated pH levels occur in Fall River pond during the summer months. Lack of flow and the presence of abundant aquatic plants in the pond contribute to low dissolved oxygen (DO), accumulations of sediment, and high nutrient concentrations. The Fall River Mills Community Services District has documented water quality problems in the Pit 1 Forebay and Fall River Pond that are believed to cause odor and taste problems in their drinking water. Current flow negotiations, which will be incorporated in the pending FERC License, result in an increase in bypass flows downstream of the project and will improve water quality in this reach.

Lower Fall River, Downstream of the Fall River Weir to the Pit River. Under the current FERC license, no flow releases are required downstream of the Pit 1 Forebay Dam with the exception of water releases to the Fall River Pond to supply the private water right. As a result, this section of stream channel is dry the majority of time and only receives flow from seepage or during high flow spill events caused by heavy runoff. Some water is present in pools that formed in the lava bedrock of the historic river channel. Since flows were eliminated from this reach, riparian vegetation, mainly willow species, has encroached into the historic river channel. A short distance downstream from the Fall River Weir (0.2 miles), the channel gradient increases substantially, forming a series of step runs. Just prior to joining the Pit River, the channel forms a steep cascade where the channel drops about 60 feet in elevation.

Pit River. The Pit 1 Project vicinity includes approximately 11.2 miles of the Pit River from the confluence of the Fall River downstream to Lake Britton. From its confluence with the Fall River, downstream to Big Eddy (approximately two miles), the Pit River has virtually no gradient and is characterized by three long deep pools separated by two short riffles. The pools have a depth of up to 40 feet and the channel ranges in width from 60 to 300 feet. The pool:run:riffle ratio through this reach is 98:2:0. Channel substrates across riffle habitats are comprised of large cobble and small boulders. This two-mile section ends at a large lava-formed bedrock sill at Big Eddy.

Downstream of Big Eddy the river enters the Pit River Gorge and is characterized as a steep narrow canyon with a stream gradient drop of approximately 80 feet per mile. River widths through this reach range from about 60 to 100 feet and depths range from 2 to 4 feet across riffle habitats and from 5 to 7 feet in pool habitats. The pool:run:riffle ratio through this reach is 21:51:28. Substrates through this reach range in size from large cobble to large boulders up to 10 feet in diameter. Small gravel pockets occur infrequently and when present are found behind velocity barriers such as large boulders, in pools, or near river margins. In run habitats large boulders provide velocity shelters and create additional pocket-water habitat types. Pit River Falls, the largest falls on the Pit River, is located within this reach less than two miles upstream from the Pit 1 Powerhouse. Summer low flows at the head of this reach of the Pit River range from approximately 60 to 230 cfs. Numerous small springs located downstream of Pit River Falls contribute an additional 105 cfs of flow to the Pit River. The physical nature of the canyon, bedrock walls and large substrates prevents development of significant stands of riparian vegetation along the stream banks. In the lower reaches of the canyon, riparian vegetation is more common and includes white alder, Oregon ash, willow, and mixed conifer species. The Pit 1 Powerhouse is located near the bottom of the canyon reach about five miles upstream from Lake Britton.

Downstream of the Pit River Gorge, the river gradient deceases substantially to approximately 25 feet per mile. Habitats in this reach include pools and slow runs separated by short shallow riffles. The ratio of pools:riffles:runs in this section is 16:52:32. River widths through this reach increase from approximately 80 to 100 feet just below the Pit 1 Powerhouse to 400 feet as the river enters Lake Britton. Gravel deposits are rare in this section with the majority of substrates comprised of large cobble to medium boulders. Riparian vegetation in this section is more firmly established than in the canyon reach located upstream. Typical riparian species include Oregon ash, white alder, willow sp., and various sedge and herb species.

Flow releases from the Pit 1 Powerhouse contribute the vast majority of flow to this lower section upstream of Lake Britton. Typical mean monthly summer releases from the powerhouse range from about 1,100 to 1,200 cfs, and winter releases range from about 1,300 to 1,450 cfs. Because the Pit 1 Project is operated on a block-loaded peak basis, daily flows downstream of the Pit 1 Powerhouse vary significantly. Typical releases ranging from a high of 1,800 to 2,028 cfs during daytime and evening hours and are reduced to a low flow of about 200 to 350 cfs during the night and early morning hours. Sucker Springs Creek enters the Pit River approximately 0.75 mile below the Pit 1 Powerhouse and contributes an additional 36 cfs.

Fishery Resources

The fish associated with the Pit 1 Project consist mostly of native cool-water species dominated by Sacramento sucker in the Pit River, and tui chub, sculpin, and sucker in the Tule River and Lower Fall River. Game species include rainbow and brown trout, largemouth bass, channel catfish, and bullhead. A complete list of fish species present in the Pit 1 Project vicinity is presented in Table 4.4-5.

Moyle and Daniels (1982) describe five fish zones within the Pit River System. Three of these zones are present within the Project vicinity and include the Rough Sculpin Zone, Introduced Warmwater Zone, and Squawfish Zone. The Rough Sculpin Zone is the largest of the three zones present in the Pit 1 Project vicinity and is characterized by deep, clear runs with abundant beds of aquatic vegetation. These habitats are present in the Fall River, Tule River and Little Tule River. Species characteristic of this zone include rough sculpin, bigeye marbled sculpin, and tui chub. Rainbow trout and brown trout are also abundant in this zone and comprise an important fishery resource for anglers.

The Introduced Warmwater Zone occurs in the slow, deep water run and pool area of the Pit River from the confluence of the Fall River downstream to Big Eddy Pool. The dominant species in this zone are comprised of several nonnative gamefish that include bluegill (*Lepomis machrochirus*), green sunfish (*L. cyanellus*), largemouth bass *(Micropterus salmoides*), and black crappie (*Pomoxis nigromaculatus*). Native fish species include hardhead (*Mylopharodon concephalus*) and Sacramento pikeminnow.

The Squawfish Zone occurs in the canyon reach of the Pit River downstream of the Big Eddy Pool to Lake Britton. Typical fish species that occur in this zone include Pit sculpin, Sacramento sucker (*Catostomus occidentalis*), hardhead, tule perch (*Hysterocarpus traski*) and Sacramento pikeminnow. Trout are also present in this zone and provide some angling opportunities.

Table 4.4-5 Shasta Regional Bundle – Pit 1 Project (FERC 2687) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Pit-Klamath brook lamprey	Rainbow trout	Brown trout	Tui chub	Hardhead	Sacramento pikeminnow	Crap	Golden shiner	Sacramento sucker	Brown bullhead	Black bullhead	Channel catfish	Mosquitofish	Bluegill	Green sunfish	Black crappie	Largemouth bass	Smallmouth bass	Tule perch	Pit sculpin	Bigeye marbled sculpin	Rough sculpin
Fall River Pond (Pit 1 Diversion Dam)	None	X	X	X	X		X	X		X	X	X		X	X	X		X				X	X
Fall River between Pit 1 Diversion Dam and Pit 1 Forebay	Pit 1 Diversion Dam is operated to simulate natural seasonal water levels in the Fall River	X	X	X	X		X	X		X	X	X		X	X	X		X				X	X
Pit 1 Forebay	None		X		X	X	X	X		X		X		X	X	X	X	X				X	X
Fall River from Pit 1 Forebay to confluence with Pit River	Proposed for pending license: 6/1-10/31: 150 cfs 11/1-11/15: 75 cfs 11/16-11/30: 50 cfs 12/1-4/30: 25 cfs 5/1-5/15: 50 cfs 5/16-5/31: 75 cfs	X	X	X	X		X	X		X	X	X		X	X	X		X				X	X
Pit River from confluence with Fall River to Pit 1 Powerhouse	Receives releases from Fall River and flows from Pit River upstream of confluence with Fall River and accretion		X			X	X	X	X	X		X	X		X	X	X	X	X	X	X		X
Pit River from Pit 1 Powerhouse tailrace to Lake Britton	Proposed for pending license: Year round: 700 cfs		X			X	X	X	X	X		X	X		X	X	X	X	X	X	X		X

a cfs = cubic feet/second

Fall River Wild Trout Area. In 1972, the Fish and Game Commission designated Fall River as one of the State's original 16 streams to receive special management and habitat protection under the Wild Trout Program. The Wild Trout Area includes the entire river from its headwaters at Thousand Springs downstream to the Pit 1 Diversion Dam. Special fishing regulations have been established for this section from its headwaters to the mouth of the Tule River, including Spring Creek, to enhance and maintain a quality wild trout fishing experience. Hatchery trout have not been planted in this reach since 1956. Current regulations allow for a two fish (trout) limit with a 14-inch maximum size limit, and only artificial lures with barbless hooks may be used. Nearly all of the land adjacent to Fall River is under private ownership and public access to the river is limited to a few access points.

As a result, a boat is required to take full advantage of the fishing opportunities that are available along Fall River within the Wild Trout Area. The California Department of Fish and Game has periodically conducted fish population surveys in the Wild Trout Area of Fall River since 1975 (Rode and Weidlein, 1986). In 1986, CDFG identified ten different fish species present in Fall River upstream of the Pit 1 Diversion Dam (Rode and Weidlein, 1986). The dominant coldwater game fish species present included rainbow trout with brown trout present in much lower numbers. Native non-game species include Sacramento sucker, Sacramento pikeminnow, tui chub, rough sculpin, bigeye marbled sculpin, and brook lamprey (*Lampetra planeri*). Introduced warmwater species are also present, although rarely, and include largemouth bass and brown bullhead (*Ictalurus melas*).

In February 1986, a large volume of sediment entered the Fall River from Bear Creek during a storm event that caused flooding in much of California. This large influx of sediment impacted aquatic vegetation and may have impacted fishery populations in the years immediately following the event. Recent population surveys conducted by the CDFG indicate that fishery populations have since recovered and that impacts that may have resulted from sediment deposits did not appear to be a serious threat to trout populations which tend to be cyclic in nature (Tetra Tech, Inc., 1998). The Fall River Resource Conservation District is currently investigating potential solutions to reduce sediment within the Fall River channel to improve conditions for aquatic vegetation and fishery resources.

Special-Status Species. Three special-status fish species occur in the vicinity of Pit 1 Project waters and are endemic to the Middle Pit Drainage, including portions of Fall River, Hat Creek, and Rising River. These species are rough sculpin, a State threatened species, and hardhead and bigeye marbled sculpin, State species of concern (Table 4.4-6). Rough sculpin, marbled sculpin, and hardhead are affected by conversion of riverine habitat to reservoir habitat that favors introduced species, by reduced flows in the bypass reach, and by fluctuating flows downstream of the powerhouse. Levee repairs may also impact rough sculpin and bigeye marbled sculpin and other fishes. Pit roach may also be present in the Pit River upstream of Lake Britton.

Table 4.4-6 Special-Status Fish Species That Occur in the Shasta Regional Bundle

Family Name Common Name (*Scientific Name*)	State/Federal Designations[a]	Status of Occurrence by Project					
		Hat Creek (FERC 2661)	Pit 1 (FERC 2687)	Pit 3, 4 and 5 (FERC 0233)	McCloud-Pit (FERC 2106)	Kilarc-Cow Creek (FERC 0606)	Battle Creek (FERC 121)
Salmonidae (Salmon and Trout Family)							
Central Valley steelhead ESU[b] (*Oncorhynchus mykiss irideus*)	--/FT						Documented to occur in lower reach of Battle Creek[c,j]
McCloud River redband trout (*Oncorhynchus mykiss* spp. 2)	CSC/FSS				Documented from upper McCloud River and tributaries[c]		
Chinook salmon (*Oncorhynchus tshawytscha*)							
Spring-run	ST/FT, FSS						Documented to occur in lower reach of Butte Creek[c,j]
Fall-run	CSC/FC, FSS					Known from Cow Creek	Documented to occur in lower reach of Butte Creek[c,j]
Late fall-run	CSC/FC, FSS					Known from Cow Creek	Documented to occur in lower reach of Butte Creek[c,j]
Winter-run	SE/FE						Possible use of Battle Creek, but spawning success uncertain
Cyprinidae (Minnow Family)							
Pit roach (*Hesperoleucus symmetricus mitrulus*)	CSC/--		May occur; occurs in adjacent Pit 3,4 and 5 Project[e]	Documented to occur[h]	Documented from Pit 6 Reservoir[e]		
Hardhead (*Mylopharodon conocephalus*)	CSC/FSS	Documented to occur[c]	Documented to occur[f]	Documented to occur[h]	Documented from Pit River[c,i]		

Table 4.4-6 Special-Status Fish Species That Occur in the Shasta Regional Bundle

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		Hat Creek (FERC 2661)	Pit 1 (FERC 2687)	Pit 3, 4 and 5 (FERC 0233)	McCloud-Pit (FERC 2106)	Kilarc-Cow Creek (FERC 0606)	Battle Creek (FERC 121)
Cottidae (Sculpin Family)							
Rough sculpin (*Cottus asperrimus*)	ST, DFG FP/--	Documented during 1997-98 surveys[d]	Documented to occur[g]	Documented to occur[h]	May occur in Pit 6 and/or Pit 7 reservoirs[e]		X
Bigeye marbled sculpin (*Cottus klamathensis macrops*)	CSC/--	Documented to occur[d]	Documented to occur[d]	Documented to occur[h]	Documented from Pit 6 Reservoir[e]		

a Designation Abbreviations:

-- = No designation

State Designations
CSC = California Special Concern species
DFG FP = Department of Fish and Game Fully Protected species
ST = State Threatened species
SE = State Endangered species

Federal Designations
FSS = Forest Service Sensitive species
FC = Federal Candidate species
FT = Federal Threatened species
FE = Federal Endangered species

b ESU = Evolutionarily Significant Unit

c CDFG. 2000. California Natural Diversity Database. California Department of Fish and Game, Natural Heritage Division, Sacramento. July.

d PG&E Co. 1998a. Hat Creek Project, Application for New License, Vol. I, Exhibit E.

e PG&E Co. 1998b. Pit 3, 4, and 5 Project, Application for New License, First Stage Consultation Package, Exhibit E.

f PG&E Co. 1993. Pit 1 Project, Application for New License, Exhibit E.

g Tom Hesseldenz and Associates. 1993. Survey of crayfish, sculpin, and their habitat in the Fall River and midreaches of the Pit Drainage, Northeastern California, Pacific Gas and Electric Company Hydroelectric Project Relicensing, Shasta County, California. March.

h PG&E Co. 1998c. Pit 3, 4, and 5 Project, Biological Compliance Monitoring Annual Report – 1997.

i PG&E Co. 1990. McCloud River Coordinated Resource Management Plan, Part 3 – Assessment of Existing Situation.

j PG&E Co., Bureau of Land Management, U.S. Fish and Wildlife Service, and CDFG. 1977. Angler Access Study for Battle Creek Hydroelectric Project, Federal Energy Regulatory Commission (FERC) No. 1121.

FERC 2687 License Status

Issues related to habitat conditions for various aquatic species continue to be the basis for discussions with resource agencies. FERC's license articles address fisheries and other biological issues with regard to the Project. FERC License Articles 16, 17, and 32 require Pacific Gas and Electric Company to cooperate with both CDFG and USFWS in the conservation and improvement of fish resources within the Project. FERC License Article 29 requires a schedule of water releases from the powerhouse that are compatible with Project operations and maintenance of downstream aquatic life. In addition, FERC License Article 29 calls for a report on any land leased to CDFG to expand the Pit River experimental hatchery. Pacific Gas and Electric Company operates the Project in compliance with license conditions and regulatory requirements.

The Pit 1 Project is currently in the FERC relicensing process and the following environmental measures relating to instream flows and aquatic habitat are anticipated to be added to the new license (FERC, 1999b).

- Mechanically harvest vegetation from Fall River Pond four times a year to control nuisance level excessive growth;
- Release a minimum flow to the lower Fall River downstream of the Pit 1 Forebay Dam of 150 cfs from June 1 through October 31, 75 cfs from May 16 through May 31 and from November 1 through November 15, 50 cfs from May 1 through May 15 and from November 16 through November 30, and 25 cfs from December 1 through April 30;
- Monitor minimum flows;
- Provide flows through the Powerhouse to yield a total flow in the Pit River of 700 cfs or greater downstream of the tailrace;
- Extend the upramping period to about 32 minutes by reducing the maximum generator uploading rate to 0.5 MW/minute;
- Monitor aquatic vegetation in Fall River Pond, and water quality and fish populations from Fall River Pond to the tailrace; and after 5 years, reassess harvesting frequency and flow regime;
- Fund trout stocking of Fall River Pond;
- Develop and implement a plan to provide Pit River flow information by phone or Internet.

These conditions are intended to enhance aquatic habitat within the immediate Pit 1 FERC License Project boundary. Pacific Gas and Electric Company has in the past conducted fish rescues on an as-needed basis at the Pit 1 Project. This activity has been associated with unusual events such as a levee failure at Pit 1.

Pit 3, 4, and 5 (FERC 0233)

The Pit 3, 4, and 5 Project is located entirely on the Pit River within Shasta County in Northeastern California. The Pit 3, 4, and 5 Project facilities are located in the canyon reach of the lower Pit River, which begins at Pit 1 Diversion Dam (Lake Britton) and continues westward for 60 miles to the Pit 6 Dam upstream of Lake Shasta. From Lake Britton (spillway elevation 2,732.25 feet) downstream, the Pit 3, 4, and 5 Project encompasses approximately 37.8 miles of the Pit River. The Project drains a watershed area of approximately 4,900 square miles, of which 2,800 square miles are mountainous and about 2,100 square miles are valley or mesa land. The annual precipitation averages 13 inches near Alturas at the headwaters, 26 inches at Burney near the Pit 3 Project, and 75 inches at the Pit 5 Powerhouse. In the lower reaches of the Pit River where the Pit 3, 4, and 5 Project is located, flows average about 2,000 cfs in the summer and can exceed 10,000 cfs during winter and spring.

The Pit 3, 4, and 5 Project encompasses aquatic habitats of the lower Pit River from the confluence of Hat Creek at Lake Britton downstream to the headwaters of the Pit 6 reservoir (FERC

License 2106). The bodies of water included in the Pit 3, 4, and 5 Project include Lake Britton, Pit 4 Reservoir, Pit 5 Reservoir, Pit 5 Open Conduit (tunnel reservoir) and three sections of the Pit River which include the Pit 3 bypass reach (six miles), Pit 4 bypass reach (7.5 miles), and the Pit 5 bypass reach (nine miles). The Pit 3, 4, and 5 Project includes both warmwater and coldwater habitats in lacustrine (lake) and riverine (river) habitats. The following sections describe the aquatic habitats, fisheries, and special-status fish species present within the immediate Pit 3, 4, and 5 Project vicinity.

In February 1983, Pacific Gas and Electric Company agreed to fund a study to address critical bald eagle management issues related to the operation of Pit 3, 4, and 5. An Instream Flow Study was conducted as part of that analysis to help determine the appropriate flow releases that may be necessary to provide important fish forage for bald eagles and improve the native trout fishery in the Pit River below the Pit 3, 4, and 5 facilities. The study estimated available habitat conditions, weighted usable area (WUA), for rainbow trout, Sacramento pikeminnow, Sacramento sucker, and hardhead within each of the bypass reaches over a range of flows from 10 to 600 cfs (PG&E Co., 1985c).

Aquatic Habitats

Lake Britton. The forebay of the Pit 3 Diversion Dam forms Lake Britton, which is the largest reservoir operated by Pacific Gas and Electric Company on the Pit River. Water is diverted from Lake Britton through the Pit 3 intake (elevation 2,689.9 feet). Water passes through the intake to the Pit 3 Tunnel that leads approximately 4.3 miles to the Pit 3 Powerhouse. The Pit 3 Tunnel has a maximum capacity ranging between 3,300 cfs and 3,500 cfs depending on flow and head conditions during operation. The Pit 3 Diversion Dam has a spillway elevation of 2,732.5 feet. After the threat of spills passes, three 6-foot high inflatable bladder gates are raised to increase the spillway elevation (2,738.5 feet) and storage capacity of the lake. Under normal power peaking operations, the water level of Lake Britton fluctuates on a daily and weekly basis. Generally, lake levels decrease from three to seven feet from Monday through Friday and the lake refills over the weekend when power demands are less.

Lake Britton has a surface area of approximately 1,264 acres, and has a storage capacity of approximately 40,600 acre-feet. The reservoir is about eight miles long, but is less than 0.5 miles wide in most locations. Lake Britton is located in upper reaches of the Pit River canyon, and the upper two-thirds of the reservoir retains the narrow riverine characteristics common in the Pit River. Burney Creek enters Lake Britton from the south and contributes flows between 125 and 198 cfs. The lower one-third of the reservoir is deeper, covers a wider area, and also contains some shallow water habitats, such as Burney Creek Cove, that are important for some warmwater gamefish species. Minimum hydraulic retention time in Lake Britton is 6 days, with a typical retention time estimated between 8 to 10 days.

Surface water temperatures range from less than 45°F (7°C) during winter to 77°F (25°C) during summer. The reservoir develops a weak to moderate level of thermal stratification during the summer months with maximum stratification occurring in July. Water profile temperatures for the period June through August (1987-1992) ranged from 46.7 °F (12.9°C) to 59.7 °F (25.9°C) (PG&E Co., 1998). Profile data indicate that the thermal gradient ranged from 6.3 °F (3.5 °C) to 18.5 °F (10.3°C).

The Environmental Protection Agency conducted an eutrophication survey of Lake Britton in 1975 (USEPA 1978 as cited by PG&E Co., 1998). Results of the survey revealed that Lake Britton receives nutrient rich inflow from the Pit River and Hat Creek, so that USEPA characterized Lake Britton as an over-enriched reservoir. The reservoir was not characterized as eutrophic because of its short retention period (approximately six days). Extensive agricultural use, grazing practices, and timber harvest activities in the upper Pit River drainage are likely sources of non-point nutrient loads, primarily phosphorus, to the river. USEPA also characterized Lake Britton as being nitrogen limited. Because of the over-enriched condition, heavy blooms of algae occur in midsummer and may cause floating mats of organic material across the lake surface (CDFG, 1980).

Pit 3 Bypass Reach. The Pit 3 bypass reach includes approximately six miles of the Pit River downstream of the Pit 3 Diversion Dam to the Pit 3 Powerhouse, which releases diverted flows directly into Pit 4 Forebay. Prior to 1987, bypass flows were limited to spring flow accretions (approximately 50 cfs) within the reach, contributions from Rock Creek, and spills over Pit 3 Diversion Dam. In January 1987, FERC issued an order approving an increase in minimum flows to 150 cfs to the Pit 3 bypass reach. This flow increase was made to enhance bald eagle foraging habitat and improve habitat for rainbow trout (FERC, 1987). Spill flows of up to 4,000 cfs are common during the spring run off period, and spills can exceed 20,000 cfs during large storm events.

The Pit 3 bypass reach is confined to a steep-sided narrow canyon and is characterized by short, deep riffles, interspersed by sections of run and large pools. Bottom substrates consist primarily of cobble and boulder covered by diatoms and filamentous algae. The woody riparian plant community is primarily comprised of willow and white alder. A combination of low level water releases from Pit 3 Diversion Dam and additional spring flow accretion provide cool water temperatures throughout this reach. Mean water temperatures are generally between 48.8°F (15°C) and 50.8°F (17°C), with maximum water temperatures during July and August between 49.8°F (16°C) and 52.8 °F (19°C). Since 1987, when bypass flows were increased to 150 cfs, low-level water releases from Pit 3 Diversion Dam have resulted in an increase in water turbidity to the bypass reach. This increase in water turbidity is primarily caused by algae, which gives the water a green color.

Rock Creek is the only significant tributary that enters the Pit River in the Pit 3 bypass reach. The creek enters the bypass reach at about the midway point, approximately three miles upstream of the

Pit 3 Powerhouse. The lower reach of the creek has a moderate gradient and consists primarily of small pools, pocket water, short riffles and cascades. Stream substrates are a mixture of boulders, cobbles and gravel. Riparian vegetation, primarily comprised of white alder, is well developed and provides a dense canopy over the stream. Approximately 1.6 miles upstream of the mouth, the first of several falls forms a complete barrier to trout migration. Prior to 1987, a 12-foot high diversion dam was present on Rock Creek 0.9 miles upstream of the mouth. The dam diverted flows in Rock Creek (25 cfs maximum) into the Pit 3 Tunnel. Bypass flows to lower Rock Creek only occurred when flows in the creek exceeded the 25 cfs diversion capacity. As a result, lower Rock Creek flows were usually limited to accretion and seepage (1 cfs) from late spring until the first major rainfall occurred in the fall. The diversion dam was removed in the spring of 1987, and natural flows have been restored, providing improved spawning and rearing habitat for trout populations in the Pit 3 bypass reach.

Pit 4 Reservoir. Pit 4 Reservoir has a surface area of approximately 105 acres and a gross capacity of 1,970 acre-feet. The dam has a spillway crest elevation of 2,408 feet and is controlled by two drum-type gates that regulate the reservoir elevation to 2,422.5 feet. The reservoir has a hydraulic retention time ranging from 0.2 to 0.3 days. Pit 4 Reservoir serves as both an afterbay for the Pit 3 Powerhouse, which is located at the head of the reservoir, and a forebay for water diversions through the Pit 4 Tunnel that leads to the Pit 4 Powerhouse. The Pit 4 Tunnel has diversion capacity of approximately 3,700 cfs under normal operating conditions, and a 4,500 cfs capacity under high head, high flow conditions. Average flow to the Pit 4 Powerhouse is approximately 2,500 cfs. Because of the small size of the reservoir and its short retention time, the reservoir is isothermic and has little affect on water temperatures. Water surface elevations fluctuate daily in response to power peaking operations through the Pit 4 Tunnel.

Pit 4 Bypass Reach. The Pit 4 bypass reach is a well defined channel characterized by meanders with relatively long narrow runs and pools separated by riffles. The reach is approximately 7.5 miles long. Bottom substrates are primarily comprised of cobble and boulder. Since 1987, fish flow releases of 150 cfs have been maintained downstream of the Pit 4 Diversion Dam. Canyon Creek and Deep Creek are the two primary tributary streams entering the Pit River in this reach. Canyon Creek is estimated to contribute a flow between 0 and 88 cfs, while Deep Creek is estimated to contribute between 10 to 66 cfs of flow to the reach. Pacific Gas and Electric Company operates a gauging station immediately below the Pit 4 Diversion Dam. For the period from 1922 to 1998, flows to the Pit 4 bypass reach ranged from 22 to 33,700 cfs.

Water releases to the Pit 4 bypass reach originate from a combination of flow from the Pit 3 Powerhouse and Pit 4 Reservoir. Releases from the Pit 4 Dam occur at midlevel and surface locations. Water temperatures in the Pit 4 bypass reach are warmer than in the Pit 3 bypass reach with mean daily temperatures in July commonly between 52.8°F and 53.8°F (19 and 20°C) in the upper three-fourths of the reach. Coldwater inflows from Deep Creek and springs decrease water temperatures by approximately 1.8 to 2.6°F (1 to 2°C) in the lower one-fourth of the reach.

Pit 5 Reservoir. Pit 5 Reservoir is the smallest of the three diversion reservoirs included in FERC License No. 233. The reservoir has a surface area of 32 acres and has a usable storage capacity of 202 acre-feet. The calculated average hydraulic retention time ranges from 1.44 to 1.92 hours. The reservoir has slow moving water velocities and is long and narrow. Habitats in Pit 5 Reservoir are more characteristic of a riverine environment than a reservoir. It has steep banks for most of the shoreline with the exception of a riffle located at the head of the reservoir just below the Pit 4 Powerhouse. Pit 5 Dam has a spillway crest elevation of 2,018 feet. Reservoir elevation is controlled by four 50 foot wide steel gates, which increase the maximum water surface elevation to 2,040.5 feet. Fish water releases to the Pit 5 bypass reach are made through two fixed orifices. One is the No. 1 spillgate and the second is a 30 inch slide gate located on the left bank of the dam. Water diversions from Pit 5 Reservoir are made through the Pit 5 Intake (elevation 2,018.5 feet), which has a maximum diversion capacity of approximately 4,000 cfs under normal operating conditions and about 4,100 cfs under high flow and high head conditions. From the Pit 5 Intake water enters the Pit 5 Tunnel, which leads to the Pit 5 Tunnel Reservoir and eventually to the Pit 5 Penstocks and Powerhouse. Water surface elevations in the reservoir fluctuate daily in response to power peaking operations as water diversions are made through the Pit 5 Intake and Tunnel.

Pit 5 Tunnel Reservoir. Pit 5 Tunnel Reservoir (also referred to as Open Conduit) is comprised of an open section of the Pit 5 Tunnel. It is a wide, shallow reservoir with a surface area of 50 acres and a gross storage capacity of 958 acre-feet. The reservoir is retained by a boulder-lined levee along the north shore. The south side of the reservoir has several shallow coves with extensive beds of aquatic vegetation. The average hydraulic retention time is calculated at 0.1 to 0.2 days. Water exits the reservoir through an intake structure located on the west end that leads directly into the Pit 5 Tunnel and eventually to the Pit 5 Powerhouse. Average flow through the Pit 5 Powerhouse is approximately 2,680 cfs.

Pit 5 Bypass Reach. Pit 5 bypass reach is approximately nine miles long and begins just downstream of the Pit 5 Diversion Dam. Water proceeds downstream to the upper end of the Pit 6 Reservoir (FERC License No. 2106) and Pit 5 Powerhouse. The small community of Big Bend is located about midway between the Pit 5 Dam and Pit 6 Dam where the river canyon widens. River meander amplitude increases in the section upstream of Big Bend but becomes longer and straighter in the section downstream of Big Bend. Upstream of Big Bend the river has a high percentage riffle habitat interspersed by a few large pools. The canyon is more open in the lower section, downstream of Big Bend, where the river has a broader floodplain, larger bars, and less developed riparian vegetation. Substrates throughout the reach are comprised of boulder, cobble, and lesser amounts of gravel. Riparian vegetation is comprised of white alder, willow, and sedges.

Two larger tributaries, Nelson Creek and Kosk Creek, join the Pit River in this reach. Nelson Creek enters the river from the north just upstream of Big Bend, has a drainage area of approximately 30.9 square miles, and contributes an estimated annual average flow of 92 cfs (FERC, 1998). Kosk Creek enters the river from the north about two miles downstream of Nelson

Based upon information presented in the Bald Eagle and Fish Study (Woodward-Clyde Consultants, 1985), mean daily water temperatures at the bottom of the reach ranged from 45.9 to 55.6°F (12.1 to 21.8°C) for the period June through August 1984. Pit 5 Dam mean daily release water temperatures during the same period ranged from 48.5 to 53.7°F (14.7 to 19.9°C). The highest water temperatures occurred just upstream of Nelson Creek where maximum water temperatures reach 57.8°F (24°C) and higher for short periods during July. Cooler water contributions from Nelson Creek and Kosk Creek decrease water temperatures slightly for the remainder of the reach downstream.

Fishery Resources

Fish species associated with the Pit 3, 4, and 5 Project consist mostly of native coldwater and coolwater species in the river reaches and a mixture of these species and introduced warmwater species in the reservoirs. The river reaches are primarily occupied by native species including rainbow trout, Sacramento sucker, Sacramento pike minnow, hardhead, and Pit sculpin. Other less common species include tule perch, Pit roach, speckled dace, and rough sculpin. Brown trout, a nonnative species, has also been introduced and provides additional sport fishing opportunities. Brook trout have been introduced in Hat Creek and other smaller tributaries outside the immediate Pit 3, 4, and 5 Project vicinity and may occasionally be present in the Pit River bypass reaches. Cold and coolwater native species commonly found in the Pit 3, 4, and 5 Project Reservoirs include rainbow trout, Sacramento sucker, Sacramento pike minnow, hardhead, tui chub, tule perch, Pit sculpin, Pit-Klamath brook lamprey. Less common native cold/coolwater species include rough sculpin, speckled dace, and Pit roach. Introduced coldwater species that may also be present in the Pit 3, 4, and 5 Project reservoirs include brown and brook trout. Introduced warmwater species commonly found in Pit 3, 4, and 5 Project reservoirs include largemouth bass, bluegill, green sunfish, black crappie, white crappie (*Pomoxis annularis*), channel catfish, brown bullhead, carp, and golden shiner (*Notemigonus crysolevcus*). Table 4.4-7 contains a complete list of the fish species occurring within Pit 3, 4, and 5 Project boundaries. A more detailed description of fish species found within the Pit 3, 4, and 5 Project waters is presented in the following sections.

Lake Britton. All species found within the Pit 3, 4, and 5 Project waters are present within Lake Britton in varying degrees. Native cold/coolwater fish species tend to be more common in the upper portion of the reservoir in the transition zone between riverine and reservoir habitat. Rainbow trout are the most common coldwater gamefish species present in the upper sections of the reservoir and they also use coolwater areas associated with tributary inflow at the mouths of Clark Creek, Fish Creek, Burney Creek, and Hat Creek. Brown trout are also present in the same locations, but in much lower numbers.

Table 4.4-7 Shasta Regional Bundle – Pit 3, 4 and 5 Project (FERC 0233) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Pit-Klamath brook lamprey	Rainbow trout	Brown trout	Pit roach	Speckled dace	Tui chub	Hardhead	Sacramento pike minnow	Carp	Golden shiner	Sacramento sucker	Brown bullhead	Black bullhead	Channel catfish	Bluegill	Green sunfish	Black crappie	White crappie	Largemouth bass	Smallmouth bass	Tule perch	Pit sculpin	Bigeye marbled sculpin	Rough sculpin
Lake Britton	Lake levels may fluctuate up to 13 feet; Pacific Gas and Electric Company voluntarily maintains higher lake levels during summer recreational season		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Pit River from Lake Britton downstream to Pit 4 Forebay	Year round: 150 cfs		X	X				X	X			X													
Pit 4 Forebay	None		X	X	X	X		X	X			X				X	X			X	X	X	X	X	X
Pit River from Pit 4 Forebay downstream to Pit 5 Intake Reservoir	Year round: 150 cfs		X	X				X	X			X													
Pit 5 Intake Reservoir	None		X	X	X			X	X			X				X	X	X		X	X	X	X	X	
Pit River from Pit 5 Intake Reservoir downstream to Pit 6 Forebay	Year round: 120 cfs measured downstream of confluence with Nelson Creek		X	X				X	X			X													

a cfs = cubic feet/second

Other cold/coolwater native species commonly found in the upper portions of Lake Britton include tui chub, tule perch, Sacramento sucker, Sacramento pike minnow, and hardhead. Speckled dace are also present in low numbers. Introduced warmwater species are more abundant in the larger lower portion of the reservoir and include largemouth bass, smallmouth bass, bluegill, green sunfish, white crappie, black crappie, channel catfish, brown bullhead, and black bullhead (*Ictalurus melas*). Golden shiner is another nonnative species abundant in the reservoir.

Largemouth bass provided an excellent fishery in Lake Britton prior to 1948. In 1948, the Pit 3 Project began power peaking operations, which caused reservoir elevations to drop seven feet during the week from Monday through Friday and then refill over the weekend. The primary largemouth bass spawning area is located in Burney Creek Cove and weekly reservoir drawdown dewatered largemouth bass spawning nests causing serious losses to incubating eggs and newly hatched fry. Largemouth bass typically spawn in the late spring or early summer when surface water temperatures reach 70°F (21.1°C). To insure largemouth bass spawning success in Burney Creek Cove, CDFG recommends that the reservoir elevation be maintained at 2,732.5 ± 0.5 feet (equal to the spillway crest elevation) from April 15 to July 15 (CDFG, 1980). In 1989, Pacific Gas and Electric Company installed permanent inflatable bladder gates on the Pit 3 Dam spillway replacing the wooden flashboards that were installed seasonally. These permanent inflatable bladder gates allow the licensee to operate the Pit 3 Project in a power peaking mode without reducing the reservoir elevations below 2,732.5 feet. Numbers of young-of-the-year largemouth bass captured in fish sampling surveys have generally increased since 1989. However, numbers of 1+ and older bass have declined and this decline may be related to increased competition with smallmouth bass, which have increased in number in recent years.

The CDFG avoided planting smallmouth bass into the lake because of the potential for the species to become established in riverine reaches to the detriment of trout. Regardless, smallmouth bass were illegally introduced into Lake Britton around 1985, and have become well established, gradually expanding into other Project reservoirs and riverine reaches. Smallmouth bass spawn in deeper areas of the lake, usually on rocky substrates. As was true for largemouth bass, fluctuations in reservoir elevation could impact spawning success of smallmouth bass through nest dewatering or through water temperature fluctuations during the egg incubation period.

Black and white crappie were introduced to Lake Britton in 1969 and 1970, and, along with bluegill and green sunfish, have created additional sportfishing opportunities in the lake. Black crappie continue to provide a good fishery, but white crappie have since become rare. Young-of-year production of centrachids (bass, crappie, bluegill, and sunfish) has increased since 1988 when compared to estimates for 1983 and 1984. This increase in young-of-the-year production may be attributed to the lack of reservoir drawdown that was necessary to change the wooden flashboards during the centrachid nesting period prior to 1989. Habitat structures, primarily cabled trees, have been installed at various locations along the lakeshore and have been effective in creating additional habitat for introduced centrachids. Introduced channel catfish, brown bullhead, and black bullhead have also created additional fishing opportunities for visiting anglers.

In an attempt to improve the coldwater fishery the CDFG began stocking Lake Britton with various salmonid species in 1966. Salmonids stocked include three strains of rainbow trout (Pit River, Eagle Lake, and Pit River x Eagle Lake hybrids), brown trout, kokanee salmon (*O. nerka*), and coho salmon (*O. kisutch*). Tagging studies were conducted in 1966, 1972, 1973, and 1976 to evaluate the success of trout plants. Harvests of planted trout by sport fishermen were generally well below 50 percent and as a result, the CDFG discontinued the stocking of trout and other salmonid species (CDFG, 1980).

Pit 4 Reservoir. Pit 4 Reservoir has much less habitat diversity than Lake Britton, including fewer coves and less structural habitat in the form of fallen trees and aquatic vegetation. Most of species that occur in Lake Britton also occur in the Pit 4 Reservoir, although not at the same level of abundance. Centrachids tend to be much less abundant relative to native species, and the lower water retention time, lack of preferred habitat types, and water surface fluctuations associated with power peaking render Pit 4 Reservoir less suitable for centrachid production. Smallmouth bass are better adapted to riverine environments and may become more common in the Pit 4 Reservoir in the future as their distribution throughout the system increases.

Native species of Sacramento pike minnow, Sacramento sucker, hardhead, and tule perch are the most abundant fish species present in the reservoir and provide an important prey species to bald eagles. Pit roach, speckled dace, Pit sculpin, bigeye marbled sculpin, and rough sculpin are also present in lower numbers. Rainbow trout are present in the reservoir in low numbers and do not provide a substantial fishery in the reservoir.

Pit 5 Reservoir. Pit 5 Reservoir is long and narrow with steep sides along most of the shore. The riverine nature of the reservoir does not provide favorable habitat for introduced centrachids. The riffle at the head of the reservoir just downstream of the Pit 4 Powerhouse provides good habitat for Sacramento sucker and rainbow trout, which are relatively abundant in that section. Both Sacramento sucker and hardhead spawn in the riffle section and these two species along with Sacramento pike minnow and Pit roach are the most abundant species present in the reservoir. Tule perch, speckled dace, Pit sculpin, bigeye marbled sculpin, and possibly rough sculpin are also present in the reservoir.

Pit 5 Tunnel Reservoir. The Pit 5 Tunnel Reservoir is a small reservoir located along an open section of the Pit 5 Tunnel. Fish populations are dominated by non-game native species, including Sacramento sucker, hardhead, Sacramento pike minnow, tule perch, and Pit roach. Bigeye marbled sculpin and Pit sculpin are found along the riprap habitat area on the north shore. Shallow coves along the south shore of the reservoir provide some suitable habitat for centrachids. Green sunfish are abundant in this area. Largemouth bass, bluegill, and black crappie are also present in low numbers. Smallmouth bass are likely present in the Pit 5 Tunnel Reservoir as they were captured in the Pit 4 Reservoir in 1992.

Riverine Fisheries. Riverine fisheries associated with the Pit 3, 4, and 5 Project include the bypass reaches located downstream of the Pit 3, Pit 4 and Pit 5 Dams. These river reaches provide a substantial trout fishery comprised mainly of native rainbow trout and lesser numbers of brown trout.

From 1950 through 1972, wild trout populations were supplemented by plants of catchable-sized Mount Whitney strain rainbow trout. In 1972, CDFG conducted an evaluation to determine the contribution of these fish to the fishery. In addition to the Mount Whitney strain, plants of offspring from native Pit River strain were planted. The Pit River strain evaluated was the first generation of trapped wild spawners from the Pit River which are resistant to *Ceratomyxa Shasta*, a protozoan parasite, occurring in the Pit River. Catch returns of Mount Whitney strain were only 3 percent and were only 10 percent for the Pit River strain (CDFG, 1980). These return rates were well below the 50 percent return rate required by the California Fish and Game Commission as a policy for catchable trout programs (Fish and Game Code, 1999). As a result, planting of catchable rainbow trout in the Pit 3, 4, and 5 river reaches was discontinued in 1973.

Angler surveys of the Pit 3, 4, and 5 reaches were conducted by the FERC licensee from 1988 through 1992 as part of the Biological Compliance Monitoring Program for the Project. The primary purpose for the surveys was to evaluate the fishery provided by the 150 cfs flow level release to the Pit 3 reach initiated in 1987. For comparative purposes, surveys of the Pit 4 and Pit 5 reaches were also conducted. Fishing regulations during 1987 and 1988 allowed for a five fish take with no size limitations in all three reaches. In 1989, the limit for the Pit 3 reach was reduced to two trout, and in 1990 the regulation was modified again to include a minimum size of 18 inches or greater with special gear restrictions requiring the use of artificial flies or lures with barbless hooks. As a result of the establishment of special regulations in the Pit 3 bypass reach, use of the Pit 4 and 5 bypass reaches by bait anglers increased with fly anglers concentrating primarily in the Pit 3 bypass reach with some increase in the Pit 4 bypass reach also. Results of the survey found that Pit River provides a valuable native trout fishery. Most of the trout caught were from 8 to 14 inches in length, with 10 to 20 percent of the catch greater than 14 inches. Catch rates by fly and lure anglers in the Pit 3 reach ranged from 0.86 to 1.99 fish per hour (PG&E Co., 1998e).

Since 1993, CDFG has been conducting angler surveys of the Pit 3 bypass reach to continue monitoring the trout fishery under the established special regulations. Results through 1997 reveal that angler success has remained high and ranged from 1.03 fish per hour in 1993 to 1.57 fish per hour in 1996. The size of rainbow trout caught also increased slightly during the survey. Although brown trout populations comprise a small percentage of the trout fishery, the size of brown trout caught during the survey increased with approximately 15 to 30 percent of brown trout caught equal to or greater than 18 inches (PG&E Co., 1998e). The trout fishery in the Pit 3 bypass reach compares favorably with five other wild trout streams in Northern California including Fall River and Hat Creek. The percentage of trout caught measuring greater than 12 inches during the survey period is considerably higher than in the other five streams. The trout fishery in the Pit 3 bypass reach provides anglers with a quality angling experience and the opportunity to catch trophy-sized trout.

Sacramento sucker, Sacramento pike minnow, and hardhead are also present throughout the Pit 3, 4, and 5 bypass reaches and provide important prey species for bald eagles in the area.

Special-Status Fish Species

Four special-status fish species occur in project waters, of which three are endemic only to the Middle Pit Drainage, which includes portions of the Fall River, Hat Creek, and Rising River. These endemic species are rough sculpin, a State threatened species, bigeye marbled sculpin, a State species of concern, and Pit roach, a State species of concern. The fourth species is the hardhead, a State species of concern and a Forest Service sensitive species (see Table 4.4-6). Minimum flow releases from the dams are specified by FERC orders dated January 28, 1987, and May 18, 1998. However, as the flow rates and reservoir levels that are optimal for one resource potentially conflict with other resources, they will be studied during the current relicensing of the project.

FERC 0233 License Status

FERC's license articles address fisheries and other biological issues with regard to project operations. FERC's License Articles 15 and 16 address the conservation and development of fisheries resources within project boundaries. Pacific Gas and Electric Company operates the project in compliance with license conditions and regulatory requirements. A 1998 FERC order also requires that Pacific Gas and Electric Company release water from Lake Britton for bald eagle habitat and aquatic resource protection. Under this order, Pacific Gas and Electric Company must release 150 cfs from Lake Britton into the 6-mile Pit 3 bypass reach year-round. A 1987 FERC order requires a 150 cfs release from Pit 4 Reservoir into the 7.5-mile long bypass reach which is often supplemented by spilled water during high flow periods. Average annual flow in the bypass reach was 499 cfs between 1955 through 1996. The 1987 FERC order also sets a minimum flow of 120 cfs, measured below Nelson Creek, in the Pit 5 bypass reach (FERC, 1987). FERC License Article 19 requires Pacific Gas and Electric Company to take reasonable measures to prevent stream sedimentation and any form of water pollution (FPC, 1975).

McCloud-Pit (FERC 2106)

McCloud-Pit Project is located in southern Siskiyou and Shasta counties on the McCloud River, Iron Canyon Creek, and Pit River. The majority of McCloud-Pit Project facilities are situated in the Pit River basin with the exception of McCloud Reservoir located on the McCloud River. The McCloud River originates in the Cascade Range east of Mount Shasta and drains a total of 670-square miles in Modoc and Shasta counties. The perpetual snowfields and glaciers of Mount

Shasta are the principal sources of flow for the McCloud River. A brief description of the Pit River is presented in the previous sections discussing the Pit 1 Project and Pit 3, 4, and 5 Project.

The project consists of the McCloud Reservoir, Iron Canyon Reservoir, Pit 6 Dam, Pit 7 Dam, the James B. Black Penstock and Powerhouse, Pit 6, and Pit 7 powerhouses and associated facilities. McCloud Reservoir is located on the McCloud River south of the town of McCloud, and serves to divert water from the McCloud River to Iron Canyon Reservoir. From Iron Canyon Reservoir, water is diverted to the James B. Black Penstock and Powerhouse, located on the Pit River just upstream from the Pit 6 Reservoir. Pit 6 Dam is located on the Pit River just downstream of the Pit 5 Powerhouse (FERC License 0233). Pit 6 Dam diverts water to the Pit 6 Powerhouse located just upstream of Pit 7 Reservoir.

The McCloud-Pit Project includes both warmwater and coldwater habitats in lacustrine (lake) and riverine (river) habitats. The following sections describe the aquatic habitats, fisheries, and special-status fish species present within the vicinity of the McCloud-Pit Project.

Aquatic Habitats

McCloud Reservoir. McCloud Reservoir (elevation 2,680 feet) has a usable storage capacity of 35,229 acre-feet and a surface area of 520 acres. Pacific Gas and Electric Company has a multi-level intake structure at McCloud Reservoir and draws from the bottom port for purposes of water temperature management. Use of the bottom port is a management practice used by Pacific Gas and Electric Company to maintain a coolwater habitat for fish. Continued operation in this manner is necessary to protect coldwater fish habitat, and avoid impacting fishery resources within the McCloud-Pit Project. Immediately downstream of McCloud Dam, for a distance of 10.5 miles, the McCloud River has been designated as a Wild Trout Area by CDFG. Water is released from Lake McCloud into the 1,450-cfs-capacity McCloud Tunnel, where it is diverted 7.1 miles to Iron Canyon Reservoir, lying in the Pit River basin. The mean annual flow in the tunnel between 1966 and 1996 was 857 cfs.

Pacific Gas and Electric Company currently operates McCloud Reservoir to minimize releases of highly turbid and warm water into the McCloud River. The McCloud River is naturally turbid; the selective operation of sluice gates and the middle and lower freshwater intakes has the potential to reduce turbidity and water temperature. These measures enhance the water quality of downstream river reaches while maintaining effective reservoir operation.

McCloud River Wild Trout Area. Flows in the lower McCloud River are highly regulated by releases at McCloud Dam. Uncontrolled spills below McCloud Dam are very rare and only occur during major storm events that cause rapid snowmelt runoff. Three tributary streams, Hawkins Creek, Ladybug Creek, and Baldwin Creek enter the McCloud River in the Wild Trout Area. Hawkins Creek is located approximately one mile downstream from McCloud Dam. Ladybug Creek and Baldwin Creek enter near the downstream end bottom of the Wild Trout Area. Land ownership in the reach is under a mixture of public (USFS) and private holdings. The Nature Conservancy, the largest of the private landowners along the lower half of the Wild Trout Area, manages their reach as preserve, commonly referred to as the McCloud River Preserve. Other private landowners include Pacific Gas and Electric Company and the Hearst Corporation.

Under current FERC license conditions, minimum fishery releases are required downstream of McCloud Dam to insure protection of trout habitat in the Wild Trout Area. In normal water years, a minimum flow release of 50 cfs from May 1 to November 30 and 40 cfs from December 1 to April 30 is required below McCloud Dam. In addition, minimum flows of 160 cfs from January 1 to February 28, 170 cfs from March 1 to May 15, 200 cfs from May 16 to August 31, 210 cfs from September 1 to December 15, and 170 from December 16 to December 31 must be achieved at the Ah-Di-Na gauge station located three miles downstream of the McCloud Dam. In dry water years, when Shasta Lake inflow is less than 300,000 acre-feet, a slight reduction in flow is allowed. The mean annual flow at the Ah-Di-Na gauge between 1965-1996 was 315 cfs, resulting from spill at the Project facilities during wet periods and tributary inflow.

Use of the multi-level intake structure in McCloud Reservoir allows for releases from McCloud Dam to provide coldwater to the McCloud River. Summer water temperatures in the Wild Trout Area typically range from the high 40s to the upper 50s °F and provide excellent conditions for trout. Water clarity is generally excellent; however, highly turbid water originating from Mount Shasta’s Konwakiton glacier via Mud Creek upstream of McCloud Reservoir does periodically enter the lower McCloud River giving it a milky green color characteristic of glacially fed rivers.

The Wild Trout Area ranges in elevation from 2,460 feet at the base of McCloud Dam to 1,680 feet at the downstream boundary and has a mean stream gradient of 74 feet per mile. The river is moderately sized and with widths ranging from 30 to 75 feet. Lower McCloud River is noted for being a classic pocket water trout stream. It is characterized by long boulder-strewn runs alternating with large bedrock formed pools. The runs typically range in depth from 1.5 to 3 feet and are 15 to 1,200 feet in length. Pools are typically between 6 and 12 feet deep by 60 to 300 feet long. Substrates are comprised of boulders, cobbles, and smaller pockets of gravel. Instream cover is provided by boulders, large cobbles, downed trees, and occasional undercut banks. Fine sediments and silt have accumulated in spawning gravel and likely originate from inflows of naturally turbid water of Mud Creek and pass through McCloud Reservoir.

Iron Canyon Reservoir. Water diverted from McCloud Reservoir enters Iron Canyon Reservoir (elevation 2,665 feet) in the Pit River Basin. Iron Canyon Reservoir is located on Iron Canyon Creek and has a capacity of 24,197 acre-feet. Iron Canyon Reservoir serves as the regulating forebay for the James B. Black Powerhouse. Water is released from the reservoir into the 2,000 cfs capacity Iron Canyon Tunnel that carries it 2.9 miles to a penstock leading to the James B. Black Powerhouse.

Pacific Gas and Electric Company does not have spill rights at Iron Canyon Reservoir, requiring Pacific Gas and Electric Company to carefully manage flows in and out of the reservoir. In addition, a 1964 MOU with the USFS limits the maximum operating water level in Iron Canyon Reservoir to provide capacity for storm water storage and minimize possible spillage into and scouring of Bluejay Creek. A revised recreation plan modified the maximum level of Iron Canyon Reservoir to 2,665 feet (a one-foot increase); however, under normal operating conditions this capacity is never reached. FERC License Article 31 requires a release of 3 cfs below the Iron Canyon Dam into Iron Canyon Creek.

During the fishing season, Pacific Gas and Electric Company maintains the level of the Iron Canyon Reservoir to make the boat ramp operational. Pacific Gas and Electric Company conducts this practice in a way that avoids reservoir spills. This practice is conducted informally, and is not specifically required under FERC license or other regulatory requirements.

Iron Canyon Reservoir provides habitat for both warmwater and coldwater fish species.

Pit 6 Reservoir. The James B. Black Powerhouse is located on the Pit River just upstream of the Pit 5 Powerhouse at the upper end of Pit 6 Reservoir. Pit 6 Reservoir, formed by Pit 6 Dam, has a design capacity of 15,605 acre-feet. The dam is a 183-foot high concrete gravity structure. Pit 6 Reservoir is about five miles long and has a surface area of 268 acres. The reservoir is very narrow and has very steep sides with limited littoral habitat. Water surface elevations fluctuate in response to power peaking flows that enter the reservoir via the James B. Black and Pit 5 Powerhouses. Two steel penstocks with a normal maximum capacity of 6,470 cfs extend from Pit 6 Dam to Pit 6 Powerhouse. Pit 6 Powerhouse discharges directly into Pit 7 Reservoir below Pit 6 Dam.

Pit 7 Reservoir. Pit 7 Reservoir is located just downstream of the Pit 6 Dam and contains similar habitats as those contained in Pit 6 Reservoir. Pit 7 Reservoir is long and narrow with steep sides and has a storage capacity of approximately 34,302 acre-feet. Pit 7 Dam is a 288 foot high concrete gravity structure. Water is released from the Pit 7 Reservoir into two steel penstocks with a normal maximum capacity of 7,440 cfs, leading to the Pit 7 Powerhouse. The powerhouse operates at a normal maximum gross head of 205 feet. Tailrace water is discharged to Pit 7 Afterbay, located on the Pit River, to reduce flow energies prior to entering Shasta Lake. FERC License Article 34 stipulates that Pacific Gas and Electric Company must operate the Pit 6 and Pit 7 Reservoirs to maintain minimum pools of not less than 1,000 af, except during Project maintenance. FERC License Article 47 requires a minimum flow release of 150 cfs below the Pit 7 Reservoir, although daily flows are generally in excess of this minimum. Average annual flow in the river just downstream of the dam for the period 1966 through 1996 was 4,875 cfs.

Fisheries

Fish habitat in the vicinity of the McCloud-Pit Project includes coldwater stream habitat in the McCloud and Pit Rivers and in Iron Canyon Creek and surrounding tributaries. Project reservoirs and smaller impoundments also provide reservoir habitat for coldwater fish species. Table 4.4-8 contains a listing of all the fish species present in the immediate vicinity of the McCloud-Pit Project.

McCloud Reservoir and Upper McCloud River. The primary gamefish species in the Upper and Lower McCloud Rivers include rainbow, brook, and brown trout. Dolly Varden (later classified as bull trout (*Salvelinus confluentus*)) were once known to inhabit the river but none have been reported in several years. CDFG has officially declared it extirpated. McCloud River redband trout are rare and could be present in the upper reaches of the McCloud River upstream of McCloud Reservoir. CDFG plants catchable-sized trout in McCloud Reservoir to support recreational trout fishing in the lake. Other fish species that are likely present include Sacramento pike minnow, Sacramento sucker, hardhead and riffle sculpin.

Lower McCloud River Wild Trout Area. Six fish species, rainbow trout, brown trout, riffle sculpin, Sacramento pike minnow, Sacramento sucker, and hardhead have been observed in the Wild Trout Area of the lower McCloud River (Rode 1989). Of these, rainbow trout, brown trout, and riffle sculpin are the most abundant.

Special regulations have been in place for waters of the Wild Trout Area since 1976 when the reach was designated as a Wild Trout Area and all hatchery stocking was stopped to encourage development of the wild trout fishery. From the base of McCloud Dam downstream to the confluence of Ladybug Creek there is a two fish limit and only artificial lures with a single barbless hook may be used. From the confluence of Ladybug Creek downstream to the southern boundary of the USFS Loop there is a zero fish limit with the same gear restrictions. The remainder of the lower McCloud River downstream is closed to fishing all year. Evaluation of the fishery from 1976 through 1986 found that angler success was high ranging from 0.81 fish per hour to 1.80 fish per hour. Rainbow trout comprised 80.4 and 91.7 percent of the harvest with brown trout comprising the majority of the remaining trout caught (Rode, 1989).

Electrophoretic analyses revealed that McCloud River rainbow trout are more closely related to coastal California native rainbow, steelhead, and most California hatchery strains than they are to the inland redband rainbow trout found in the upper McCloud River above Middle Falls.

The migration barrier formed by Lower Falls, Middle Falls, and Upper Falls in the upper river have likely isolated those populations from the lower reaches that were accessible to anadromous steelhead and rainbow trout populations.

Table 4.4-8 Shasta Regional Bundle – McCloud-Pit Project (FERC 2106) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Pit-Klamath brook lamprey	Rainbow trout	McCloud River redband trout	Brown trout	Brook trout	Pit roach	Speckled dace	Tui chub	Hardhead	Sacramento pike minnow	Sacramento sucker	Green sunfish	Tule perch	Prickly sculpin	Pit sculpin	Bigeye marbled sculpin	Riffle sculpin
Lake McCloud	None		X	X	X	X		X				X						X
McCloud River from Lake McCloud downstream to Shasta Lake	5/1-11/30: 50 cfs 12/1-4/30: 40 cfs Additional water may be released on a seasonal basis to meet flows of 170 to 210 cfs at Ah-Di-Na gauging station about 3.9 miles downstream.		X		X			X		X	X	X			X			X
Iron Canyon Reservoir	U.S. Forest Service MOU and Recreation Plan limits maximum storage to 2,665 feet in elevation; during summer Pacific Gas and Electric Company maintains reservoir level to inundate boat ramp.		X		X	X		X				X						
Iron Canyon Creek	Year round: three cfs		X		X			X				X						
Pit River from Pit 6 Forebay downstream to Pit 7 Forebay	Year round: 150 cfs	X																
Pit 6 Forebay	1,000 af		X				X	X	X	X	X	X	X	X		X	X	
Pit 7 Forebay	1,000 af		X				X	X	X	X	X	X	X	X		X	X	
Pit River from Pit 7 Forebay downstream to Lake Shasta	Year round: 150 cfs	X																

a cfs = cubic feet/second
af = acre-feet

Bull trout (Dolly Varden) were historically present in the lower McCloud River and were last observed in 1975. McCloud River bull trout was the only known population in California and represented the southern-most population of the species. Extensive survey efforts through the 1980s failed to capture a single specimen and it appears that the species has been extirpated.

Native non-game species present in the Wild Trout Area include riffle sculpin, Sacramento pike minnow, and Sacramento sucker. Riffle sculpin are abundant throughout the Wild Trout Area, while Sacramento sucker and Sacramento pike minnow are rarely observed.

Iron Canyon Reservoir. Iron Canyon Reservoir provides recreational trout fishing opportunities during the recreational season. California Department of Fish and Game has stocked the reservoir with catchable sized trout including rainbow, brown and brook trout to improve fishing. Small tributary streams provide only limited spawning habitat to sustain the trout fishery and therefore continual planting of the reservoir is needed to maintain the trout population at levels high enough to support recreational fishing. Although extensive fish surveys of the reservoir have not been conducted, non-game fish species that are likely to be present in the reservoir include Sacramento sucker, Sacramento pike minnow, speckled dace, and riffle sculpin which could all access the reservoir through the McCloud Tunnel.

Pit 6 and Pit 7 Reservoirs. Fishery populations found in the Pit 6 and Pit 7 reservoirs are dominated by native non-game species including hardhead, Sacramento sucker, Sacramento pike minnow, and tule perch. Pit roach, speckled dace, Pit sculpin, bigeye marbled sculpin, and Pit-Klamath brook lamprey are also present in lower numbers. Native rainbow trout are present in numbers too low to provide a substantive fishery. Non-native centrachids (green sunfish) have been observed in the reservoirs. However, poor habitat conditions prevent establishment of a sustainable centrachid fishery.

Special-Status Species

McCloud River redband trout, a State Species of Special Concern and a USFS sensitive species, could be present in some upper reaches and tributaries of the Upper McCloud River. Several Species of Special Concern, hardhead, Pit roach, and bigeye marbled sculpin occur in the Pit River. Special-status fish species that may occur in the vicinity of the McCloud-Pit Project are included in Table 4.4-6.

FERC 2106 License Status

FERC's license articles address fisheries and other biological issues with regard to the McCloud-Pit Project. Specific FERC license articles addressing fisheries issues include 29, 30, and 45. FERC License Article 29 requires Pacific Gas and Electric Company to construct, maintain, and operate protective devices and comply with reasonable modifications of project structures and operations in the interest of fish resources. FERC License Article 30 also requires Pacific Gas and Electric Company to grant use of lands, reservoirs, waterways, and project works to resource agencies in order to construct or improve fish handling facilities. Additionally, FERC License Article 45 requires structures for control of water temperatures below McCloud Diversion Dam in the interest of fish life, as well as removal of barriers to fish in the McCloud River, which would occur due to reduced flows. FERC License Article 45 requires Pacific Gas and Electric Company to provide structures for the control of temperatures below the McCloud diversion dam in the interest of fish life, remove barriers to fish in the McCloud River which would occur because of reduced flows, and construct a barrier to the migration of rough fish from Lake Shasta into the McCloud River, upon the recommendation of CDFG or the Secretary of the Interior, after notice and opportunity for hearing. FERC License Article 47 requires Pacific Gas and Electric Company to participate in a fish tagging study with CDFG in McCloud Reservoir; this study will continue through the year 2000 according to an agreement with CDFG. Pacific Gas and Electric Company operates the project in compliance with license conditions and regulatory requirements. Minimum flow requirements for the project were set by a 1960 agreement with the CDFG, included in FERC License Article 31, and further amended by a 1989 FERC order. FERC License Article 31 requires a minimum release from Lake McCloud to the McCloud River of 50 cfs from May through November and 40 cfs from December through April. It also stipulates that Pacific Gas and Electric Company release additional water above the minimum at certain times to meet minimum flows of 170 cfs to 210 cfs (depending on the time of year and water year type) at the Ah-Di-Na gauging station 3.9 miles downstream of McCloud Dam. FERC License Article 31 requires a release of 3 cfs below the Iron Canyon Dam. FERC License Article 34 stipulates that Pacific Gas and Electric Company must operate the Pit 6 and Pit 7 Reservoirs to maintain minimum pools of not less than 1,000 af, except during Project maintenance. FERC License Article 47 requires a minimum flow release of 150 cfs below the Pit 7 Reservoir, although daily flows are generally in excess of this minimum. FERC License Article 50 requires that Pacific Gas and Electric Company prevent the discharge of silt and debris into the McCloud and Pit Rivers, and prevent the loss of gravel from the McCloud River channel downstream of the diversion dam.

Bundle 3: Kilarc-Cow Creek

Kilarc-Cow (FERC 0606)

The Kilarc-Cow Creek Project lies in the Cow Creek basin within Shasta County. Located in the Cascade Mountain Range, Cow Creek is a direct tributary to the Sacramento River, entering downstream of Lake Shasta. The headwaters of the North Fork Cow Creek (also referred to as Old Cow Creek) originate near Crater Peak (elev. 8,677 ft.) within Lassen National Forest in Shasta County. The headwaters for the South Fork Cow Creek originate near Latour Butte (elev. 6,732 ft.), also within Lassen National Forest in Shasta County. Drainage areas contributing to the Kilarc and Cow Creek hydroelectric generating facilities are 28.8 and 71.6 square miles, respectively. The Kilarc facility lies in the North Fork Cow Creek Sub-basin while the Cow Creek facility lies in the South Fork Cow Creek Sub-basin. The Kilarc-Cow Creek Bundle only includes one FERC Licensed Project (FERC 0606), which includes two hydroelectric projects, each located on separate watersheds.

Precipitation in the region ranges from an annual total of 16 inches in the valley areas to 80 inches in the higher elevation mountainous areas. The average annual precipitation for the region is about 40 inches.

Project facilities, consisting of the Kilarc and Cow Creek hydroelectric generating facilities, are located approximately 30 miles east of Redding near the rural community of Whitmore. Each facility is comprised of a powerhouse, diversion dams, and associated appurtenant facilities (conduits and penstocks) distributed within the Cow Creek basin.

Kilarc Project is located on the Old Cow Creek Watershed, while the Cow Creek Project is located on the South Fork Cow Creek Watershed. The Old Cow Creek Watershed ranges in elevation from 3,807 feet at the Kilarc Main Canal Diversion Dam to 7,000 feet at the headwaters. Surface runoff coincides with the duration and intensity of precipitation from October through March. From April through June, runoff is primarily due to snowmelt. Average monthly runoff measured at the Kilarc Main Canal Diversion Dam ranges from 1,800 acre-feet in September to 6,700 acre-feet in May (PG&E Co., 1976).

South Fork Cow Creek ranges in elevation from 1,558 feet at the South Cow Creek Diversion Dam to 6,800 feet at the headwaters. The majority of the watershed is located below 4,000 feet. From October through March, flows in South Cow Creek respond rapidly to storm duration and intensity. From April through May, flows in the creek are provided by snowmelt runoff. Average monthly runoff in South Cow Creek ranges from 1,300 acre-feet in September to 11,300 acre-feet in April (PG&E Co., 1976a).

Kilarc Project Facilities

Kilarc facility begins with a 1.5 cfs water diversion from North Fork Canyon Creek into North Canyon Creek Canal, which discharges to South Canyon Creek. The water is then diverted into South Canyon Creek Canal, where it is conveyed approximately 0.9 miles to the 3.5-mile-long Kilarc Main Canal, with a maximum capacity of 55 cfs. The Kilarc Main Canal receives its primary source of water from Old Cow Creek via the Kilarc Diversion Dam. A minimum release of 2 cfs is made into Old Cow Creek below Kilarc Diversion Dam in compliance with FERC License Article 43. The terminus of the Kilarc Canal is the Kilarc Forebay, which has a designed storage capacity of 30.4 acre-feet. At the Kilarc Forebay, water is conveyed through a steel penstock approximately 4,800 ft. long into two turbines at Kilarc Powerhouse, which has a capacity of 43 cfs. The powerhouse operates at a normal maximum gross head of 1,192 feet. Tailrace water discharges into Old Cow Creek. The Kilarc Powerhouse (elevation 2,590 feet) is situated on a terrace above the streambed of Old Cow Creek, which occupies a narrow channel in a steep walled canyon. The Kilarc Forebay (elevation 3,782.4 feet) is situated on a flat plateau at the west end of Miller Mountain. Because Kilarc Powerhouse has little upstream storage and relies on available streamflow, it is operated as a run-of-river facility.

Cow Creek Project Facilities

The Cow Creek facility begins with the diversion of water from Mill Creek (a tributary of the South Fork Cow Creek) into Mill Creek Canal. Mill Creek Canal delivers up to 5 cfs to the South Fork Cow Creek immediately above the South Cow Creek Diversion Dam. The diversion dam diverts water into the South Cow Creek Main Canal, which has a maximum capacity of 54 cfs. Water is conveyed 2.1 miles in the South Cow Creek Main Canal before entering the Cow Creek Forebay. The Cow Creek Forebay has a design storage capacity of 5.4 acre-feet. A penstock conveys water from the forebay to the Cow Creek Powerhouse, which has a capacity of 50 cfs. The powerhouse operates at a normal maximum gross head of 715 feet. The Cow Creek Powerhouse (elevation 825 feet) is located on Hooten Gulch. The Cow Creek Forebay (elevation 1,537.2 feet) is located on the flat crest of southwest trending ridge above the Powerhouse. Water that passes through the powerhouse is discharged into Hooten Gulch a short distance upstream of Cow Creek. Cow Creek Powerhouse operates as a run-of-river facility, relying solely on available streamflow.

Aquatic Habitats and Fishery Populations

Fish habitat in the vicinity of the Kilarc-Cow Project is primarily the coldwater stream habitat in North Canyon, South Canyon, Old Cow Creek, and South Cow Creek, and in the surrounding tributaries, although some warmer water habitat is provided in Project forebays and in lower stream reaches. Table 4.4-9 presents a complete list of fish species occurring within the immediate vicinity of the Kilarc-Cow Creek Project. Additional discussion of aquatic habitats and fishery species associated with each component of the Kilarc-Cow Creek Project facilities follows.

Kilarc Forebay and Canal. The Kilarc Forebay has a capacity of about of 30.4 acre-feet and covers a surface area of 4.5 acres. The normal maximum forebay water surface elevation is 3,782.4 feet. Flow rates through the forebay combined with the small area of the forebay prevent significant warming of the water, and as a result, habitat for warmwater fisheries is not present in the forebay and warmwater species have not been observed. Some aquatic vegetation is present in the forebay and provides some cover for trout. Rainbow and brown trout are present and CDFG manages the small forebay as a put-and-take trout fishery. Other non-game species that may be present in the forebay include Sacramento suckers, Sacramento pike minnow, speckled dace, and riffle sculpin.

The Kilarc canal contains cold water throughout the summer, with maximum water temperatures ranging from 51 to 63°F (10.5 to 17.2°C) at the head of the canal, and provides some additional habitat for trout. The canal supports aquatic invertebrate populations and has some aquatic vegetation. Riparian vegetation along the banks of the canal provides additional overhead cover and shade to the canal.

Table 4.4-9 Shasta Regional Bundle – Kilarc-Cow Creek Project (FERC 0606) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Fall-run chinook salmon	Late fall-run chinook salmon	Rainbow trout	Brown trout	Speckled dace	Sacramento sucker	Riffle sculpin
Kilarc Forebay	None			X	X	X	X	X
Old Cow Creek from North Canyon Creek Diversion Dam downstream to Cow Creek	Year round: two cfs	X	X	X	X			X
South Cow Creek Forebay	None			X	X			X
South Fork Cow Creek from South Fork Cow Creek Diversion Dam downstream to Cow Creek	Normal water-year: four cfs Dry water-year: two cfs	X	X					X

a cfs = cubic feet/second

The licensee, in coordination with CDFG, conducts fish rescue operations when the canal is shut down for maintenance.

Old Cow Creek Bypass Reach. The Kilarc Canal diverts water from a 3.8 mile section of Old Cow Creek between stream miles 17.7 and 21.5. This section of stream ranges in elevation from 3,807 feet at the diversion dam to 2,590 feet at the Kilarc Powerhouse and has a steep gradient of 355 feet per mile. This stream reach is characterized by cascades, riffles, and a few pools. The channel is bordered by diverse and dense stands of riparian vegetation comprised of cottonwood, white alder, valley oak, elderberry, wild grape, Himalaya blackberry, poison oak, and thimbleberry. Maximum water temperatures, as measured during the spring and summer of 1974 at the bottom of the bypass reach, ranged from approximately 65.5 to 73.3°F (18.6 to 22.9°C). A waterfall located downstream of project facilities at stream mile 11.0 creates a natural barrier to anadromous salmonids seeking access to the upper reaches of Old Cow Creek.

Rainbow trout, brown trout, and riffle sculpin have been observed in Old Cow Creek. Trout populations are abundant and are supported by healthy populations of aquatic invertebrates and diverse instream habitats with abundant cover and riparian vegetation. Poor access and rugged terrain limit use of the reach by anglers.

South Cow Creek Forebay and Canal. The Cow Creek Forebay, which supplies water to the Cow Creek Powerhouse, has a storage capacity of 5.4 acre-feet and a surface area of approximately one acre. The normal maximum water surface elevation is 1,537.2 feet. Water depths in the forebay range from 3 to 10 feet. In the spring and summer of 1974, mean water temperatures ranged from 45° to 77°F (7.2 to 25°C). There is dense aquatic vegetation in the forebay (PG&E Co., 1976a).

During the summer, when water diversions are made through the canal, the canal provides suitable habitat for trout. Mean temperatures at the head of the canal in August 1974 were less than approximately 64°F (17.7°). Cool water temperatures, abundant aquatic invertebrates, and overhead cover are provided (PG&E Co., 1976a).

Fish species recorded in the forebay include rainbow trout, brown trout, Sacramento sucker, and green sunfish.

South Cow Creek Bypass Reach. South Cow Creek Canal diverts water from a 3.5 mile section of South Cow Creek. This stream reach traverses the gently sloping hillsides and steep terrain of Wagoner Canyon. The stream channel ranges in elevation from 1,558 feet at the diversion dam (stream mile 9.5) to 820 feet at the Cow Creek Powerhouse tailrace (Hooten Gulch) junction with South Cow Creek (stream mile 6.0). The upper 1.5 miles of the bypass reach, between the diversion dam and the top of Wagoner, has a moderate stream gradient of 13 feet per mile. The gradient increases dramatically to 400 feet per mile as the stream passes through Wagoner Canyon downstream to the junction of Hooten Gulch.

The upper section of the bypass reach, upstream of Wagoner Canyon, is characterized by numerous pool and riffle habitats and provides suitable spawning habitats for anadromous salmonids. Additional spawning habitat for anadromous salmonids is available in South Cow Creek upstream of project facilities and a fish ladder on the South Cow Creek Diversion Dam has been installed to provide salmonids access to the areas. A fish screen has also been installed on the diversion canal to reduce entrainment of salmonid fry into the canal. In the lower section of the bypass reach, through Wagoner Canyon, the stream is characterized by steep cascades and has abundant boulders and logs.

Sacramento sucker, riffle sculpin, and green sunfish have been reported in Cow Creek. South Cow Creek supports a moderate trout fishery and small runs of anadromous fall run and late-fall run chinook salmon and steelhead trout. The South Cow Creek Drainage has 52 miles of spawning and rearing habitat for salmon and steelhead.

Special-Status Species

The fall run and late-fall run chinook salmon (Central Valley Evolutionarily Significant Unit [ESU]) have recently been proposed for Federal listing as threatened, and steelhead (Central Valley ESU) have been listed as threatened (Table 4.4-6). A query of the CNNDB for the project, covering the area within the FERC Project boundary and a one-mile buffer around it, found no other special-status fish species (CNDDB, 2000).

FERC 0606 License Status

FERC License Articles 15 and 16 address the conservation and development of fish resources within the Kilarc-Cow Project. FERC License Article 19 requires Pacific Gas and Electric Company to take measures to prevent stream sedimentation and any other form of water pollution. FERC License Article 33 required fish passage facilities at South Cow Creek Diversion Dam. In addition, FERC License Article 37 requires a 30-day notice to CDFG prior to any dewatering of project canals in order to arrange for fish rescue. FERC License Article 43 requires a minimum flow release of 4 cfs to South Fork Cow Creek below the South Cow Creek Diversion Dam in normal water years; these flows can be reduced to 2 cfs during dry years.

Bundle 4: Battle Creek

Battle Creek (FERC 1121)

The Battle Creek Project is located in Shasta and Tehama counties near the communities of Anderson, Paynes Creek, and Manton, southwest of the Latour Demonstration State Forest, and west of the Lassen National Forest. Battle Creek drains the western slopes of Mount Lassen, which lies in the southernmost range of the Cascade Mountains. It is a direct tributary to the Sacramento River, entering downstream of Lake Shasta approximately five miles southeast of the town of Cottonwood, and drains a watershed of approximately 360 square miles. Just upstream of the valley floor, Battle Creek splits into two main forks, the North Fork and South Fork of Battle

Creek. The North Fork headwaters (elevation 6,109 feet) drain the south side of Huckleberry Mountain just east of the Latour Demonstration State Forest. The South Fork Battle Creek originates along the western slopes of Morgan Mountain, east of the town of Mineral. Martin Creek, Summit Creek, Nanny Creek, and small spring-fed tributary streams join the South Fork at Battle Creek Meadows (elevation 4,794 feet) just south of Mineral. The Battle Creek Project has the widest range of elevations between hydroelectric facilities in the Shasta Regional Bundle ranging from North Battle Creek Reservoir at the highest elevation (5,567 feet in elevation) to Coleman Forebay (942 feet in elevation).

Battle Creek has a natural flow pattern, high winter and moderate summer-fall flows typical of Mount Shasta-Cascade spring-fed streams. Near its mouth, the stream has average flows of 240 to 260 cfs in summer and fall. Even in drier years, flows are more than 150 cfs due in large part to the many springs that contribute to the creek throughout the basin. Winter flows typically range between 1,200 to 2,400 cfs.

The Coleman National Fish Hatchery is located just downstream of Battle Creek Project facilities and is approximately six miles upstream of the mouth of Battle Creek. The hatchery is managed and operated by the US Fish and Wildlife Service. It was constructed as partial mitigation for the construction of Shasta Dam and produces fall-run chinook salmon, late-fall-run chinook salmon, and steelhead trout. Winter-run chinook salmon, a Federally and State-listed endangered species, were also successfully propagated in small numbers at the hatchery to supplement the wild population. The winter-run chinook artificial propagation program at Coleman was stopped and is in the process of being moved to a new facility at the base of Shasta Dam.

Project Facilities

The Battle Creek Project consists of two small storage reservoirs, four unscreened hydropower diversions on the North Fork Battle Creek, three unscreened hydropower diversions on South Fork Battle Creek, a complex system of canals and forebays, and five powerhouses. The five hydroelectric generating facilities include Volta 1, Volta 2, South, Inskip, and Coleman. Two of the facilities, Volta 1 and Volta 2, are located within the North Fork Battle Creek Sub-basin. Two more, South and Inskip, are located within the South Fork Battle Creek Sub-basin, and the Coleman facilities are located at the base of the Battle Creek Basin downstream of the confluence of the North Fork and South Fork of Battle Creek.

Volta 1 and Volta 2 Powerhouses use water from the North Fork Battle Creek, Ash Creek, Baldwin Creek, and several smaller diversions present on small feeder streams. South and Inskip Powerhouses use water from the South Fork Battle Creek Sub-basin as well as water transferred from the North Fork Battle Creek through cross basin diversion canals. The following sections describe the aquatic habitats and fishery resources associated with Battle Creek Project.

Aquatic Habitats

The Battle Creek Project supports a variety fish species, aquatic resources, and habitats. Major water bodies located in the vicinity of the Battle Creek Project include both lacustrine (lake) and riverine (river) habitats. North Battle Creek Reservoir, Macumber Reservoir, Lake Grace, and Lake Nora comprise the more substantial coldwater lucustrine habitats. The Project also includes approximately 17 miles of riverine habitat provided by North Fork Battle Creek, South Fork Battle Creek, and various smaller coldwater tributary streams. The following sections further describe these aquatic habitats and the fishery resources that utilize them.

North Battle Creek and Macumber Reservoirs. The North Battle Creek Reservoir (elevation 5,563 feet) is the first Project storage reservoir and is located approximately two miles downstream from the headwaters. North Battle Creek Reservoir has a usable storage capacity of 1,090 acre-feet, has a surface area of approximately 80 acres, and is the largest storage reservoir associated with the Battle Creek Project. This reservoir has good water quality and cold water fed by springs located upstream of the reservoir provides good habitat for trout. Water discharged from North Battle Creek Reservoir flows into Macumber Reservoir located approximately 5.8 miles downstream.

Macumber Reservoir (elevation 4,085 feet), the second major storage reservoir on the North Fork Battle Creek, has a storage capacity of 430 acre-feet and a surface area of approximately 85 acres. This reservoir provides suitable coldwater habitat for trout and has abundant object cover in the form of snags, downed logs, and emergent and submergent aquatic vegetation. The northern shoreline is shallow and provides good summer habitat for waterfowl and wading birds. Recreational facilities have been developed on the reservoir and good fishing opportunities are provided for anglers. CDFG regularly plants catchable sized trout in the reservoir.

Water releases from the Macumber Reservoir flow down the North Fork Battle Creek Sub-basin where it is used within the sub-basin for power production. Downstream from Macumber Reservoir, North Fork Battle Creek is joined by Deer Creek, which has been augmented by a diversion from Bailey Creek flowing through Loomis Mill Ditch, then into Armstrong Canal 1, and finally Armstrong Canal 2. Armstrong Canal 2 can deliver up to about 14 cfs to Deer Creek.

Lake Grace and Lake Nora. Lake Grace (elevation 3,478 feet) and Lake Nora (elevation 3,429 feet) are located in close proximity to each other about one to two miles southeast of the town of Shingletown on State Highway 44. Both lakes are small forebays that provide water to the Volta 1 Powerhouse. Water diversions from the North Fork Battle Creek via the Al Smith Canal (55 cfs capacity), Lower Millseat Creek Canal (77 cfs capacity), and a smaller diversion from Baldwin Creek via the Baldwin-Lake Grace Canal (4 cfs) flow into Lake Grace. Water diversions from the North Fork Battle Creek and Berry Creek flow into Lake Nora via the Keswick Canal (55 cfs capacity). Lake Grace has a storage capacity of 46.5 acre-feet and covers a surface area of 8.5 acres. Lake Nora has a storage capacity of 14.9 acre-feet and covers a surface area of 3.5 acres. The lake bottoms are comprised of sand, silt, clay, and decaying organic matter. Both lakes are shallow, contain abundant submerged and emergent aquatic vegetation, have good water quality, and contain suitable water temperatures to support a small trout fishery popular among local residents and campers. CDFG regularly plants catchable-sized trout in both lakes to create additional angling opportunities.

North Fork Battle Creek. The North Fork Battle Creek (North Fork) provides good habitat for both resident and anadromous salmonids. From its headwaters downstream to the confluence with the South Fork, the North Fork Battle Creek is approximately 29.5 miles in length. Of this, the upper 16 miles of the creek are not accessible to anadromous salmonids because of natural barriers (Kier Associates, 1999). The creek and its tributaries drain the volcanic slopes of Mt. Lassen located at the top and center of the watershed between the North and South Fork. The large snowfields on this peak (elevation 10,000 feet) maintain streamflow until late in the summer. Volcanic formations and ancient stream channels buried by lava flows store a portion of the wet season runoff and convey it to the streams in the dry season via numerous cold springs. The channel is well shaded throughout most of the reach by riparian vegetation and local topographic features (TRPA, 1996). Stream gradients between the Al Smith Diversion Dam and North Battle Feeder Diversion Dam are approximately 5 percent. Stream gradients downstream of North Battle Feeder Diversion Dam to about Eagle Canyon Diversion Dam are lower at approximately 2.9 percent. Average summer water temperatures observed at the confluence of the North Fork Battle Creek during July and August of 1995 were 59.9°F (15.5°C) (Kier Associates, 1999). The North Fork Battle Creek contains deep cold pool habitat ideal for holding spring run chinook salmon (CALFED, 1999). Suitable spawning habitat for anadromous salmonids is available throughout the creek.

Several diversion dams are situated on the North Fork and serve to divert flow from the North Fork to hydropower generation facilities located within the basin. Diversion dams present include Wildcat Dam (Rivermile, RM 2.49), Eagle Canyon Dam (RM 5.29), North Battle Feeder Dam (RM 9.35), and Keswick Dam (RM 13.48). Minimum bypass flows have been identified below each diversion in the FERC license. FERC requires that a minimum flow of 3 cfs be released below Al Smith and Keswick dams, 30 cfs be released below North Battle Feeder Diversion Dam, and 3 cfs be released below Eagle Canyon and Wildcat Diversion dams. A fish ladder has been built at each of these dams to allow anadromous access. The Battle Creek Salmon and Steelhead Restoration Plan (Restoration Plan), of which Pacific Gas and Electric Company is a participant, identifies several restoration actions to restore anadromous salmonid habitat in both the North and South Forks of Battle Creek.

Under the Restoration Plan, the Wildcat Diversion Dam would be decommissioned and ladders would be improved on the Eagle Canyon and North Battle Feeder Diversion dams. In addition, the plans recommend that flows be increased from between 35 to 88 cfs seasonally below diversion dams to improve conditions in holding, spawning, and rearing habitat for anadromous salmonids.

South Fork Battle Creek. The South Fork Battle Creek (South Fork) also provides good habitat for resident and anadromous salmonids. It is approximately 28 miles in length from headwaters to confluence. The upper ten miles of the South Fork are not accessible to anadromous salmon and steelhead due to a natural barrier present near Panther Creek, upstream of the South Battle Diversion Dam. The creek has good stands of riparian vegetation and stream substrates provide adequate spawning and rearing habitat for salmonids.

The South Fork generally has a lower gradient than the North Fork and from the South Battle Diversion Dam downstream to the Inskip Diversion Dam (approximately 5.78 miles) the gradient is about 1.9 percent. From the Inskip Diversion Dam downstream to the Coleman Diversion Dam (approximately 5.42 miles), the gradient is less at approximately 1.5 percent (TRPA, 1996). Suitable spawning and rearing habitat for anadromous salmonids is provided in the entire reach of the South Fork downstream of the natural barrier, and suitable holding habitat for spring-run chinook salmon is provided upstream of the Inskip Diversion Dam.

Fishery Resources

Fish species found within the Battle Creek Project include rainbow and brown trout, smallmouth bass, sunfish, and several non-game species such as Sacramento pike minnow, riffle sculpin, Sacramento sucker, tule perch, and speckled dace (Table 4.4-10). CDFG operates a trout hatchery and has conducted Sacramento pike minnow eradication programs at Macumber Reservoir. Rainbow trout are planted in North Battle Creek and Macumber reservoirs, and at Lake Grace and Lake Nora. Rainbow and brown trout have also been stocked in the north and south forks of Battle Creek since 1940.

Spring-run, fall-run, and late fall-run chinook salmon, and steelhead are found in the lower reaches of Battle Creek. The spring-run chinook salmon is listed as threatened by the USFWS and State of California. The Central Valley steelhead was recently listed as a Federally threatened species, and the Central Valley fall-run and late fall-run salmon were proposed as Federally threatened species and have since been classified as a candidate species by the NMFS. Battle Creek has also been used by winter-run chinook salmon. According to CDFG, young-of-the-year winter-run chinook have been collected in the North Fork Battle Creek indicating successful spawning (H. Rectenwald, CDFG, Pers. Comm.). Winter-run chinook salmon is listed as endangered under both the Federal Endangered Species Act and California Endangered Species Act.

Surveys conducted before the construction of Shasta Dam indicate that, with sufficient water, the stream reaches above the fish hatchery could provide spawning habitat for more than 1,800 pairs of salmon. The stream reaches up to Macumber Dam are not reachable by anadromous fish because of barriers. The anadromous reach in the North Fork, Battle Creek extends up to approximately two miles above the North Fork Battle Feeder Dam. An evaluation of spawning habitat in those portions of Battle Creek accessible to anadromous fish above Coleman Hatchery Fish Barrier

Table 4.4-10 Shasta Regional Bundle – Battle Creek Project (FERC 1121) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Fall-run chinook salmon	Late fall-run chinook salmon	Winter-run chinook salmon	Spring-run chinook salmon	Rainbow trout	Steelhead - Central Valley ESU	Brown trout	Brook trout	California roach	Speckled dace	Sacramento pike minnow	Sacramento sucker	Tule perch	Riffle sculpin
North Fork Battle Creek Reservoir	6/1-9/10: 1,039 af					X		X	X						
North Fork Battle Creek from North Fork Battle Creek Reservoir downstream to Macumber Reservoir	Maximum release: 40 cfs 4/1-10/31: 0.3 cfs					X		X	X						
Macumber Reservoir	Must be full for recreation from 4/1-9/10; Cannot be drawn down by more than 12 feet					X		X	X						
North Fork Battle Creek from Macumber Reservoir downstream to Al Smith Canal	4/1-9/10: 0.3 cfs					X		X	X						
Al Smith Canal	Year round: three cfs					X		X							
Keswick Canal	Year round: three cfs					X		X							X
North Battle Creek Feeder Diversion Dam release to North Fork Battle Creek	47 to 88 cfs release adjusted seasonally (Battle Creek MOU)[b]	X	X	X	X	X	X	X							
Eagle Canyon Diversion Dam release to North Fork Battle Creek	35 to 46 cfs release adjusted seasonally (Battle Creek MOU)[b]	X	X	X	X	X	X	X		X	X	X	X	X	X
Wildcat Diversion Dam downstream to confluence with South Fork Battle Creek	three cfs minimum flow (FERC); 33 cfs +/- five cfs interim flow (Battle Creek Agreement)[b]	X	X	X	X	X	X	X		X	X	X	X	X	X
South Fork Battle Creek from South Battle Creek Diversion Dam downstream to Inskip Diversion Dam	Year round: five cfs	X	X	X	X	X	X	X							
South Fork Battle Creek from Inskip Diversion Dam downstream to Coleman Diversion Dam	40 to 86 cfs adjusted seasonally (Battle Creek MOU)[b]	X	X	X	X	X	X	X		X		X	X		X

Table 4.4-10 Shasta Regional Bundle – Battle Creek Project (FERC 1121) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Fall-run chinook salmon	Late fall-run chinook salmon	Winter-run chinook salmon	Spring-run chinook salmon	Rainbow trout	Steelhead - Central Valley ESU	Brown trout	Brook trout	California roach	Speckled dace	Sacramento pike minnow	Sacramento sucker	Tule perch	Riffle sculpin
South Fork Battle Creek from Coleman Diversion Dam downstream to confluence with Battle Creek	30 ± five cfs (Battle Creek Agreement)[b]	X	X	X	X	X	X	X		X	X	X	X	X	X
Battle Creek downstream of Coleman Powerhouse tailrace	Unimpaired flow minus local diversions to Gover Ditch, Orwick Ditch and Coleman National Fish Hatchery.	X	X	X	X	X	X	X		X	X	X	X		X

a cfs = cubic feet/second

af = acre-feet

b Battle Creek Agreement is an interim agreement signed by Pacific Gas and Electric Company. Battle Creek MOU was signed by Pacific Gas and Electric Company, NMFS, USBR, USFWS and CDFG 1999. Conditions will be incorporated into the FERC license through amendment.

estimate 166,000 square feet of spawning gravel. Potentially, this much spawning habitat could accommodate 3,500 spawning pair. Because of the critically low numbers of spring-run chinook salmon and steelhead in the Sacramento River drainage, any expansion of available habitat for these fish has a high priority.

Special-Status Species

A query of the CNDDB for the project, covering the area within the Battle Creek Project boundary and a one-mile buffer around it, produced no additional special-status fish species sighting records (Table 4.4-6).

Fish Hatcheries

A privately owned fish hatchery is located along the Cross Country Canal, approximately one-half mile north of its junction with South Battle Creek Canal. Spring Gardens Fish Hatchery is along Eagle Canyon Canal, approximately 12 miles northeast of the Inskip Powerhouse. Macon Springs Fish Hatchery is located approximately 12 miles south of the powerhouse and the Darrah Springs State Fish Hatchery is about one-half mile east of the Asbury Pump. The Coleman National Fish Hatchery is located about one mile west of the Coleman Powerhouse on the main stem of Battle Creek. Several residential buildings are associated with each fish hatchery.

The water discharged from the Coleman Powerhouse enters a tailrace channel flowing into Battle Creek, which also supplies the Coleman National Fish Hatchery. FERC License Article 33 requires that the flows be maintained at a minimum of 150 cfs for the fish hatchery and for irrigation, either by releasing water from the powerhouse or by spilling from the forebay into the natural channel. The minimum release is measured by the USGS gauge below the hatchery diversion structure. Pacific Gas and Electric Company has an informal agreement with the Coleman National Fish Hatchery to not intentionally disrupt the water supply to the hatchery between October 1 and mid-May, in order to avoid negative impacts to hatchery operations.

Battle Creek Salmon and Steelhead Restoration Project

Pacific Gas and Electric Company has been supporting the anadromous fish restoration program component of the CVPIA. In 1996, and again in 1998, Pacific Gas and Electric Company and the USBR signed a short-term agreement for the purchase of water from the Battle Creek Project to aid the restoration of the salmon and steelhead fishery.

The restoration group will monitor the effects of annual closures of fish ladders to prevent fall-run chinook from potentially contaminating Project canals with an infectious virus. In addition, Pacific Gas and Electric Company, Federal and State resource agencies, and other stakeholders are developing a long-term agreement for the Battle Creek system known as the Battle Creek Salmon and Steelhead Restoration Project. In the interim, a short-term agreement was created for 1995-1997 and a second short-term agreement was signed in 1998, to run through February 1999, with a provision for renewal for a maximum of two successive twelve-month periods. The agreement was renewed and is currently in effect. Both short-term agreements involve increasing the instream flows at Eagle Canyon and Coleman and ceasing all Wildcat Canal diversions. In addition, both the Eagle Canyon and Coleman fish ladders are closed year round per the agreement.

On March 2, 1999, Pacific Gas and Electric Company, in cooperation with the USFWS, the NMFS, the USBR, and the CDFG announced that they had agreed in principle to pursue a long-term Battle Creek Salmon and Steelhead Restoration Project.

Proposed terms for the agreement include: (1) increasing the minimum instream flows from the present amount of three to five cfs year round to approximately 35-88 cfs adjusted seasonally; (2) decommissioning several diversion dams (Wildcat, Coleman, South Lower Ripley Creek and Soap Creek Diversion Dams) and transferring their associated water rights to instream uses; (3) screening and enlarging ladders at three diversion dams (Inskip, Eagle Canyon, and North Battle Creek feeder diversion dams); and (4) constructing new infrastructure (tailrace connectors) that eliminate mixing of North and South fork waters and significantly reduce redundant screening requirements. An EIR/EIS is currently being prepared for this proposed agreement with U.S. Bureau of Reclamation and the State Water Resources Control Board acting as federal/state lead agencies respectively.

FERC 1121 License Status

FERC License Articles 15 and 16 address the conservation and development of fish resources within the Battle Creek Project. FERC License Article 33 sets minimum flows for the purpose of protecting the aquatic habitat and fishery resources associated with the project. For project facilities located on the North Fork, FERC License Article 33 requires a minimum release of three cfs year round from the Al Smith Diversion, Keswick Canal Diversion, North Battle Feeder Diversion, and Eagle Canyon Diversion Dam into the North Fork for fish habitat. On the South Fork, FERC License Article 33 requires a minimum flow release of 5 cfs year round to the SFBC at the South Battle Creek Canal diversion and Inskip Diversion Dam to benefit fish habitat.

However, a 1998 agreement between Pacific Gas and Electric Company, the USBR, and other parties specifies a larger release of 30 cfs, plus or minus five cfs, for fisheries habitat purposes. The larger release provides a greater volume of colder water, which has been identified as benefiting the habitat as colder temperatures are critical for successful salmon spawning, rearing, and adult over-summering activities.

FERC License Article 33 requires a five cfs year-round minimum release from Coleman Diversion Dam to the South Fork. However, the Battle Creek Agreement specifies a larger release of 30 cfs, plus or minus five cfs, for fisheries habitat purposes. Wildcat Diversion Dam, located on North Fork, formerly diverted water into the Wildcat pipe where it was conveyed 1.7 miles to the Coleman Canal. While FERC License Article 33 requires a three cfs minimum flow release from the Wildcat Diversion to North Fork, the Battle Creek Agreement has led to the temporary cessation of diversions at Wildcat Canal in 1996, and prompted a 33 cfs minimum, plus or minus five cfs, release for fishery habitat purposes.

FERC License Article 37 requires a 30-day notice to CDFG prior to dewatering of project canals in order to arrange for fish rescue.

FERC License Article 33 requires that North Battle Creek Reservoir be maintained at or above 1,039 of capacity during the annual recreation season from June 1 to September 10. In addition, the article stipulates that an elevation at or above a minimum pool of 75 acre-feet (elevation 5,544 feet) be maintained from September 11 through May 31 (except for purposes of maintaining streamflow releases, maintenance and repairs, or emergencies) and controlled releases cannot exceed 40 cfs. An hourly ramping rate required by FERC License Article 33 further constrains releases from the reservoir. During upramping, flow in the stream may be doubled each hour, while during downramping, the flow may be reduced by half each hour, to a minimum of five cfs. The license article also specifies a minimum flow release of 0.3 cfs from April 1 to October 31.

FERC License Article 33 specifies that Macumber Reservoir also must be full to provide for recreational uses between April 1 and September 10 and must make a minimum release of 0.3 cfs during that same period. Pacific Gas and Electric Company has an informal agreement with the CDFG not to lower the Macumber Reservoir below 12 feet at any time to avoid potential adverse impacts to fish.

4.4.4.2 DeSabla Regional Bundle

Regional Setting

A majority of Pacific Gas and Electric Company’s DeSabla Regional Bundle hydroelectric projects are located on the North Fork Feather River (NFFR), a tributary of the Feather River. The NFFR drains the northern end of the Sierra Nevada Mountain Range into the Sacramento River. The headwaters of the NFFR lie on the southeastern slopes of Mt. Lassen, in Plumas County. The main river channel flows for approximately 63 miles before reaching Lake Oroville, in Butte County. Included within its flow is the East Branch North Fork Feather River, which extends 18 miles eastward and includes more than 30 smaller tributaries that converge into the NFFR, contributing to the 2,200-square-mile basin. The drainage area within the NFFR basin utilized by the project is 612 square miles, as measured from directly below Belden Dam, the most downstream diversion facility (USGS 1997).

Bucks Creek Project, located in Plumas County, is situated on three tributaries of the NFFR (Bucks, Grizzly, and Milk Ranch creeks), which flow in a westerly direction from the crest of the Sierra Nevada Mountain Range to the NFFR.

The DeSabla-Centerville Project, located in Butte County, is situated within two separate north-to-south drainage basins of the Sierra Nevada Mountain Range: the West Branch Feather River (WBFR) and Butte Creek. Both drainage basins have headwaters at an elevation of approximately 7,000 feet on the Sierra Nevada crest. The WBFR watershed utilized by the project is 46 square miles, as determined at Hendricks Diversion, the downstream diversion facility. Butte Creek flows directly into the Sacramento River. The drainage area within Butte Creek utilized by the project is approximately 60 square miles.

There are a vast array of fishery resources that inhabit the streams and reservoirs contained in the DeSabla Regional Bundle (Table 4.4-11). The fish resources of the NFFR basin projects consist of a combination of warmwater and coldwater species. Fish habitat in the NFFR and the surrounding tributaries is primarily coldwater stream habitat. Lake Almanor, Butt Valley Reservoir, and smaller impoundments associated with the projects, provide habitat for a combination of both warm and coldwater fish species.

Fish habitat in the vicinity of the Bucks Creek Project includes coldwater stream habitat in Bucks, Grizzly, and Milk Ranch creeks and the surrounding tributaries. Bucks Lake, Lower Bucks Lake, Three Lakes, and Grizzly Forebay provide lake habitat for both warm and coldwater fish species.

Fish habitat in the vicinity of the DeSabla-Centerville Project, as well as the two non-FERC licensed powerhouses found on the WRFR, is primarily coldwater stream habitat in Butte Creek and West Branch Feather River and the surrounding tributaries. Philbrook Reservoir and DeSabla Forebay provide habitat for lake-dwelling, coldwater fish species.

Spring-run chinook salmon and steelhead trout, State and Federally listed as threatened, are seasonally abundant in Butte Creek approximately one mile below the existing Centerville Diversion Dam. Salmon are found upstream of the powerhouse, particularly in the upper three to four miles of the bypass reach where adequate flows and cooler water temperatures exist. The spring-run chinook salmon enter Butte Creek from April through May and hold over in deep pools until they spawn in late September and October.

Local Regulations and Policies

The DeSabla Regional Bundle falls within or is adjacent to several jurisdictional entities with local and regional plans and policies applicable to Pacific Gas and Electric Company's holdings. The DeSabla Regional Bundle is located within the counties of Butte, Plumas, and Lassen. Each county's General Plan strives to maintain the quantity and quality of water resources for multiple beneficial uses, including fisheries and aquatic resources. Provisions within the General Plans for Butte, Plumas, and Lassen counties require evaluation and/or regulation to minimize water pollution and accelerated erosion caused by development.

Table 4.4-11 Distributional Checklist of the Fishes of the DeSabla Regional Bundle by Pacific Gas and Electric Company Project

Family Name Common Name (*Scientific Name*)	Hamilton Branch (non-FERC)	Upper North Fork Feather River (FERC 2105)	Rock Creek-Cresta (FERC 1962)	Poe (FERC 2107)	Bucks Creek (FERC 619)	Lime Saddle (non-FERC)	Coal Canyon (non-FERC)	DeSabla-Centerville (FERC 803)
Petromyzontidae (Lamprey Family)								
Pacific lamprey (*Lampetra tridentata*)								X
Osmeridae (Smelt Family)								
Wakasagi (*Hypomesus nipponensis*)		X	X					
Clupeidae (Herring Family)								
Threadfin shad (*Dorosoma petenense*)								
Salmonidae (Salmon and Trout Family)								
Chinook salmon (*Oncorhynchus tshawytscha*)		GL[a]						SR, FR, LFR[a]
Kokanee (*Oncorhynchus nerka kennerlyi*)	X	X			X			
Rainbow trout (*Oncorhynchus mykiss irideus*)	X	X	X	X	X	X	X	X
Steelhead - Central Valley ESU (*Oncorhynchus mykiss irideus)*								X
Brown trout (*Salmo trutta*)	X	X	X	X	X	X	X	X
Brook trout (*Salvelinus fontinalis*)	X	X			X			X
Lake trout (*Salvelinus namaycush*)		X			X			
Cyrinidae (Minnow Family)								
California roach (*Hesperoleucus symmetricus*						X	X	X

Table 4.4-11 Distributional Checklist of the Fishes of the DeSabla Regional Bundle by Pacific Gas and Electric Company Project

Family Name Common Name (*Scientific Name*)	Hamilton Branch (non-FERC)	Upper North Fork Feather River (FERC 2105)	Rock Creek-Cresta (FERC 1962)	Poe (FERC 2107)	Bucks Creek (FERC 619)	Lime Saddle (non-FERC)	Coal Canyon (non-FERC)	DeSabla-Centerville (FERC 803)
symmetricus)								
Hitch (*Lavinia exilicauda*)		X						
Speckled dace (*Rhinichthys osculus*)					X			X
Tui chub (*Gila bicolor*)		X						
Hardhead (*Mylopharodon conocephalus*)		X	X	X				X
Sacramento pikeminnow (*Ptychocheilus grandis*)		X	X	X		X		X
Carp (*Cyprinus carpio*)		X	X	X				
Golden shiner (*Notemigonus crysoleucas*)					X			X
Lahontan redside (*Richardsonius egregius*)					X			
Catostomidae (Sucker Family)								
Sacramento sucker (*Catostomus occidentalis*)		X	X	X		X		X
Tahoe sucker (*Catostomus tahoensis*)		X						
Ictaluridae (Catfish Family)								
Brown bullhead (*Ictalurus nebulosus*)		X	X					X
Channel catfish (*Ictalurus punctatus*)	X	X						
Centrarchidae (Sunfish Family)								
Sacramento perch	X	X						

Table 4.4-11 Distributional Checklist of the Fishes of the DeSabla Regional Bundle by Pacific Gas and Electric Company Project

Family Name Common Name (*Scientific Name*)	Hamilton Branch (non-FERC)	Upper North Fork Feather River (FERC 2105)	Rock Creek-Cresta (FERC 1962)	Poe (FERC 2107)	Bucks Creek (FERC 619)	Lime Saddle (non-FERC)	Coal Canyon (non-FERC)	DeSabla-Centerville (FERC 803)
(*Archoplites interruptus*)								
Bluegill (*Lepomis macrochirus*)			X		X			X
Green sunfish (*Lepomus cyanellus*)								X
Redear sunfish (*Lepomus microlephus*)								X
Largemouth bass (*Micropterus salmoides*)	X	X	X	X		X		X
Smallmouth bass (*Micropterus dolomieui*)		X	X	X		X		X
Embiotocidae (Surfperch Family)								
Tule perch (*Hysterocarpus traski*)								X
Cottidae (Sculpin Family)								
Riffle sculpin (*Cottus gulosus*)		X	X					X
Total Fish Taxa	**7**	**20**	**12**	**8**	**9**	**7**	**3**	**22**

a FR = Fall-run
LFR = Late fall-run
SR = Spring-run
GL = Fall-run from Great Lakes stock

The DeSabla Regional Bundle is, in many cases, either adjacent to or completely surrounded by the Plumas and Lassen National Forests. Both Plumas and Lassen National Forests are managed by the U.S. Forest Service (USFS) and have Land and Resource Management Plans (LRMPs). The LRMPs provide direction for planning and conducting resource management activities on National Forest land. The goals of these plans are, among others, to monitor and protect habitat for Federally-listed threatened, endangered, and candidate species, provide for continued use and new development of hydroelectric facilities, and expand recreational fisheries opportunities. The LRMP goals for both National Forests generally relating to fisheries issues include: (1) providing water of sufficient quality and quantity to meet beneficial uses; (2) avoiding significant cumulative effects on water quality and fisheries; (3) managing riparian areas and maintaining or improving riparian-dependent resources; and (4) maintaining or improving habitat for all native and compatible non-native fish species. An amendment to the LRMPs includes the 1995 PACFISH interim strategy which was developed to protect at risk anadromous fish stocks.

The Bureau of Land Management (BLM) owns and manages various small land holdings throughout the DeSabla Regional Bundle. BLM develops Resource Management Plans to guide where and how the BLM will administer public lands. BLM Resource Management Plans make provisions for maintaining fisheries habitat and improving the quality of riparian vegetation. The majority of BLM land situated near the DeSabla Regional Bundle is located in the “Forks of Butte Creek” subsection of the Ishi Management Area which is found in the vicinity of the Centerville-DeSabla project. BLM’s Forks of Butte Creek management area contains Pacific Gas and Electric Company land.

Bundle 5: Hamilton Branch

Hamilton Branch (non-FERC)

The Hamilton Branch Powerhouse area supports a variety of fisheries and aquatic resources and habitats. The following section describes these resources, the sources and nature of potential impacts on these resources, and project-specific regulatory conditions related to these resources, if any.

The main storage facility for the non-FERC licensed Hamilton Branch project is Mountain Meadows Reservoir, which impounds the waters of the Hamilton Branch at Indian Ole Dam, approximately 5.5 miles upstream of Lake Almanor. The reservoir has a gross capacity of 23,942 acre-feet (af) and is bordered by great expanses of marsh and meadow. Water is stored in the reservoir during periods of high runoff and released into the Hamilton Branch NFFR during periods of low flow. Because of the large surface-to-depth ratio, water stored in Mountain Meadows Reservoir is subject to a high degree of evaporation (PG&E Co., 1973). Ninety percent of its 5,700 acre surface is less than 3 meters deep at maximum water surface elevation (PG&E Co. et al, 1990a). To reduce evaporation loss, Pacific Gas and Electric Company historically utilized the stored water as early in the year as possible. Cattle grazing has contributed to reductions in fish habitat in tributary streams and the reservoir shoreline by reducing cover provided by riparian vegetation (PG&E Co. et al, 1990a).

Water released from the Indian Ole Dam transits 1.8 miles of the river before reaching the Hamilton Branch Diversion Dam. From the Hamilton Branch Diversion Dam, water is diverted in the Hamilton Branch Canal, a 3.3-mile-long flume and ditch facility with a capacity of 210 cfs. Additional water is fed into the canal from small diversions on Clear Creek, Spring Creek, and the

Hamilton Branch at Red Bridge. Water discharged from the Hamilton Branch powerhouse flows directly into Lake Almanor (PG&E Co., 1999f).

Aquatic Habitat and Fisheries Management

Fish habitat in the project vicinity is primarily warm and coldwater lake habitat in Mountain Meadows Reservoir (also known as Walker Lake). Stream habitat exists in tributaries to the reservoir, such as Goodrich Creek, and in the Hamilton Branch and its tributaries downstream between Mountain Meadows Reservoir and Lake Almanor (Table 4.4-12).

Mountain Meadows Reservoir is a shallow impoundment that contains catfish and largemouth bass, stocked by CDFG. Mountain Meadows Reservoir is considered one of the preeminent largemouth bass fisheries in northeastern California (CDFG, no date). Rainbow and brown trout are also found in the reservoir. Goodrich Creek, the largest tributary to the reservoir, Duffy Creek, and Mountain Meadows Creek support self-sustaining populations of rainbow trout (PG&E et al, 1990a).

The Hamilton Branch of the NFFR has a resident population of brown and rainbow trout and is stocked with brown, rainbow, and brook trout by CDFG. In 1999, CDFG stocked 1,290 catchable rainbow trout and 1,560 catchable Eagle Lake trout (CDFG, 1999). Tributaries of the stream, including Clear, Spring, and Rock creeks, are used for spawning by trout and kokanee salmon migrating upstream from Lake Almanor.

Instream Flow and Lake Level Requirements

A 1989 agreement between Pacific Gas and Electric Company and CDFG regulates water management within Mountain Meadows Reservoir, stipulating drawdown limits and pool elevations in different seasons and water year types. It also establishes minimum flow releases from the reservoir and at four other points of diversion (PG&E Co. and CDFG, 1989). Pacific Gas and Electric Company must release a minimum flow of two cfs, when combined with dam leakage, from Indian Ole Dam into Hamilton Branch throughout the year. A minimum flow of four cfs is released from the Hamilton Branch Diversion Dam into the Hamilton Branch, as measured at the entrance to the fish ladder, throughout the year. In addition, Pacific Gas and Electric Company must release a minimum flow of four cfs at Red Bridge Diversion, three cfs at Clear Creek Diversion, and one cfs at Spring Creek Diversion.

As part of a 1989 agreement with CDFG, fish ladders are maintained at the Red Bridge and Clear Creek diversions. The 1989 CDFG agreement is in effect as long as the Hamilton Branch Hydroelectric project is operated by Pacific Gas and Electric Company or its successors or assigns (PG&E Co. and CDFG, 1989). The agreement also stipulates the development of a Wildlife Habitat Enhancement Plan. Key components of this plan include placement of spawning gravel for trout and largemouth bass in Mountain Meadows Reservoir, fencing to restrict cattle access to sensitive areas along the reservoir and its tributaries, and riparian planting along selected tributaries and the reservoir.

Special-Status Species

A query of the CNDDB for the powerhouse, covering the facilities and a one-mile buffer around them, produced no special-status fish species sighting records (CNDDB, 2000).

Table 4.4-12 DeSabla Regional Bundle - Hamilton Branch Project (Non-FERC) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Rainbow trout	Brown trout	Brook trout	Kokanee	Largemouth bass	Channel catfish	Sacramento perch
Mountain Meadows Reservoir (*aka* Walker Lake)	An agreement between Pacific Gas and Electric Company and CDFG stipulates drawdown limits and pool elevations in different seasons and water-year types[b].	X	X			X	X	X
Goodrich Creek	None	X	X					
Hamilton Branch between Indian Ole Dam and Hamilton Branch Diversion Dam	Year round: two cfs	X	X	X				
Hamilton Branch between Hamilton Branch Diversion Dam and Hamilton Branch Powerhouse	Year round: four cfs	X	X	X	X			
Spring Creek upstream of Spring Creek Diversion	None	X	X	X	X			
Spring Creek between Spring Creek Diversion and confluence with Hamilton Branch	Year round: one cfs	X	X	X	X			
Clear Creek upstream of Clear Creek Diversion	None	X	X	X	X			
Clear Creek between Clear Creek Diversion and confluence with Hamilton Branch	Year round: three cfs	X	X	X	X			
Red Bridge Diversion	Year round: four cfs	X	X	X	X			

a cfs = cubic feet/second

b Minimum stream flow/reservoir level requirements are provided under a 1989 Fish and Wildlife Agreement between Pacific Gas and Electric Company and CDFG.

Bundle 6: Upper North Fork Feather River

The upper watershed of the upper NFFR consists of a broad plateau-like basin which is densely timbered except for several large meadows. The largest of these meadows, named Big Meadows in pioneer times, is now inundated by Lake Almanor, a 101-square-km reservoir. Below Lake Almanor and below the confluence of Spanish and Indian creeks on the East Branch, the NFFR has cut a deep, rugged canyon downstream to Oroville. This reach of the NFFR is paralleled by State Highway 70 which runs through most of the Feather River Canyon (CDFG, 1987).

The stream has been highly modified for power production by Pacific Gas and Electric Company Between Lake Almanor, the first major impoundment on the system, and Lake Oroville approximately 100 km downstream, there are four smaller impoundments on the NFFR and two impoundments on tributaries.

The construction and operation of Pacific Gas and Electric Company's hydroelectric water storage developments within the NFFR system have altered the aquatic habitat and fishery resources. The creation of reservoirs and reduction of instream flows have resulted in a habitat that favors non-game fish species rather than trout (CDFG, 1987).

The following sections discuss the effects of existing NFFR hydroelectric development on fisheries and aquatic resources and their habitats, discusses formal regulatory and informal agreement protection of fisheries and aquatic resources, and identifies the fisheries and aquatic resources associated with each Pacific Gas and Electric Company hydroelectric project and associated Watershed Lands, including endangered, threatened, or rare species and their habitats.

Upper North Fork Feather River (FERC 2105)

The Upper North Fork Feather River Project and the associated Watershed Lands support a variety of fisheries and aquatic resources and habitats. The following sections describe these resources, the sources and nature of potential impacts on these resources, and project-specific regulatory conditions related to these resources, if any.

The primary project storage facility is Lake Almanor, a 1,142,964 af reservoir on the NFFR (PG&E Co., 1987). Lake Almanor is the largest Pacific Gas and Electric Company reservoir with respect to both surface area and volume and provides the major regulation of water flow through the NFFR. Water management within the lake is coordinated to optimize the operation of a chain of seven powerhouses throughout the river. Water is generally stored for the first half of the year (January through May) and released during the second half. The end of the year target water storage level is generally around 650,000 af, but is highly variable due to natural factors and legal water obligations (PG& E Co., 1999f).

Pacific Gas and Electric Company established the end-of-year target water storage level in 1986 in response to an inquiry by FERC. Storage must be maintained above 500,000 af year-round, while maximum storage shall not exceed 1,142,960 af based on a maximum reservoir elevation set by the California Division of Dam Safety (PG&E Co., 1986e).

Outflows from Lake Almanor include the diversion of water into the Prattville Tunnel which leads to the Butt Valley Powerhouse on Butt Creek and releases to the NFFR from the dam outlet tower. Tailrace water from the Butt Valley Powerhouse immediately enters Butt Valley Reservoir which lies about three miles south of Lake Almanor on Butt Creek and has a usable storage capacity of 49,897 af (PG&E Co., 1999g). Pacific Gas and Electric Company releases water from the Butt Valley Reservoir directly into a pair of 1.8-mile tunnels feeding the penstocks for Caribou 1 and 2 powerhouses. Water discharging from these powerhouses flows directly into Belden Reservoir (2,400 af), located on the NFFR approximately ten miles downstream from Lake Almanor Dam.

Belden Reservoir serves as the forebay to both Oak Flat Powerhouse and Belden Powerhouse. The Oak Flat Powerhouse is located at the base of Belden Dam on the NFFR, and its output is determined by minimum instream flow requirements because water released through Oak Flat Powerhouse immediately enters the NFFR. Pacific Gas and Electric Company also diverts water from Belden Reservoir into a 6.6-mile-long tunnel to the Belden Powerhouse which is located on Yellow Creek immediately upstream of its confluence with the NFFR.

Aquatic Habitat and Fishery Management

The fish resources of the project impoundments and the NFFR and its tributaries consist of a combination of warmwater and coldwater species. Fish habitat in the vicinity of the project is primarily coldwater stream habitat in the NFFR downstream of Lake Almanor and in the surrounding tributaries. Lake Almanor, Butt Valley Reservoir, and smaller impoundments associated with the project, including Belden Reservoir, provide habitat for a combination of both warm and coldwater fish species (Table 4.4-13).

The primary sport fishery in Lake Almanor is for rainbow trout, brown trout, and chinook salmon. A sport fishery also exists for smallmouth and largemouth bass; however, due to the lake's coldwater conditions, largemouth bass will never become a significant sport fishery, (CDWR, 1986). During studies from 1981 through 1985, surface water temperatures in the reservoir exceeded the 68°F upper limit for coldwater habitat only during the hottest time of the year (CDFG, 1988). Wakasagi (*Hypomesus nipponensis*) (Japanese pond smelt) is the major forage species. Carp, (*Cyprinus carpio*) brown bullhead, tui chub, Sacramento perch, Sacramento pikeminnow, Sacramento sucker, kokanee salmon, hardhead, lake trout (*Salvelinus namaycush*), channel catfish, pond smelt, and Tahoe sucker also occur in the lake (CDWR, 1986). California Department of Fish and Game has estimated that Lake Almanor could produce several thousand pounds of trout annually if not for large populations of tui chub and smelt. These species utilize zooplankton as their major food source, thus inhibiting rainbow trout and kokanee salmon populations through competition for food (PG&E Co., 1989a).

The NFFR, Benner Creek, and the Hamilton Branch of the NFFR, all tributaries to the lake, are good stream habitat for salmonids (CDFG, 1976). Under terms of the FERC license and in cooperation with CDFG, Pacific Gas and Electric Company has contributed to habitat improvement and restoration and paid for annual stocking of trout in Lake Almanor. In 1999, CDFG stocked 58,950 catchable brown trout, 42,800 catchable Eagle Lake trout, 50,112 fingerling Eagle Lake trout and 60,000 yearling chinook salmon in Lake Almanor (CDFG, 1999).

The primary game fish in the NFFR below Lake Almanor are rainbow trout and brown trout. Smallmouth bass are also present (PG&E Co., 1996b). FERC License Article 26 requires a total

Table 4.4-13 DeSabla Regional Bundle - Upper North Fork Feather River Project (FERC 2105) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Wakasagi	Chinook salmon	Kokanee	Rainbow trout	Brown trout	Brook trout	Lake trout	Hitch	Tui chub	Hardhead	Sacramento pikeminnow	Carp	Sacramento sucker	Tahoe sucker	Brown bullhead	Channel catfish	Sacramento perch	Largemouth bass	Smallmouth bass	Riffle sculpin
Lake Almanor	650,000 af[b]	X	X[e]	X	X[e]	X		X		X	X	X	X	X	X	X	X	X	X	X	
Benner Creek Tributary to Lake Almanor	None			X	X	X		X													
North Fork Feather River upstream of Lake Almanor	None			X	X	X		X													
Butt Creek upstream of Butt Valley Powerhouse	None				X	X															
Butt Valley Reservoir	None	X	X		X	X			X	X		X	X	X		X		X		X	X
North Fork Feather River downstream of Lake Almanor Dam Outlet to Caribou 1/2 Powerhouse	Year round: 35 cfs[c]			X	X	X		X	X	X	X	X		X				X			
Belden Reservoir	None			X	X	X		X	X	X	X	X		X				X			
North Fork Feather River downstream of Belden Reservoir to confluence with Gansner Fish Barrier	Between 60 - 140 cfs[d]			X	X	X		X	X	X	X	X						X			
North Fork Feather River downstream of Gansner Fish Barrier to confluence with East Branch Feather River	None	X			X	X					X	X	X	X		X			X	X	X

Table 4.4-13 DeSabla Regional Bundle - Upper North Fork Feather River Project (FERC 2105) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Wakasagi	Chinook salmon	Kokanee	Rainbow trout	Brown trout	Brook trout	Lake trout	Hitch	Tui chub	Hardhead	Sacramento pikeminnow	Carp	Sacramento sucker	Tahoe sucker	Brown bullhead	Channel catfish	Sacramento perch	Largemouth bass	Smallmouth bass	Riffle sculpin
North Fork Feather River downstream of confluence with East Branch Feather River to North Fork Feather River confluence with Yellow Creek (Belden Powerhouse)	None	X			X	X					X	X	X	X		X			X	X	X
Yellow Creek[f]	None				X	X								X							X

a cfs = cubic feet/second

af = acre-feet

b The end-of-year target water storage level was established in 1986 by Pacific Gas and Electric Company in response to an inquiry by FERC. It is generally established as 650,000 af, but is dependent on the amount of runoff carry-over from the previous year. Storage must be maintained above 500,000 af year-round, while maximum storage shall not exceed 1,142,960 af based on a maximum reservoir elevation level set by the California Division of Dam Safety.

c FERC License 0026 requires a total annual release of 25,000 af each calendar year from Lake Almanor to the North Fork Feather River, subject to a release schedule provided by CDFG. In addition, CDFG may request flusihng flow releases from the dam to improve fish spawning habitat in an annual amount not to exceed 1,000 af single-time-release subject to a cumulative total not to exceed 5,000 af.

d The flow schedule provided by CDFG requires a release of 140 cfs beginning the Friday preceding the last Saturday in April in order to correspond to the opening of trout season. After Labor Day flows are reduced to 60 cfs.

e A Great Lakes variety of chinook salmon (fall-run) is planted in Lake Almanor by CDFG.

f Designated as a Wild Trout Stream in the California Wild Trout Program.

annual release of 25,000 af each calendar year from Lake Almanor Dam to the NFFR, subject to a release schedule provided by the CDFG. Under a 1987 agreement, CDFG may request flushing flow releases from the dam to improve fish spawning habitat in an annual amount not to exceed 1,000 af single-time release subject to a cumulative total not to exceed 5,000 af. While the distribution of these amounts is subject to consultation with CDFG, dam releases are normally maintained at 35 cfs (FERC, 1964). Additional fisheries improvements related to water temperature will occur at the Prattville Intake at Lake Almanor under terms of an agreement between Pacific Gas and Electric Company and CDFG on the Rock Creek-Cresta project. This agreement is discussed in greater detail in the Rock Creek-Cresta section.

Butt Valley Reservoir receives water from Lake Almanor through the Prattville Tunnel as well as from Butte Creek, which has typical flows varying from about 40 cfs in summer to 190 cfs in winter (PG&E Co., 1996a). Butt Valley Reservoir provides additional lacustrine habitat for fish within the project. The reservoir is considered a very good natural trout fishery and is noted for large rainbow and brown trout, particularly in the narrow upper end of the reservoir near Butt Valley Powerhouse where trophy size fish are often taken (PG&E Co., 1996a). Game fish are not stocked in this reservoir, and the indigenous wild trout appear well adapted for survival and natural reproduction. FERC License Article 10 was amended requiring some areas of snags to be left in Butt Valley Reservoir to provide food and shelter for fish. Smelt are also present, but their numbers are currently insufficient to pose a threat to game fish (PG&E Co., 1989a). During fish surveys conducted when Butt Valley Reservoir was drawn down for maintenance, 13 species of fish were collected, including rainbow trout, brown trout, smallmouth bass, Sacramento sucker, Wakasagi, Sacramento pikeminnow, bullhead, Sacramento perch, carp, tui chub, hitch, sculpin, and chinook salmon[1]. The most abundant species was Sacramento pikeminnow (PG&E Co., 1996c). Wakasagi, often called Japanese pond smelt, provide a major food source for trout (PG&E Co., 1996a). Butt Creek, a perennial tributary to the reservoir, supports spawning populations of brown and rainbow trout.

Belden Reservoir is a small run-of-the-river reservoir below the Caribou 1 and 2 Powerhouse tailraces on the NFFR. Belden Reservoir contains a large population of suckers which can reduce trout populations. Suckers are omnivorous scavengers that forage on bottom material and consume many of the benthic invertebrates preferred by trout. At the same time, they displace trout from their most desirable feeding locations. The warmer water temperature that characterizes this reservoir, as well as the Rock Creek, Cresta, and Poe reservoirs downstream, provides non-game species with a competitive advantage over existing trout species (CDWR, 1986). Pacific Gas and Electric Company has funded extensive studies on this matter (PG&E Co., 1989a). Fish tissue sampled in Belden Reservoir contains PCB (polychlorinated biphenyl) in concentrations above the limit of detection. The situation in Belden is a result of slope failure that severely damaged Caribou

1 Chinook salmon are planted in Lake Almanor by CDFG, and may be diverted to Butt Valley Reservoir.

Powerhouse and is currently being monitored. In 1999, CDFG planted 10,485 catchable rainbow trout in Belden Reservoir (CDFG, 1999).

The flow released to the NFFR below Belden Dam must total 64,000 af each calendar year. The flow schedule provided by the CDFG requires a release of 140 cfs beginning the Friday preceeding the last Saturday in April, in order to correspond to the opening of trout season. After Labor Day, flows are reduced to 60 cfs (FERC, 1991b). Fish habitat in the NFFR has also been altered by installation of a fish barrier at Gansner Bar in the 1970s to stop migration of non-game fish into the stretch of the NFFR below Belden Dam (Aquatic Systems Research, 1994).

California Department of Fish and Game has developed a draft plan for fisheries management based on the results of a study conducted from 1981 through 1986. The plan and data focus mainly on the NFFR downstream of the Rock Creek Powerhouse but also provide management recommendations for the Upper NFFR and the East Branch Feather River up to its confluence with Spanish and Indian creeks. The most important fishery management tools suggested in the plan for restoring trout are habitat preservation, restoration, and improvement. These improvements include decreased water temperature, increased flow, spawning habitat improvement, barrier removal and recruitment of rainbow trout from tributaries, and sediment control (CDFG, 1987). The plan is discussed in more detail below in the Rock Creek-Cresta project section.

FERC License Articles 28 and 29 address protection of fishery resources through construction, operation, and maintenance of fish screens, if necessary, and by avoiding a sudden release of large flows. In addition, FERC License Article 104 requires annual consultation with the USFS regarding measures to ensure protection and utilization of natural resources on the land added to the license for the Belden Siphon Slope Stabilization project.

Special-Status Species

Sacramento perch, a State Species of Special Concern, occur in Lake Almanor and Butt Valley Reservoir (Table 4.4-14). Hardhead, another State Species of Special Concern and a USFS sensitive species, are also known to occur within the project. A query of the CNDDB for the project, covering the area within the FERC project boundary and a one-mile buffer around it, produced no additional special-status fish species records (CNDDB, 2000).

Rock Creek-Cresta (FERC 1962)

The Rock Creek-Cresta Project and the associated Watershed Lands area support a variety of fisheries and aquatic resources and habitats. The following sections describe these resources, the sources and nature of potential impacts on these resources, and project-specific regulatory conditions related to these resources, if any.

The project is hydrologically linked to Pacific Gas and Electric Company's Upper North Fork Feather River Project (FERC 2105), Bucks Creek Project (FERC 0619), and Poe Project

(FERC 2107). Water stored upstream in Pacific Gas and Electric Company's Lake Almanor is released during the summer and fall months to power the Rock-Creek-Cresta Project, while runoff emanating from the East Branch NFFR supplies significant flow during winter and spring.

Table 4.4-14 Special-Status Fish Species That Occur in the DeSabla Regional Bundle

Family Name Common Name (*Scientific Name*)	State/Federal Designations[a]	Status of Occurrence by Project				
		Upper North Fork Feather River (FERC 2105)	Rock Creek-Cresta (FERC 1962)	Poe (FERC 2107)	DeSabla-Centerville (FERC 803)	Hamilton Branch (Non FERC Jurisdictional)
Salmonidae (Salmon and Trout Family)						
Central Valley steelhead ESU[b] (*Oncorhynchus mykiss irideus*)	--/FT				Occurs in Butte Creek downstream of Centerville Diversion Dam[f]	
Chinook salmon (*Oncorhynchus tshawytscha*)						
Spring- run	ST/FT, FSS				Occurs in Butte Creek downstream of Centerville Diversion Dam[f]	
Fall-run	CSC/FC, FSS				Occurs in Butte Creek downstream of Centerville Diversion Dam[f]	
Late fall-run	CSC/FC, FSS				Occurs in Butte Creek downstream of Centerville Diversion Dam[f]	
Cyprinidae (Minnow Family)						
Hardhead (*Mylopharodon conocephalus*)	CSC/FSS	Documented to occur[c]	Documented to occur[d]	Documented to occur[e]	Documented to occur[f]	
Centrarchidae (Sunfish Family)						
Sacramento Perch (*Archoplites interruptus*)	CSC/FSC	Occurs in Lake Almanor and Butt Valley Reservoir[c]				

a Designation Abbreviations:
-- = No designation
State Designations
CSC = California Special Concern species
ST = State Threatened species
Federal Designations
FSS = Forest Service Sensitive species

FC = Federal Candidate species
FT = Federal Threatened species
FSC = Federal Special Concern species

b ESU = Evolutionarily Significant Unit

c USFS. 1998. List of Sensitive Animal Species (updated 8 June).

d Pacific Gas and Electric Company. 1984. Rare, Threatened, Endangered and Emphasis Recovery Wildlife Species Associated with the Chambers and Jackass Creeks Diversions Amendment to the Rock Creek-Cresta project.

e Fry. 1994. Terrestrial Biological Resources associated with the Rock Creek-Cresta Sediment Management Plan.

f Federal Energy Regulatory Commission. 1991. Environmental Assessment for Amendment of Hydropower License DeSabla-Centerville Project, Federal Regulatory Commission (FERC) 0803.

The upstream facility begins with the Rock Creek Reservoir which captures water from two primary sources: (1) water discharged from the Belden Powerhouse; and (2) inflow from the NFFR which consists of releases made at the Belden Reservoir plus inflow from the East Branch NFFR. Rock Creek Reservoir has a gross storage capacity of 4,400 af, although the accumulation of sediments in the reservoir has significantly reduced its capacity (PG&E Co., 1989c).

Sedimentation is and probably always has been a problem in the NFFR; upstream areas have soils that are easily eroded. These areas also have been subjected to land use practices that have increased erosion and consequently increased bedload (Aquatic Systems Research, 1994). The East Branch NFFR in particular has contributed high levels of sediment. In 1994, it was estimated that storage capacity in Rock Creek Reservoir had been reduced approximately 54 percent due to accumulated sediments (Aquatic Systems Research, 1994). Water is diverted from the Rock Creek Reservoir into a tunnel that leads to the Rock Creek Powerhouse. Pacific Gas and Electric Company also releases water from Rock Creek Dam to the NFFR where it flows 8.4 miles from the Rock Creek Reservoir to Cresta Reservoir.

Cresta Reservoir captures water from Bucks Creek and the Bucks Creek Powerhouse via the NFFR. Other sources of inflow to the reservoir include the NFFR downstream of Rock Creek Dam and tributary inflow from several small creeks. The Cresta Reservoir has a gross storage capacity of 4,140 af, although, as with Rock Creek Reservoir, storage in the Cresta Reservoir has been diminished due to sedimentation. In 1994, it was estimated that storage capacity in Cresta Reservoir had been reduced approximately 44 percent due to sediment accumulation (Aquatic Systems Research, 1994). Water is diverted from the Cresta Reservoir into a tunnel and penstock combination leading to the Cresta Powerhouse 4.1 miles downstream of the reservoir.

Aquatic Habitat and Fishery Management

Fish habitat in the vicinity of the project is primarily coldwater stream habitat in the NFFR and in the surrounding tributaries. The reservoirs associated with the project provide habitat for a combination of both warm- and coldwater fish species (Table 4.4-15). The NFFR in this area runs through a rugged, narrow canyon of relatively low gradient dominated by large boulders and bedrock as substrate.

Table 4.4-15 DeSabla Regional Bundle - Rock Creek-Cresta Project (FERC 1962) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Wakasagi	Rainbow trout	Brown trout	Hardhead	Sacramento pikeminnow	Carp	Sacramento sucker	Brown bullhead	Bluegill	Largemouth bass	Smallmouth bass	Riffle sculpin
Rock Creek Reservoir	None	X	X	X	X	X	X	X	X	X	X	X	X
North Fork Feather River between Rock Creek Diversion Dam and Cresta Reservoir	5/1-10/31: 100 cfs 11/1-4/30: 50 cfs[b]		X	X	X	X	X	X	X	X	X	X	X
Cresta Reservoir	None		X	X	X	X	X	X	X	X	X	X	X
North Fork Feather River between Cresta Diversion Dam and Poe Reservoir	Year round: 50 cfs[b]		X	X	X	X	X	X	X	X	X	X	X
Soda Creek	Unimpaired. Watershed lands.		X	X									
Kingsbury Ravine	Unimpaired. Watershed lands.		X	X									
Mill Creek (Hallsted)	Unimpaired. Watershed lands.		X	X									
Berry Creek	Unimpaired. Watershed lands.		X	X									
York Creek	Unimpaired. Watershed lands.		X	X									
Rush Creek	Unimpaired. Watershed lands.		X	X									
Mill Creek (Rich Bar)	Unimpaired. Watershed lands.		X	X									
French Creek	Unimpaired. Watershed lands.		X	X									
Kellog Ravine	Unimpaired. Watershed lands.		X	X									
Oak Ravine	Unimpaired. Watershed lands.		X	X									
Fern Canyon	Unimpaired. Watershed lands.		X	X									
Belden Ravine	Unimpaired. Watershed lands.		X	X									
Yellow Creek	Unimpaired. Watershed lands.		X	X									
Little Indian Creek	Unimpaired. Watershed lands.		X	X									

Table 4.4-15 DeSabla Regional Bundle - Rock Creek-Cresta Project (FERC 1962) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Wakasagi	Rainbow trout	Brown trout	Hardhead	Sacramento pikeminnow	Carp	Sacramento sucker	Brown bullhead	Bluegill	Largemouth bass	Smallmouth bass	Riffle sculpin
Chips Creek	Unimpaired. Watershed lands.		X	X									
Pauls Creek	Unimpaired. Watershed lands.		X	X									
Murphy Creek	Unimpaired. Watershed lands.		X	X									
Opapee Creek	Unimpaired. Watershed lands.		X	X									
Milk Ranch Creek	Unimpaired. Watershed lands.		X	X									
Chambers Creek	Unimpaired. Watershed lands.		X	X									X
Granite Creek	Unimpaired. Watershed lands.		X	X									
Jackass Creek	Unimpaired. Watershed lands.		X	X									
Bucks Creek	Unimpaired. Watershed lands.		X	X									
Rock Creek	Unimpaired. Watershed lands.		X	X									
Elephant Creek	Unimpaired. Watershed lands.		X	X									
Swamp Creek	Unimpaired. Watershed lands.		X	X									

a cfs = cubic feet/second

b When a new license is issued, these releases are expected to increase to levels stipulated in a 1991 Fish and Wildlife Agreement between Pacific Gas and Electric Company and CDFG.

The Rock Creek and Cresta stream sections can each be divided into two distinct subsections. The upper 4.7 miles of the Rock Creek section and the lower 2.9 miles of the Cresta section are characterized by low stream gradient (11.6 and 7.7 ft/mile, respectively) and long, deep pools connected by relatively short riffles and runs. In contrast, the lower 3.7 miles of the Rock Creek section and the upper 15 miles of the Cresta section are characterized by steeper stream gradient (28.9 and 21.2 ft/mile, respectively) and swifter waters in a boulder strewn canyon (CDFG, 1987). Thick riparian vegetation greater than 5 feet tall covers less than 40 percent of the bank area in each river section. Aquatic weed beds are non-existent (CDFG, 1987).

Before the project was created in the 1950s, the area supported a sport fishery for rainbow and brown trout. The creation of reservoirs, reduction of streamflows, and other factors created conditions more favorable for non-game fish than trout. Presently, Cresta Dam, Rock Creek Dam, and the Gansner Bar Fish Barrier Dam are main stem barriers to fish migration. No barriers of any kind are found on 17.5 miles of the East Branch NFFR from its confluence with the NFFR to Highway 89 (CDFG, 1987). There are 13 species of fish established in the Rock Creek-Cresta Project. The principal trout species present are rainbow trout followed by a much smaller population of brown trout. Non-game fish populations are dominated by Sacramento sucker, Sacramento pikeminnow, and hardhead. However, smallmouth bass are found primarily in the Cresta section but are occasionally also found in the Rock Creek section. However, this species contributes very little to the sport fishery. Sculpin are very numerous throughout both sections, while brown bullhead are present but are rarely seen in angler's catch or standing crops (CDFG, 1987). Additional surveys have documented carp, bluegill, largemouth bass, Wakasagi, and delta smelt (within the project) (Aquatic Systems Research, 1994; CDWR, 1986).

Unlike the river and reservoir, most of the NFFR tributaries within the project contain predominantly wild trout. Tributaries are essential as spawning grounds for the NFFR fishery because of their relatively cooler water temperature and desirable habitat. There are over 20 small tributaries within the project vicinity that may act as nurseries for the recruitment of young to the main river channel (CDWR, 1986). Sixty percent of these tributaries have human-made barriers near the mouths that prevent adult trout migrations, thereby reducing total habitat available (CDFG, 1987). Highway and railroad construction activities have greatly influenced the geomorphology and fish habitat of the NFFR. Portions of Highway 70 were built on terraces or floodplains on the NFFR, reducing room for the NFFR to meander thus increasing river gradient (Aquatic Systems Research, 1994). In addition, over 30 percent of the tributaries are blocked by natural barriers (Table 4.4-16). Because of the steep topography within the North Fork Feather River canyon, tributaries rarely have long stretches of low gradient stream reaches near the main river confluence.

Through the 1950s, the trout fishery in the NFFR declined despite stocking efforts. In 1966, CDFG chemically treated portions of the NFFR with a fish toxicant called rotenone to control non-game species and then planted hatchery brown and rainbow trout (PG&E Co., 1981a). The 1966 chemical treatment improved trout populations very briefly; however, by the early 1970s, non-game species dominated project waters again.

CDFG tried chemical treatments again in 1977. Rainbow, brown and cutthroat/rainbow hybrid trout were planted, but within a few years non-game species began to dominate the river and reservoir sections (PG&E Co., 1981a).

FERC License Article 13 requires a minimum flow release from Rock Creek Dam to the NFFR of 100 cfs from May 1 through October 31, and 50 cfs from November 1 through April 30. Additionally, Article 13 requires a minimum flow of 50 cfs, measured at gauge NF-56, below Cresta Reservoir. Releases are expected to increase as a result of the Rock Creek-Cresta Agreement.

California Department of Fish and Game developed a draft plan for fisheries management based on the results of a conducted study from 1981 to 1986. According to CDFG, virtually no suitable spawning gravel is left in the main river. Total available spawning gravel in the Cresta and Rock Creek sections was estimated at 125 and 392 square meters, respectively. These estimates represent 0.07 and 0.13 percent of the total area available in the two respective stream sections (CDFG, 1987).

The draft 1987 CDFG plan also identifies water temperature, decreased flows, and increased sediment in the NFFR as contributors to the decline of the pre-project trophy fishery. During 1981 through 1985, mean daily water temperatures in the Cresta and Rock Creek sections of the NFFR exceeded 66.2° (19°C), which approaches the upper limit for coldwater habitat, the majority of days in August of most years and July and September of some years. The pre-project summer flows were much higher than the current flows and likely resulted in much lower water temperatures in these sections of the river. Lower water temperatures in turn may have supported the spawning of salmon and steelhead in this reach.

The most important fishery management tools suggested for restoring the trout fishery identified in CDFG's Fisheries Management Plan were habitat preservation, restoration, and improvement. These improvements include management of water temperature through improved releases from Lake Almanor at the Prattville Intake, increased flows below the Rock Creek and Cresta Dams, spawning habitat improvements through gravel placement and artificial channel design on the NFFR and selected tributaries, barrier removal or fish passage improvement along selected tributaries to gain access to spawning habitat, and sediment control considerations (CDFG, 1987; CDFG, 1988). The plan also recommends that hatchery production, recreational access, and more stringent fishing regulations be developed (CDFG, 1987). Recommended improvements are contained in the Rock Creek-Cresta Settlement Agreement. According to the agreement, the increased minimum streamflows will be maintained at designated existing gauges below Rock Creek and Cresta Dams, as shown in Table 4.4-17. Pacific Gas and Electric Company must also make supplemental water releases at Rock Creek Dam during summer months of up to 3,600 af for the purpose of providing

Table 4.4-16 Summary of Stream Bed Distances (in meters) to Barriers on Tributaries to the North Fork Feather River and the East Branch of the North Fork Feather River

Reach/Stream	Mouth to First Barrier	First Barrier Type	Distance to Nest Upstream Barrier	Upstream Barrier Description
Cresta Reach				
Dogwood Creek	0	Railroad Culvert	50	Falls
Camp Creek	20	Railroad Culvert	50	Falls
(Unnamed) Cedar Creek	30	Railroad Culvert	50	Falls
Bear Ranch Creek	70	Falls	No Further	----
Grizzly Creek	1000	High Gradient**	1000	Falls
Rock Creek Reach				
Swamp Creek	10	Railroad Culvert	20	Falls
Elephant Creek	10	Falls**	No Further	----
Rock Creek	70	PG&E Co. Weir	30	Falls
Bucks Creek	250	Falls	100	Falls
Jackass Creek	100	Railroad Culvert**	No Further	----
Granite Creek	70	Highway Culvert	100	Falls
Chambers Creek	300	Falls**	No Further	----
Milk Ranch Creek	150	Railroad Culvert	500	Falls
Oppapee Creek	120	Highway Culvert**	No Further	----
Belden Reach				
Murphy Creek	50	Falls	No Further	----
Pauls Creek	40	Falls	No Further	----
Chips Creek	4000	----	Unknown	Unknown
Little Indian Creek	0	Highway Culvert	1000	Dam
Belden Ravine	200	Cascade Falls	No Further	----
Yellow Creek	1000	Falls**	No Further	----
Fern Creek	200	High Gradient**	10	Railroad Culvert
East Branch				
Oak Ravine	100	Railroad Culvert**	No Further	----
Kellogg Ravine	80	Falls**	No Further	----
Mill Cr. (Rich Bar)	80	Railroad Culvert	1300	Falls
Rush Creek	50	Highway Culvert	2000	Falls
Mill Cr. (Hallsted)	300	Railroad Culvert	2000	----
Soda Creek	20	Highway Culvert	1500	Falls

** Judged to be a partial barrier.

Source: CDFG. 1987. Fisheries Management Plan, North Fork Feather River, California Department of Fish and Game (CDFG), Region 2.

Table 4.4-17 Minimum Flows Below Rock Creek and Cresta Reservoirs for the First 5-Year Test Period

Stream Reach	Normal and Wet	Dry	Critically Dry
Rock Creek (measured at USGS Gage No. 11.4032.00)	180-250 cfs	150-200 cfs	110-150 cfs
Cresta (measured at USGS Gage No. 11.4043.30)	220-250 cfs	175-200 cfs	100-140 cfs

The Rock Creek-Cresta relicensing agreement stipulates minimum flows by month for three 5-year test periods. Within each period there are different minimum flows, ramping rates, and pulse flows. The values presented above are the range of minimum flows for the first 5-year period.

Water year types are determined as follows based on unimpaired inflow to Lake Oroville as follows:

Wet – Inflow to Oroville of greater than or equal to 5,679 thousand acre-feet (taf);

Normal – Inflow to Oroville of less than 5,679 taf but greater than or equal to 3,228 taf;

Dry – Inflow to Oroville of less than 3,228 taf but greater than or equal to 2,505 taf;

Critically Dry – Inflow to Oroville of less than 2,505 taf.

Source: Pacific Gas and Electric Company 2000. Rock Creek-Cresta Project (FERC no. 1962), Rock Creek-Cresta Relicensing Settlement Agreement. Appendix A.

water temperatures in the NFFR that will protect fishery resources. These releases will be implemented at the request of CDFG. As discussed above, new minimum releases are meant to commence on a date and in a manner to be specified by FERC during the relicensing process.

In addition, Pacific Gas and Electric Company will stock 30,000 trout per year between Rock Creek and Cresta Reservoirs, create a spawning channel at Opapee Creek, provide spawning gravel at Granite Creek as needed, remove several weir and rock barriers, and construct/maintain a fish ladder on Mill Creek (Halstead Flat) at the railroad crossing (PG&E Co. and CDFG, 1991). The Fish and Wildlife Agreement stipulates additional enhancement to the fishery and wildlife resources within the NFFR watershed to be conducted on Pacific Gas and Electric Company's Watershed Lands in the Humbug Valley (see discussion below).

The Watershed Lands associated with the Rock Creek-Cresta project support a variety of fisheries and aquatic resources and habitats. Fish habitat at or in the vicinity of the Watershed Lands is primarily coldwater stream habitat in the NFFR and in the surrounding tributaries. Yellow Creek, which flows through Humbug Valley northeast of the project, is one of 17 statewide streams designated a Wild Trout Stream and, consequently, preserved for its attractive trout fisheries which are naturally sustained by wild trout strains rather than artificially sustained by domesticated, catchable-sized trout stocked on a put-and-take basis (CDWR, 1986). Yellow Creek may contribute substantially to NFFR wild trout populations and is an important source of cooling water to the NFFR. The Humbug Valley land totals approximately 2,300 acres. A near-pristine setting, biologically productive waters, quality angling for wild trout, and self-sustaining wild trout population that are relatively unaffected by angling pressure, are all necessary criteria for inclusion into Wild Trout Waters status. At present, Lower Yellow Creek is managed exclusively for wild rainbow and brown trout (CDWR, 1986).

The Rock Creek-Cresta Agreement stipulates several habitat enhancements for the Humbug Valley land. Improvements to Humbug Valley land, currently leased for cattle grazing, include cattle guards, stream improvements, riparian plantings, and limits on grazing (PG&E Co. and CDFG, 1991). Pacific Gas and Electric Company must submit a general resource management plan within three years of receiving a new license for the project (an application for new license (PG&E Co., 1981) is pending before FERC) that addresses improvements to aquatic and riparian habitat, minimization of consumptive water use on grazing lands, minimization of erosion and sediment transport, evaluation of continuing grazing leases, and recommendations for best use of the existing resources (PG&E Co. and CDFG, 1991). It is important to note that this mitigation work would be performed on watershed lands outside the existing FERC boundary; however, these lands may be incorporated into the FERC boundary upon issuance of a new license.

Special-Status Species

A query of the CNDDB for the project, covering the area within the FERC project boundary and a one-mile buffer around it, produced no additional special-status fish species sighting records (CNDDB, 2000). However, hardhead, a State Species of Special Concern and a USFS sensitive species, are known to be abundant at the project (Table 4.4-14). The Sacramento perch is the only other fish species with special status that may be found in Rock Creek-Cresta project waters. Sacramento perch populations are known to exist in reservoirs in the upper NFFR drainage.

Poe (FERC 2107)

The Poe Project and associated Watershed Lands support a variety of fisheries and aquatic resources and habitats. The following sections describe these resources, the sources and nature of potential impacts on these resources, and project-specific regulatory conditions related to these resources, if any.

The Poe Project, located in Butte County, is situated in the lower reaches of the NFFR, directly upstream of Lake Oroville (operated by California Department of Water Resources). The project is hydrologically linked to Pacific Gas and Electric Company’s Upper North Fork Feather Project (FERC 2105), Bucks Creek project (FERC 619), and Rock Creek-Cresta Project (FERC 1962). Water stored upstream in Lake Almanor may be released during the summer and fall months to power the Poe Project, while runoff emanating from the East Branch NFFR may supply sufficient water during winter and spring.

The Poe Reservoir captures water in the NFFR from releases made at the Cresta Powerhouse and from the Cresta Dam. Sediment accumulation in the Poe Reservoir is minimal due to the smaller reservoir size and bottom-opening gates, which facilitate sediment passage (Aquatic Systems Research, 1994). Water is diverted from Poe Reservoir into a 6.2-mile-long tunnel to the Poe Powerhouse. Water from the powerhouse tailrace is impounded by Lake Oroville.

Fish habitat in the vicinity of the project is coldwater and warmwater stream habitat in the NFFR upstream of Lake Oroville and in the surrounding tributaries. Poe Reservoir on the NFFR provides habitat for lake dwelling fish species (Table 4.4-18).

Table 4.4-18 DeSabla Regional Bundle - Poe Project (FERC 2107)
Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Rainbow trout	Brown trout	Hardhead	Sacramento pikeminnow	Carp	Sacramento sucker	Largemouth bass	Smallmouth bass
Poe Reservoir	None	X	X	X	X	X	X	X	X
North Fork Feather River between Poe Diversion Dam and Poe Powerhouse	Year round: 25 cfs	X	X	X	X	X	X	X	X
North Fork Feather River downstream of Poe Powerhouse to Lake Oroville	None	X	X	X	X	X	X	X	X
Grizzly Creek tributary to North Fork Feather River	Unimpaired watershed lands	X	X						
Bear Ranch Creek tributary to North Fork Feather River	Unimpaired watershed lands	X	X						
Camp Creek tributary to North Fork Feather River	Unimpaired watershed lands	X	X						
Dogwood Creek tributary to North Fork Feather River	Unimpaired watershed lands	X	X						
Mill Creek tributary to North Fork Feather River	Unimpaired watershed lands	X	X						
Flea Valley Creek tributary to North Fork Feather River	Unimpaired watershed lands	X	X						

a cfs = cubic feet/second

Aquatic Habitat and Fisheries Management

The project is dominated by pool habitat (48 percent) and run/glide habitat (28 percent), with the remaining habitat composed of riffles and pocket water. Site-specific fisheries and habitat surveys of Poe Reservoir and the NFFR in the immediate vicinity of the project were conducted in 1992 (Aquatic Systems Research, 1994). Hardhead and smallmouth bass are the most abundant species in Poe Reservoir, followed by Sacramento sucker, Sacramento pikeminnow, rainbow trout and largemouth bass. In the NFFR below Poe Reservoir, the most abundant species are smallmouth bass, Sacramento sucker, and Sacramento pikeminnow. Rainbow trout, hardhead, and carp were also present (Aquatic Systems Research, 1994). According to a 1994 survey, smallmouth bass showed a linear trend of decreasing abundance in the upstream direction in the reach of the NFFR between Poe Powerhouse and Poe Dam. It is possible that sustained periods of low flow allow smallmouth bass to slowly disperse upstream from Lake Oroville (Aquatic Systems Research, 1994). In the CDFG six-year NFFR Fisheries Management study, juvenile smallmouth bass increased in abundance progressively upstream until a high streamflow event occurred.

Pacific Gas and Electric Company releases water directly into the NFFR from Poe Dam, in accordance with the FERC license. FERC License Article 26 stipulates that a minimum flow of 50 cfs must be maintained at all times in the NFFR at the downstream gauging station at Big Bar and that a minimum flow of 25 cfs is required for the Poe Diversion Dam (FPC, 1965). FERC License Articles 27 and 28 address protection of fishery resources by avoiding a sudden release of large flows, and through construction, operation, and maintenance of fish screens if needed (FPC, 1953).

Tributaries are essential as spawning grounds for the NFFR fishery because of their relatively cooler water temperature and desirable habitat. CDFG, on two tributaries below the Poe Diversion Dam, Mill Creek (Pulga) and Flea Valley Creek, documented juveniles and adult trout spawners during the NFFR Fisheries Management Study (CDFG, 1987).

Special-Status Species

A query of the CNDDB for the project, covering the area within the FERC project boundary and a one-mile buffer around it, produced no additional sighting records for special-status fish (CNDDB, 2000). As noted above, hardhead (a California Species of Special Concern) are present in the project (Table 4.4-14). Sacramento perch is the only other fish species with special status that may be found in Poe project waters. No Sacramento perch have been documented, although it is possible that they could be transported downstream into the Poe project during high flow periods. Sacramento perch populations are known to exist in reservoirs in the upper NFFR drainage (PG&E Co., 1998d).

Bundle 7: Bucks Creek

Bucks Creek (FERC 619)

The Bucks Creek project and associated Watershed Lands support a variety of fisheries and aquatic resources and habitats. The following sections describe these resources, the sources and nature of potential impacts on these resources, and project-specific regulatory conditions related to these resources, if any.

The Bucks Creek Project, located in Plumas County, is situated on three tributaries of the NFFR (Bucks, Grizzly, and Milk Ranch creeks). These all flow in a westerly direction from the crest of the Sierra Nevada Mountain Range to the NFFR. Bucks Lake is the largest of the four storage facilities in the project. It is a 105,327 af reservoir that captures natural runoff of Bucks Creek and its tributaries. Water is released from Bucks Lake Dam directly into a second reservoir, the 5,800 af Lower Bucks Lake.

The second major source of water to Lower Bucks Lake is Three Lakes, a reservoir on Milk Ranch Creek. Three Lakes has a usable storage capacity of 606 af (CDM, 1997). Water released from

Three Lakes flows down Milk Ranch Creek approximately 1,500 feet to where it is diverted into the Milk Ranch Conduit. The conduit then conveys water approximately eight miles to Lower Bucks Lake (CDM, 1997). Additional water is added to the conduit from several diversions along its length (USGS, 1997).

Water is released from Lower Bucks Lake at two locations: (1) into Bucks Creek, a tributary to the NFFR; and (2) into the Grizzly Tunnel and penstock leading to the Grizzly Powerhouse. Water that is diverted from Lower Bucks Lake to the Grizzly Powerhouse eventually flows into the 1,100 af Grizzly Forebay. The water in Grizzly Forebay, composed of inflow from Grizzly Powerhouse and Grizzly Creek, is diverted into another tunnel and penstock leading to Pacific Gas and Electric Company's Bucks Creek Powerhouse, which is located on the NFFR. Pacific Gas and Electric Company also releases instream flows from the Grizzly Forebay into Grizzly Creek, which then flows 6.2 miles before joining the NFFR.

Aquatic Habitat and Fisheries Management

Fish habitat in the vicinity of the project includes coldwater stream habitat in Bucks, Grizzly, and Milk Ranch creeks and the surrounding tributaries. Bucks Lake, Lower Bucks Lake, Three Lakes, and Grizzly Forebay provide lake habitat for both warm- and coldwater fish species (Table 4.4-19).

Three Lakes is the highest and smallest storage reservoir in the Bucks Creek project and is located at the headwaters of Milk Ranch Creek. Historically, CDFG used aerial planting to stock trout fingerlings in Three Lakes. Stocking efforts focused on brook and rainbow trout, although brown trout (golden trout and cutthroat-rainbow crosses) have also been planted. In 1999, CDFG stocked 2,400 fingerling rainbow trout and 2,160 fingerling brown trout in Three Lakes (CDFG, 1999). Studies conducted by CDFG in 1985 suggested that brook trout populations are self-sustaining (PG&E Co., 1992b). In 1992, fisheries population sampling within the project documented rainbow trout, brook trout, and golden shiner. It is unclear how long golden shiner have occupied Three Lakes. However, the fact that CDFG chemically treated the upper lake in October 1966 suggests that shiners were a problem at least by the mid-60s (PG&E Co., 1992b). Half of the reservoir is located in the Plumas National Forest Bucks Lake Wilderness Area.

Below Three Lakes Reservoir, Milk Ranch Creek is the steepest of the three streams in the Bucks Creek project with an average gradient of 22 percent over its 3.5-mile course. This stream is almost completely dominated by a stair-step pattern of waterfalls connected by steep chutes (FERC, 1981). Currently, there is no minimum flow requirement for Milk Ranch Creek; the entire flow of the stream is diverted. However, the stream is immediately rewatered below the diversion structure due to accretion of groundwater seepage and several small tributaries. The stream provides habitat for rainbow trout and also acts as a nursery for the recruitment of young trout to the NFFR (CDWR, 1986).

Table 4.4-19 DeSabla Regional Bundle - Bucks Creek Project (FERC 0619) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Kokanee	Rainbow trout	Brown trout	Brook trout	Lake trout	Speckled dace	Golden shiner	Lahontan redside	Bluegill
Three Lakes Reservoir	6,050 ft		X	X	X			X		
Milk Ranch Creek downstream of Three Lakes Reservoir	None		X	X	X					
Milk Ranch Conduit	None		X	X	X					
Bucks Lake	Normal year: 5,100 ft Dry year: 5,080 ft	X	X	X	X	X			X	X
Bucks Creek tributary to Bucks Lake	Unimpaired watershed lands	X	X	X	X					
Mill Creek tributary to Bucks Lake	Unimpaired watershed lands	X	X	X	X					
Haskins Creek tributary to Bucks Lake	Unimpaired watershed lands	X	X	X	X					
Lower Bucks Lake	4,966 ft	X	X	X	X		X			
Bucks Creek between Bucks Lake and Lower Bucks Lake	None	X	X	X	X	X			X	X
Bucks Creek downstream of Lower Bucks Lake	4/01 - 11/30: three cfs 12/01 - 4/30: one cfs	X	X	X		X			X	X
Grizzly Forebay	4,303 ft	X	X	X						
Grizzly Creek upstream of Grizzly Forebay	Unimpaired watershed lands	X	X	X						
Grizzly Creek downstream of Grizzly Forebay	4/01 - 11/30: four cfs 12/01 - 3/31: two cfs		X	X						

a cfs = cubic feet/second
ft = feet (in elevation)

Bucks Lake supports a significant coldwater fishery including rainbow trout, brook trout, brown trout, and kokanee salmon. Bucks Creek, Mill Creek and Haskins Creek, which flow into Bucks Lake, support spawning populations of these three game-fish species. Other species found in the lake include Lahontan (redsides lake trout), and sunfish (FERC, 1981). These same species are potentially found in Bucks Creek as well. The CDFG annually stocks Bucks Lake with catchable and fingerling trout to enhance the sport fishery. In 1999, CDFG planted 4,940 catchable rainbow trout 11,420 catchable Eagle Lake trout, 13,780 brook trout, 2,860 catchable brown trout, and 15,000 fingerling lake trout (CDFG, 1999). FERC License Article 13 of the project specifies maximum amounts of reservoir drawdown during the recreation season. Pacific Gas and Electric

Company currently also maintains a 45,000 af carry-over at Bucks Lake that may have a beneficial impact on the fishery resources, but there is no license requirement to do so (PG&E Co., 1999f).

Bucks Creek between Bucks Lake and Lower Bucks Lake is characterized by alternating riffles/cascades, runs, and small pools during periods of low release and by continuous rapids during periods of high releases. Holding habitat for trout is limited during high flow conditions due to high velocities. The substrate consists primarily of rubble and boulders with scattered areas of gravel suitable for trout spawning. The narrow ravine and mature conifers on the ravine slopes provide stream shading. Fish species that inhabit Bucks Lake may also occur in this stream section, entering via the Bucks Lake release. The primary importance of this stream section to fishery resources may be for spawning trout and kokanee salmon that inhabit Lower Bucks Lake (FERC, 1981). Although this stream section is apparently used by large numbers of spawning fish, spawning success may be limited by the fluctuating flow conditions (FERC, 1981).

Good water quality and cool summer water temperatures provide adequate habitat for trout in Lower Bucks Lake. Scattered boulders and stumps on the reservoir bottom and small amounts of aquatic vegetation along the shoreline shallows provide cover for fish (FERC, 1981). The fish species composition in Bucks Lake and Lower Bucks Lake is similar because of the direct release of water from the former to the latter. Lower Bucks Lake supports brown trout, rainbow trout, brook trout, kokanee salmon, and speckled dace. Small numbers of brook trout may also occur in Lower Bucks Lake, entering via the Milk Ranch Conduit from Three Lakes. In accordance with FERC License Article 13, required releases from Lower Bucks Lake Dam for the maintenance of aquatic life in Bucks Creek is 3 cfs between April 1 and November 30 and 1 cfs from December 1 through March 31.

Bucks Creek below Lower Bucks Lake has an 11 percent grade in the upper four miles of the stream and 5 percent grade in the lower 3.2 miles. The stream is well shaded over its 7.2-mile course and is dominated by small waterfalls (cascades) connected by runs, shallow pools, and pocket water (areas of swift-flowing water where numerous channel obstructions provide velocity refugia for fish) (FERC, 1997a). Bucks Creek receives some flow augmentation in the form of groundwater seepage accretion. Bucks Creek supports almost exclusively brown trout in the upper reaches and brown and rainbow in the lower reaches (FERC, 1997a). The stream also acts as a nursery for the recruitment of young trout to the NFFR (CDWR, 1986).

Grizzly Creek originates about one mile from the southwestern shore of Bucks Lake, at an elevation of 5,180 feet, and flows 12.4 miles west to its confluence with the NFFR, 0.6 miles downstream of Cresta Dam. Grizzly Creek may be divided into two distinct aquatic habitat types: Grizzly Creek above Grizzly Forebay and Grizzly Creek below Grizzly Forebay.

Grizzly Creek above Grizzly Forebay extends approximately 5.2 miles from the headwaters of Grizzly Creek near Bucks Lake downstream to Grizzly Forebay. This section has a low to moderate gradient and is characterized by alternating riffles, runs, and shallow pools. Little

Grizzly Creek and several small feeder streams contribute to the flow in this section. Bottom substrate consists primarily of rubble and boulders, with lesser amounts of gravel and sand. Boulders and overhanging riparian vegetation provide moderate to good cover and shade (CDWR, 1986). In a 1981 electrofishing survey, the only species captured were rainbow and brown trout. Rainbow trout dominated the catch, comprising 86 percent of the total. Additionally, the large number of young-of-the-year trout (less than 100 mm) caught indicates that successful reproduction is occurring (Stebbins, 1999).

Pacific Gas and Electric Company began operation of the new Grizzly Powerhouse development in 1993 for the City of Santa Clara under an amendment to the Bucks Creek project License. The development included construction of a new tunnel and penstock from Lower Bucks Lake directly to the new Grizzly Powerhouse at the Grizzly Forebay. Prior to operation of the new development, water passed from Lower Bucks Lake through a tunnel into Grizzly Creek 4.3 miles above the Grizzly Forebay. During operation of the previously existing Bucks Creek project, releases from the tunnel to Grizzly Creek could vary between 0 and 340 cfs on a daily and seasonal basis (Stebbins, 1999). The substrate had been scoured by over 60 years of augmented flows that caused a reduction in riparian and fishery habitat values in the affected reach. To address these impacts, Articles 403 and 404(c) of the FERC license required the licensees to develop plans to rehabilitate, enhance, and monitor fishery and riparian habitat in the 4.3-mile affected reach. The rehabilitation plan includes a program of planting native stock riparian vegetation, while the monitoring program includes both vegetation and fish population monitoring.

Grizzly Creek below Grizzly Forebay is approximately 6.2 miles long and extends from the Grizzly Forebay Dam to the confluence of Grizzly Creek with the NFFR. The stream flows through a shaded, well-forested, V-shaped canyon and is characterized by a very steep stream gradient (FERC, 1981). Flows in this section are regulated during non-runoff periods at Grizzly Forebay Dam as part of the Bucks Creek project. In accordance with FERC License Article 13, Pacific Gas and Electric Company has a minimum flow release of 4 cfs from April 1 through November 30 and 2 cfs from December 1 through March 31. Grizzly Creek provides spawning habitat in its lower reaches for large trout migrating upstream from the NFFR and also acts as a nursery for the recruitment of young to the NFFR (CDWR, 1986).

Grizzly Forebay is a small reservoir with good water quality and cool summer water temperatures that combine to provide good habitat for trout. Grizzly Forebay supports wild self-sustaining populations of rainbow trout and brown trout. In addition, fish species found in Lower Bucks Lake may also occur in Grizzly Forebay due to the potential migration route afforded by the Lower Bucks Lake Tunnel (FERC, 1981).

Minimum reservoir elevations and minimum streamflow releases for the project were established to maintain aquatic habitat by an agreement with CDFG (PG&E Co., and CDFG, 1988) and were incorporated into the project license (FPC, 1974). The following FERC license articles were developed for protection of fish and aquatic habitat associated with the project. FERC License

Article 13 requires Pacific Gas and Electric Company to make minimum flow releases and specifies reservoir operation criteria for Bucks Lake and minimum elevation levels for all storage project facilities, including Bucks Lake, Lower Bucks Lake, Grizzly Forebay, Lower Three Lakes, and Middle Three Lakes. FERC License Article 16 requires Pacific Gas and Electric Company to construct, maintain, and operate protective devices and comply with reasonable modifications of project structures and operations in the interest of fish resources. Similarly, FERC License Article 17 states that Pacific Gas and Electric Company shall permit resource agencies' use of lands, reservoirs, waterways, and project works necessary to construct or improve existing fish facilities. FERC License Article 17 also requires modification of project operations to permit maintenance and operation of fish facilities. In addition, a Memorandum of Understanding between Pacific Gas and Electric Company, the USFS, and the City of Santa Clara sets requirements for streamflow releases and reservoir operation at the project (PG&E Co. et al, 1998).

A set of interim minimum flows into Bucks Creek below Lower Bucks Lake Dam and into Grizzly Creek below Grizzly Forebay have been established in FERC License Article 104 to commence on November 1, 2004 (FERC, 1988b). According to CDFG, studies show that trout populations in Milk Ranch, Bucks, and Grizzly creeks are considerably lower than trout populations found in adjacent streams with similar habitat attributes and that these streams provide spawning areas for trout originating from the NFFR (FERC, 1988b). FERC License Article 103 requires Pacific Gas and Electric Company and USFS to perform various studies prior to 2001 and recommend any changes needed, including changes in minimum flows, by 2004. FERC License Article 104 provides an incentive to Pacific Gas and Electric Company to reach agreement by stating that beginning in 2004, a year round interim flow release of a minimum of 10 cfs, or natural inflow, whichever is less, from Lower Bucks Dam into Bucks Creek, and a minimum of 15 cfs, or natural inflow, whichever is less, from Grizzly Forebay into Grizzly Creek shall be made by the licensee until agreement is reached (FERC, 1988a). There are no minimum release requirements for Milk Ranch Creek below Milk Ranch Conduit.

A study was recommended by a non-governmental organization to determine the benefits of annual flushing flows on lower Grizzly Creek, Bucks Creek below Lower Bucks Lake, and Milk Ranch Creek. The study is to be designed, completed, and reported to FERC during 2000 to 2004 (FERC, 1988a). This study has been requested by FERC and will be required by Pacific Gas and Electric Company or any new owners. FERC License Article 102 requires annual consultation with the USFS on protection and utilization of natural resources.

Special-Status Species

A query of the CNDDB for the project, covering the area within the FERC project boundary and a one-mile buffer around it, produced no sighting records of special-status fish species (CNDDB, 2000). No special-status species of fish are known to occur within this area.

Bundle 8: Butte Creek

DeSabla-Centerville (FERC 0803)

The DeSabla-Centerville project and associated Watershed Lands support a variety of fisheries and aquatic resources and habitats. The following sections describe these resources, the sources and nature of potential impacts on these resources, and project-specific regulatory conditions related to these resources, if any.

The project diverts water from the West Branch Feather River (WBFR) and Butte Creek to three powerhouses (Toadtown, DeSabla, and Centerville) located in the Butte Creek watershed. The WBFR facilities consist of two high-elevation storage reservoirs and a diversion/canal system that transports water into the Butte Creek watershed.

Round Valley Reservoir, the smaller of the storage facilities, impounds up to a 1,196 af of water on the WBFR. Water released from the reservoir flows 13 miles in the WBFR before reaching the Hendricks Diversion where it enters the Hendricks Canal (PG&E Co., 1982). The larger Philbrook Reservoir impounds up to 5,009 af of water on Philbrook Creek, a tributary of the WBFR. Releases from Philbrook Reservoir pass down the natural channels of Philbrook Creek and into the WBFR about eight miles to Hendricks Diversion where the water is also diverted into the Hendricks Canal (PG&E Co., 1982a). Water is released from these reservoirs after natural flow in the WBFR recedes and capacity is available to make use of this water in the Hendricks Canal.

At Hendricks Diversion, up to 125 cfs of water is diverted through a series of canals to the Butte Creek drainage and is also released into the WBFR. The water is conveyed 11.8 miles through a series of three canals (Hendricks, Toadtown, and Butte Creek) and is supplemented by diversions at small feeder streams along the canal lengths to the DeSabla Forebay. Hendricks Canal feeds into Toadtown Canal at the Toadtown Powerhouse.

Another canal that combines with Toadtown Canal and feeds into the DeSabla Forebay is the Butte Creek Canal which begins at the Butte Creek Diversion Dam where Pacific Gas and Electric Company diverts up to 88.5 cfs of Butte Creek water into the 11.5-mile canal. Pacific Gas and Electric Company also makes releases into Butte Creek at the Butte Creek Diversion Dam. Four feeder streams, the largest of which is Clear Creek, supplement canal flow. Maximum canal flow after Butte Canal and Toadtown Canal have merged can be up to 191 cfs into the DeSabla Forebay (PG&E Co., 1982a).

The DeSabla Forebay provides water for the DeSabla Powerhouse located on Butte Creek. Up to 180 cfs of tailrace water from the powerhouse is diverted from Butte Creek at the Lower Centerville Diversion Dam into the Lower Centerville Canal, where it flows eight miles to the headworks of the Centerville Powerhouse. Water is also released to Butte Creek at the Lower Centerville Diversion Dam into the 6-mile long Centerville bypass reach (PG&E Co., 1982a).

Aquatic Habitat and Fisheries Management

Fish habitat in the vicinity of the project is primarily coldwater stream habitat in Butte Creek, WBFR, and the surrounding tributaries. Philbrook Reservoir and DeSabla Forebay provide habitat for lake dwelling, coldwater fish species (Table 4.4-20).

Butte Creek is one of the most significant remaining tributaries of the Sacramento River that provides habitat for a sustaining population of spring-run chinook salmon and additionally supports fall-run chinook and potentially a remnant population of late-fall-run chinook and steelhead. Steelhead may spawn more than one year whereas mature chinook salmon die shortly after spawning (USFWS, 1998). In addition, Butte Creek, below the Lower Centerville Diversion Dam, contains wild rainbow, brook, and brown trout, hardhead, Sacramento pikeminnow, carp, Sacramento sucker, tule perch, and sculpin. The CDFG does not stock trout in Butte Creek in the vicinity of the project.

The NMFS has designated Butte Creek as Critical Habitat for Federally designated “threatened” evolutionarily significant units (ESUs) of California Central Valley spring-run chinook salmon and California Central Valley steelhead (see Table 4.4-18). NMFS determined that listing was not warranted for the California Central Valley Fall and Late Fall-run ESU of chinook. However, the ESU is designated as a candidate for listing due to concerns over specific risk factors. Butte Creek from Lower Centerville Diversion Dam to Centerville Powerhouse is about six miles long and consists of several different habitat types. Steam gradient varies throughout the reach ranging from 100 to 300 feet per mile. The first two miles are characterized by steep canyon walls, large boulders, deep pools, and alternating riffles and cascades (PG&E Co., 1989b). The canyon opens slightly in the next two miles, giving way to smaller boulders and more riffle/run habitat. The final two miles of stream are wider and shallower and are characterized by slower water currents. Below Centerville Powerhouse, Butte Creek is characterized by relatively low gradient and long sequences of pool/riffle/run. Extensive spawning gravels occur in this reach (PG&E Co., 1989b).

Hydroelectric development in Butte Creek presents an ironic contradiction. On the one hand, an additional average annual volume of approximately 47,000 af of water has been delivered into Butte Creek from the WBFR (CDWR, 1993) through an intra-basin transfer of water for hydroelectricity and later agricultural use. This additional flow has frequently provided a general net benefit to holding and spawning salmon and incubating salmon eggs. Prior to 1980, however, Pacific Gas and Electric Company regularly dewatered the upper reach of Butte Creek between the Centerville

Table 4.4-20 DeSabla Regional Bundle - DeSabla-Centerville Project (FERC 0803) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Pacific lamprey	Spring-run chinook salmon	Fall-run chinook salmon	Late fall-run chinook salmon	Rainbow trout	Steelhead - Central Valley ESU	Brown trout	Brook trout	California roach	Speckled dace	Hardhead	Sacramento pikeminnow	Golden shiner	Sacramento sucker	Brown bullhead	Bluegill	Green sunfish	Redear sunfish	Largemouth bass	Smallmouth bass	Tule perch	Riffle sculpin
Round Valley Reservoir (*aka* Snag Lake)	None					X		X	X														
West Branch Feather River between Round Valley Reservoir and confluence with Philbrook Creek	Normal year: 0.5 cfs Dry year: 0.1 cfs					X		X	X														
Philbrook Reservoir	None					X		X	X														
Philbrook Creek between Philbrook Reservoir and confluence with West Branch Feather River	Year round: two cfs					X		X	X														
West Branch Feather River between confluence with Philbrook Creek and Hendricks Head Dam	None					X		X	X														
Fish Creek tributary to West Branch Feather River	Unimpaired watershed lands					X		X	X														
Last Chance Creek tributary to West Branch Feather River	Unimpaired watershed lands					X		X	X														
West Branch Feather River downstream of Hendricks Head Dam	Normal year: 15 cfs Dry year: seven cfs					X		X	X												X		
Little West Fork	Normal year: 0.25 cfs Dry year: 0.10 cfs					X		X	X														
Hendricks Canal	None					X		X															
Long Ravine	Normal year: 0.5 cfs Dry year: 0.25 cfs					X		X															

Table 4.4-20 DeSabla Regional Bundle - DeSabla-Centerville Project (FERC 0803) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Pacific lamprey	Spring-run chinook salmon	Fall-run chinook salmon	Late fall-run chinook salmon	Rainbow trout	Steelhead - Central Valley ESU	Brown trout	Brook trout	California roach	Speckled dace	Hardhead	Sacramento pikeminnow	Golden shiner	Sacramento sucker	Brown bullhead	Bluegill	Green sunfish	Redear sunfish	Largemouth bass	Smallmouth bass	Tule perch	Riffle sculpin
Cunningham Ravine	Normal year: 0.25 cfs Dry year: 0.10 cfs					X		X															
Toadtown Canal	None					X		X															
Little Butte Creek upstream of Paradise Reservoir	None					X		X															
Butte Creek upstream of Butte Diversion Dam	None					X		X															X
Butte Creek Canal	None					X		X															
Inskip Creek Feeder to Butte Canal	Normal year: 0.25 cfs Dry year: 0.10 cfs					X		X															
Kelsey Creek Feeder to Butte Canal	Normal year: 0.25 cfs Dry year: 0.10 cfs					X		X															
Stevens Creek Feeder to Butte Canal	Normal year: 0.25 cfs Dry year: 0.10 cfs					X		X															
Clear Creek Feeder to Butte Canal	Normal year: 0.5 cfs Dry year: 0.25 cfs					X		X															
DeSabla Reservoir	None					X		X															
Upper Centerville Canal	None					X		X															
Butte Creek between Butte Diversion Dam and Lower Centerville Diversion Dam	Normal year: 16 cfs Dry year: seven cfs					X		X															X
West Branch Butte Creek	None					X		X															
Lower Centerville Canal	None					X		X															

Table 4.4-20 DeSabla Regional Bundle - DeSabla-Centerville Project (FERC 0803) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements[a]	Pacific lamprey	Spring-run chinook salmon	Fall-run chinook salmon	Late fall-run chinook salmon	Rainbow trout	Steelhead - Central Valley ESU	Brown trout	Brook trout	California roach	Speckled dace	Hardhead	Sacramento pikeminnow	Golden shiner	Sacramento sucker	Brown bullhead	Bluegill	Green sunfish	Redear sunfish	Largemouth bass	Smallmouth bass	Tule perch	Riffle sculpin
Butte Creek between Lower Centerville Diversion Dam and Centerville Powerhouse	Normal year[b]: 12/15 – 10/31: 40 cfs 11/01 – 12/14: 30 cfs Dry year:[b] 6/01 – 9/14: 40 cfs 9/15 – 5/31: ten cfs		X	X	X	X	X	X		X		X	X		X							X	X
Butte Creek downstream of Centerville Powerhouse	Year round: 40 cfs	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Deer Creek	None		X	X	X	X	X	X															

a cfs = cubic feet/second
b Pacific Gas and Electric Company has informally agreed with CDFG not to exercise a reduction below 40 cfs.

Head Dam and the Centerville Powerhouse. The reach, which is about five miles in length, remains one of the prime summer holding areas for spring-run chinook salmon (CDFG, 1998).

FERC License Article 39 specifies releases at the Centerville Diversion Dam. Pacific Gas and Electric Company is required to make minimum flow releases ranging from 10 to 40 cfs, depending on season and water year type. During normal water years, a minimum release of 40 cfs is required from December 15 through October 31, and the release drops to 30 cfs between November 1 and December 14. During dry years, a minimum flow of 40 cfs is required from June 1 through September 14, and the remainder of the year the minimum flow release in Butte Creek can be lowered to 10 cfs. According to CDFG, releases into Butte Creek below the Centerville Head Dam under dry year criteria could result in the dewatering of spring-run chinook salmon redds. In past years, Pacific Gas and Electric Company has informally agreed with CDFG not to exercise this reduction (from 40 cfs) in order to provide flows for critical salmon habitat in downstream reaches of Butte Creek. In addition, summertime releases have been increased to 40 cfs for water temperature control during hot weather at the request of CDFG.

Spring-run salmon are distinct in their life history pattern. They migrate into Butte Creek from as early as mid-February through June and then over-summer in pools generally from the confluence of Little Butte Creek to the barrier falls at the Quartz Bowl. Spawning occurs from September through mid-October, with the peak spawning occurring between late September through early October (CDFG, 1998). Peak spawning density occurs from the upper limit of migration below Centerville Head Dam at the Quartz Bowl pool downstream to the Honey Run Covered Bridge (elevation 400 ft.), a distance of about ten miles.

In general, few fish are able to ascend the waterfall above the pool known as the Quartz Bowl. During surveys in 1995, 29 of the estimated 7,500 spring-run adults were found above this site, which lies approximately one mile below the Centerville Head Dam. During the record year of 1998, with a population estimate of over 20,000 spring-run, no fish were found above this site. It is notable that flow records as compiled for the USGS gauge (*Butte Creek Near Chico #11390000*) near the Covered Bridge reveal that far higher than normal flows existed in March (>7,000 cfs) and into May 1995 (>4,000 cfs). This unusual flow regime was not repeated during 1998. Review of the historic record for this gauge shows that flows exceeding 7,000 cfs after February occurred only four times in 57 years, and flows exceeding 4,000 cfs occurred only ten of 57 years.

Surveys of holding adult spring-run chinook were first begun in the 1950s. As early as 1960, it was estimated that 2,000 spring-run adults died in the five-mile reach from the Pacific Gas and Electric Company's Centerville Head Dam to the Centerville Powerhouse. Summer flows in this reach were often less than 5 to 10 cfs as a result of hydroelectric diversions which, coupled with high temperatures, created lethal conditions for holding chinook. CDFG erected an exclusion barrier near the Centerville Powerhouse in the late 1960s to preclude fish from entering this reach. This barrier was ineffective in preventing upstream salmon migration and was removed in the early 1980s after Pacific Gas and Electric Company agreed to maintain a minimum of 40 cfs in this reach during the critical summer holding period. Recent surveys suggest that in some years greater than 50 percent of the adult spring-run chinook now hold in this area.

The optimal temperature range for spring-run adults holding while eggs are maturing is between 59 and 60°F (15 to 15.5°C)(CDFG, 1998). Temperature records from Pool 4, located 3.8 miles downstream of the Centerville Head Dam, for the period 1992 to 1997, had mean daily water temperatures generally exceeding the optimal 60°F (15.5°C) by late May to early June and had temperatures reaching as high as 71°F (21.6°C) for short periods in mid-July to early August (Ward, 2000). Similar records for the period 1990 to 1998 from a gauge located approximately 1 mile below the Centerville Powerhouse also show mean daily water temperatures exceeding the optimal 60°F (15.5°C) by late May and early June and also reaching 71°F (21.6°C) for short periods during mid-July to early August (Ward, 2000). Throughout most of the spring-run salmon holding area, temperatures regularly exceed optimum temperatures and are near lethal for short periods; however, the historic record and recent CDFG evaluations shows that the spring-run population continues to thrive under what are sometimes considered marginal conditions.

Butte Creek supports a good population and a potential sport fishery for resident salmonids, but angler access is difficult. In the reach below the Centerville Diversion Dam, the habitat most conducive to supporting trout extends downstream to about midway between the dam and the powerhouse. Canyon walls are steep and streamside vegetation is abundant. Significant populations of non-game fish occur throughout the bypass reach, with larger individuals associated with pool habitat. These species include Sacramento pikeminnow, Sacramento sucker, California roach (*Hesperoleucus Symmetricus*), tule perch, and hardhead (a State Species of Special Concern) (FERC, 1991a).

In accordance with FERC License Article 402, Pacific Gas and Electric Company conducted a 2-year water temperature and stream flow monitoring study to determine if operational changes in the upper portion of the project might enhance water temperature below the Lower Centerville Diversion Dam for anadromous fish. Under an August 21, 1997 FERC order resulting from the 1992-1993 study, Pacific Gas and Electric Company, in order to meet water supply delivery obligations, is evaluating alternative water sources for the California Water Service Company (CWSC) to increase diversions at Hendricks Diversion. Additionally, the order placed temperature restrictions on summer releases from Round Valley and Philbrook Reservoirs to enhance fish habitat (FERC, 1997b).

Water temperature criteria, developed by CDFG and Pacific Gas and Electric Company to promote coldwater chinook habitat during late summer months in Butte Creek below the Lower Centerville Diversion Dam, require that the discharges from Round Valley Reservoir be limited to the minimum flow whenever the average daily temperature of the discharge water exceeds 50.8°F (17°C). Similar water temperature limitations apply to Philbrook Reservoir; minimum releases are required whenever the average daily temperature of the discharge water exceeds 51.8° (18°C) (PG&E Co., 1999e). Pacific Gas and Electric Company has flexibility in meeting temperature requirements, depending on certain water year types and consultation with CDFG, NMFS, and USFWS. In 1999, Pacific Gas and Electric Company collected water temperature data in several locations in the WBFR, and in Butte Creek this data will be utilized in determining future reservoir releases, i.e. release amounts, acceptable temperature, and location(s) for future monitoring to best meet the objective of lower water temperatures in Butte Creek below the Lower Centerville Diversion Dam.

Round Valley Reservoir (known locally as Snag Lake), the smaller of the two storage facilities, impounds water on the WBFR. The reservoir is usually drafted in the early summer and is normally completely emptied by September 1. Round Valley Reservoir provides a minimal fishery and is not planted with trout by CDFG; however, the WBFR below the reservoir supports native trout populations and an excellent sport fishery (PG&E Co., 1976b).

The larger Philbrook Reservoir impounds water on Philbrook Creek, a tributary of the WBFR. The fish species composition in the reservoir consists primarily of rainbow and brown trout. Because the reservoir is annually drawn down to less than 10 af, it has limited value as a fishery. Natural spawning is minimal, and the trout populations are maintained through CDFG's stocking program. In 1999, CDFG stocked 17,280 rainbow trout in the reservoir (CDFG, 1999). Releases from Philbrook Reservoir pass down the natural channel of Philbrook Creek and into the WBFR about eight miles to Hendricks Diversion where the water is diverted into the Hendricks Canal. When water is being released from the Philbrook Reservoir, Philbrook Creek provides a good trout fishery (PG&E Co., 1976b). Stream flows fluctuate during the summer months depending on downstream water and power generation demands. In its pre-project state, the creek was an important source of small trout that grew to catchable size in the WBFR (CDFG, 1977). In general, the releases from the two WBFR reservoirs enhance the fish habitat in the stream from their sources down to the Hendricks Diversion Dam from mid-summer through late summer each year (PG&E Co., 1976b). Native trout are present in this reach of the WBFR, and additionally CDFG plants catchable rainbow trout.

FERC License Article 39 and subsequent FERC orders control water management at these reservoirs and in stream reaches of the DeSabla-Centerville Project (see Table 4.4-20). The minimum instream flow release from Round Valley Reservoir is 0.5 cfs during normal years and 0.1 cfs during dry years. The minimum release from Philbrook Reservoir is two cfs, although when the inflow to the reservoir is less than 0.1 cfs, a minimum flow of at least 0.1 cfs may be released (FERC, 1980).

At Hendricks Diversion Dam, water is diverted through a series of canals to the Butte Creek drainage and released into the WBFR to provide instream habitat. Large pools in granite gorges, long riffles, and good trout habitat characterize the WBFR below Hendricks Diversion Dam (PG&E Co., 1976b). Two major tributaries, Big Kimshew Creek and Cold Creek, feed the main stem and provide habitat for brown and rainbow trout (PG&E Co., 1979). Summers of dry years can result in reduced flows and potentially stressful conditions for salmonids in this section of the WBFR.

The minimum flows released into the WBFR are 15 cfs in normal years and seven cfs in dry years, although spills are frequent during winter and spring runoff. In the summer months of dry years, Pacific Gas and Electric Company must release additional water (over the seven cfs requirement) to meet water supply delivery obligations to California Water Service at the Powers Canal (Coal Canyon Tailrace) (see setting discussion of Lime Saddle and Coal Canyon powerhouses below).

Up to 125 cfs of water is diverted at the Hendricks Diversion Dam into Hendricks Canal. The WBFR diversion into the Toadtown Canal significantly reduces flows in the WBFR below Hendricks Head Dam, although the diverted flows provide significant benefit to Butte Creek as dedicated instream flows for State and Federally listed chinook salmon and steelhead. The diverted water is conveyed 11.8 miles through a series of three canals (Hendricks, Toadtown, and Butte Creek) and is supplemented by diversions at small feeder streams along the canal lengths to the DeSabla Forebay. Hendricks Canal feeds into Toadtown Canal at the Toadtown Powerhouse. Another canal that combines with Toadtown Canal and feeds into the DeSabla Forebay is the Butte Creek Canal which begins at the Butte Creek Diversion Dam where Pacific Gas and Electric Company diverts up to 88.5 cfs of Butte Creek water into the 11.5-mile canal. Pacific Gas and Electric Company also makes releases into Butte Creek at the Butte Creek Diversion Dam. The confluence of Toadtown Canal and Butte Creek Canal is where WBFR water commingles with Butte Creek water in route to the DeSabla Forebay and ultimately enters Butte Creek at the DeSabla Powerhouse tailrace.

FERC License Article 39 requires minimum flow releases into the 10-mile DeSabla bypass reach of seven cfs during dry years or 16 cfs during normal years, although spills are frequent during winter and spring runoff. Rainbow and brown trout are the only fish species present in this stream section. Butte Creek, below Butte Creek Diversion Dam downstream to the Centerville Diversion Dam, is characterized by low summer streamflows due to low natural flows and water diversions into the Butte Creek Canal. When flow is adequate, this stream section provides excellent trout habitat with good riffle and pool areas (PG&E Co., 1976b). The stream gradient is moderate to steep, and bottom substrates are primarily boulder, cobble, and bedrock, with smaller amounts of gravel. Spawning gravels tend to be rather limited primarily due to the scouring effect of the high winter and spring flow (PG&E Co., 1989b). Streamside vegetation is generally lacking, but the steep canyon walls, covered with mature stands of pine, oak, and bay, provide partial stream shading (PG&E Co., 1988). Only one major stream, West Branch of Butte Creek, provides significant water input and additional trout habitat to Butte Creek in this section. The majority of flow from four other tributaries (Inskip, Kelsey, Stevens, and Clear Creeks) is diverted into the Butte Creek Canal system. These tributaries would not support a significant fishery even with increased flows because trout cannot ascend these streams because of impassable falls near the mouths of the streams (CDFG, 1977).

Butte Creek Canal and Toadtown Canal merge and flow into the DeSabla Forebay. DeSabla Forebay provides intermediate water regulation and storage. Except during the routine annual maintenance period, the forebay is maintained at an almost constant level throughout the year (PG&E Co., 1976b). Like Philbrook Reservoir, the DeSabla Forebay provides a good brown and rainbow trout fishery, managed on a put-and-take basis by CDFG (PG&E Co., 1976b). In 1999, CDFG planted 10,000 catchable rainbow trout in DeSabla Forebay (CDFG, 1999). Trout populations are also dependent on recruitment from the Butte and Toadtown Canals (PG&E Co., 1976b). According to CDFG, current forebay operation increases the temperature of water released for power generation, ultimately increasing water temperature in Butte Creek which is detrimental to spring-run chinook salmon. This issue is being addressed in the temperature modeling analysis being conducted by Pacific Gas and Electric Company in consultation with resource agencies.

The human-made waterways (Hendricks Canal, Toadtown Canal, and Butte Creek Canal) are for the most part unlined and stream-like in character and are all inhabited by rainbow and brown trout (PG&E Co., 1982b). They provide trout habitat by providing cool temperatures, abundant insect life and good overhead cover (PG&E Co., 1976b). The canals are fast flowing, have few eddies, and do not provide the best type of trout habitat (CDFG, 1977). Although trout are not planted in the canals and suitable spawning habitat is lacking, naturally reproducing fish or fish planted annually by CDFG enter the canals through diverted streams (WBFR, Cunningham Ravine, Little West Fork, and Little Butte Creek) (PG&E Co., 1982c). The only other Pacific Gas and Electric Company canal that holds major populations of trout is the Lower Centerville Canal. None of the DeSabla-Centerville project diversion canals are fitted with fish screens. Although fishing access is easy at several places along the Lower Centerville Canal, the canal is more remote from road access than the others, thus fishing pressure is light. Pacific Gas and Electric Company and the resource agencies have established a task force to address fisheries problems associated with scheduled canal outages. Currently, Pacific Gas and Electric Company voluntarily provides biologists and work crews to assist in fish rescue operations conducted prior to scheduled canal outages (FERC, 1992a).

FERC License Article 15 addresses the conservation and development of fish resources within project waters (FERC, 1991a). Although an earlier feasibility study found that a fish passage structure was not warranted at Lower Centerville Diversion Dam, additional studies are underway to re-examine this issue. In addition, Pacific Gas and Electric Company also has been voluntarily involved in coordinated watershed planning efforts in the Butte Creek basin with a focus on anadromous fisheries restoration.

The Watershed Lands associated with the DeSabla-Centerville project support a variety of fisheries and aquatic resources and habitats. Except where noted, biological resources are the same for the Watershed Lands as they are for the associated project.

Fish habitat at or in the vicinity of the Watershed Lands is primarily coldwater stream habitat in Butte Creek, Deer Creek, and the surrounding tributaries. Butte and Deer Creeks support a good population of salmonids. Although sport fishing of these species is allowed except for spring-run

Chinook salmon, access is difficult. Additional information on fish species associated with the DeSabla-Centerville FERC project is provided above.

Existing documentation and a query of the CNDDB provided information on special-status fish species that may occur in streams on or within a one-mile radius of Watershed Lands (see Table 4.4-18) (CNDDB, 2000). Spring-run chinook salmon (Central Valley ESU) is a State and Federally listed threatened species and is seasonally abundant in Butte Creek below the existing Centerville Diversion Dam and in Deer Creek (FERC, 1991a, and Moyle et al, 1995). Steelhead (Central Valley ESU), Federally listed as threatened, and fall-run and late fall-run chinook salmon (Central Valley ESU), Federal candidates for listing, may also occur in the vicinity of the Watershed Lands.

Lime Saddle (non-FERC)

The Lime Saddle Powerhouse area supports a variety of fisheries and aquatic resources and habitats. The following sections describe these resources, the sources and nature of potential impacts on these resources, and project-specific regulatory conditions related to these resources, if any.

Water used by the Lime Saddle Powerhouse is diverted from the WBFR at the Upper Miocene Diversion Dam into the Upper Miocene Canal. The Upper Miocene Canal has a maximum capacity of 65 cfs. The canal water flows to Kunkle Reservoir (154 af) where it is dropped through the penstock to the Lime Saddle Powerhouse. Pacific Gas and Electric Company makes a small release to the WBFR at Miocene Diversion Dam, but there is no regulatory requirement to do so. In addition, the Central Valley Regional Water Quality Control Board has no defined beneficial uses for the WBFR upstream of Lake Oroville. Water diverted at the Miocene Diversion Dam does not return to the WBFR but is instead delivered to California Water Services Company (CWSC) and other small water right holders.

The Middle Miocene Canal begins at the Lime Saddle Powerhouse tailrace. The Middle Miocene Canal has a typical flow of 45 cfs to maintain delivery of water under contract to CWSC. Therefore, Lime Saddle Powerhouse is operated as a baseload facility, with the downstream (Middle Miocene) canal system capacity acting as the primary limiting factor. Its operation also must be coordinated with that of Coal Canyon Powerhouse.

Aquatic Habitat and Fisheries Management

Fish habitat in the vicinity of the powerhouse is cold and warmwater fish habitat. Resident trout include rainbow and brown trout (Table 4.4-21). Significant populations of non-game fish are present in the nearby WBFR and include Sacramento sucker, Sacramento pikeminnow, California roach, and smallmouth bass. Below Miocene Diversion Dam, the WBFR is seasonally dewatered and reduced to a series of pools for the remaining 7.5 miles to Lake Oroville. Annual losses of trout in this section are high due to high water temperatures and stagnation of pools during the summer (CDFG, 1977). Trout fishing is best in the spring, but access is somewhat limited.

Rainbow trout, brown trout, and California roach have been collected in the Miocene canal, and likely entered the canal system at Miocene Diversion. No trout are planted in Miocene Canal or in the WBFR in this reach. Pacific Gas and Electric Company and the resource agencies have established a task force to address fisheries problems associated with scheduled canal outages.

Table 4.4-21 DeSabla Regional Bundle - Lime Saddle Project (Non-FERC) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements	Rainbow trout	Brown trout	California roach	Sacramento pikeminnow	Sacramento sucker	Largemouth bass	Smallmouth bass
West Branch Feather River downstream of Upper Miocene Diversion Dam	Pacific Gas and Electric Company makes a small instream release below the Miocene Diversion; however, there is no regulatory requirement to do so.	X	X	X	X	X		X
Upper Miocene Canal	None	X	X	X				
Kunkle Reservoir	None	X	X				X	
Middle Miocene Canal	None	X	X					

Currently, Pacific Gas and Electric Company provides biologists and work crews to assist, when necessary, in fish rescue operations conducted prior to scheduled canal outages. Kunkle Reservoir contains populations of rainbow trout, brown trout, and largemouth bass.

Special-Status Species

A query of the CNDDB for the powerhouse, covering the facilities and a one-mile buffer around them, produced no TES fish species sighting records. However, hardhead (California Species of Special Concern and Forest Service sensitive species) are known to occur in the vicinity of the powerhouse (see Table 4.4-14) (CNDDB, 2000).

Coal Canyon (non-FERC)

The Coal Canyon Powerhouse and the associated Watershed Lands support a variety of fisheries and aquatic resources and habitats. The following sections describe these resources, the sources and nature of potential impacts on these resources, and project-specific regulatory conditions related to these resources, if any.

Water use at the Coal Canyon Powerhouse is tied to the operation of the Lime Saddle Powerhouse. The Lime Saddle Powerhouse tailrace water enters the Middle Miocene Canal at a maximum capacity of 45 cfs where it is transported to the Coal Canyon Powerhouse. Tailrace water from the

Coal Canyon Powerhouse flows into the Powers Canal which is owned by CWSC. Coal Canyon Powerhouse is operated as a baseload facility and must be coordinated with the upstream Lime Saddle Powerhouse and downstream water delivery obligations.

Aquatic Habitat and Fisheries Management

Fish habitat in the vicinity of the powerhouse is cold and warmwater fish habitat. Resident trout include rainbow and brown trout (Table 4.4-22). Significant populations of non-game fish are present in the nearby WBFR and include Sacramento sucker, Sacramento pikeminnow, California roach, and smallmouth bass.

Table 4.4-22 DeSabla Regional Bundle - Coal Canyon Project (Non-FERC) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements	Rainbow trout	Brown trout	California roach
Middle Miocene Canal	None	X	X	X
Powers Canal	None	X	X	X

Special-Status Species

A query of the CNDDB for the Coal Creek Powerhouse, covering the facilities and a one-mile buffer around them, produced no sighting records of any special-status fish species (CNDDB, 2000). However, hardhead (California Species of Special Concern and USFS sensitive species) are known to occur in the vicinity of the powerhouse (see Table 4.4-14).

The Watershed Lands associated with the Coal Canyon Powerhouse area support a variety of fisheries and aquatic resources and habitats. Except where noted, biological resources are the same for the Watershed Lands as they are for the associated powerhouse.

4.4.4.3 Drum Regional Bundle

Regional Setting

The Drum Regional Bundle is located in El Dorado, Placer, Nevada, Mendocino, and Lake counties near the towns of Placerville, Auburn, Nevada City, and Potter Valley. The area contains 39 dams, 235,349 af of usable reservoir storage, 64.8 miles of canals, 9.9 miles of flumes, 11.3 miles of tunnel, and 14 powerhouses.

Five river/stream systems are found within the system: North Yuba River, South Yuba River, Bear River, American River, and Eel River. The first four of these rivers lie in the Sacramento River Basin, while the Eel River is in its own basin. Drum-Spaulding (FERC 2310), the largest bundle within this watershed, reaches from Spaulding Lake, at the headwaters of the Bear River northwest of Lake Tahoe, to Folsom Lake, east of Sacramento. Two other bundles that are part of the

Sacramento River Basin are Chili Bar (FERC 2155) and Narrows (FERC 1403). The Narrows project lies within the Yuba River Basin, in Nevada County, downstream of the confluence of the South Fork, Middle Fork, and North Fork Yuba River, while the Chili Bar project is located on the South Fork American River in El Dorado County (PG&E Co., 1999d). The fourth bundle, Potter Valley (FERC 0077), in the Drum Regional Bundle, is located in Mendocino and Lake Counties on the Eel River.

Pacific Gas and Electric Company holds approximately 26,209 acres in the Drum Watershed Region. These lands are typically located in remote areas rich in biological resources. The watershed region is associated with many public lands such as USFS and the BLM. Though not managed by these public agencies, many informal agreements have been established between these agencies and Pacific Gas and Electric Company to maintain biological habitat within many of the projects.

A variety of fish species are found in the Drum watershed, including several sensitive species such as coho salmon, spring-run chinook salmon, fall-run chinook salmon, steelhead, and hardhead (Table 4.4-23).

Specifically, this section discusses local regulations and policies pertaining to the project, aquatic resources found in the region, natural and human factors that affect these resources, instream flow/lake level requirements, special-status species found within the project, and current fisheries management practices.

Local Regulations and Policies

The Drum Regional Bundle is located in El Dorado, Placer, Nevada, Mendocino, and Lake counties. Each county's General Plan strives to maintain the quantity and quality of water resources for multiple beneficial uses, including fisheries and aquatic resources. The above counties by their policies attempt to maintain and enhance habitat for fish and wildlife species. The counties strive to maintain good water quality, minimize water pollution and minimize erosion caused by development. Additional details are discussed at the bundle level as appropriate.

Portions of the Drum Region's assets are either adjacent to or completely surrounded by the Tahoe National Forest. The Tahoe National Forest is managed by the US Forest Service (USFS) and has Land and Resource Management Plans (LRMPs). The LRMPs provide direction for planning and conducting resource management activities on National Forest land. The goals of these plans are, among others, to monitor and protect habitat for Federally-listed threatened, endangered, and candidate species, provide for continued use and new development of hydroelectric facilities, and expand recreational fisheries opportunities. The LRMP goals for Tahoe National Forest generally relating to fisheries include: (1) the use of nonstructural activities as needed to enhance coldwater fisheries; (2) establish or maintain structural improvements for coldwater fisheries; (3) maintain or enhance lake fisheries; (4) establish or maintain structural lake improvements.

Table 4.4-23 Distributional Checklist of the Fishes of the Drum Regional Bundle by Pacific Gas and Electric Company Project

Family Name Common Name (*Scientific Name*)	Drum-Spaulding FERC 2310	Narrows FERC 1403	Chili Bar FERC 2155	Potter Valley FERC 0077
Petromyzontidae (Lamprey Family)				
Pacific lamprey (*Lampetra tridentata*)		X		X
Pacific brook lamprey (*Lampetra pacifica*)				X
Acipenseridae (Sturgeon Family)				
White sturgeon (*Acipenser transmontanus*)		X		
Green sturgeon (*Acipenser medirostris*)		X		X
Osmeridae (Smelt Family)				
Wakasagi (*Hypomesus nipponensis*)				X
Clupeidae (Herring Family)				
Threadfin shad (*Dorosoma petenense*)				
American shad (*Alosa sapidissima*)		X		
Salmonidae (Salmon and Trout Family)				
Coho salmon (*Oncorhynchus kisutch*)				X
Chinook salmon (*Oncorhynchus tshawytscha*)	FR	FR, SR		FR
Kokanee (*Oncorhynchus nerka kennerlyi*)		X		
Rainbow trout (*Oncorhynchus mykiss irideus*)	X	X	X	X
Steelhead - Central Valley ESU (*Oncorhynchus mykiss irideus)*		X		
Eagle Lake trout (*Oncorhynchus mykiss aquilarum*)		X		
Columbia River redband trout (*Oncorhynchus mykiss gairdner)*	X			
Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*)	X			
Brown trout (*Salmo trutta*)	X	X	X	
Brook trout (*Salvelinus fontinalis*)	X			X
Cyrinidae (Minnow Family)				
California roach (*Hesperoleucus symmetricus symmetricus*)				X
Speckled dace (*Rhinichthys osculus*)	X			X
Tui chub (*Gila bicolor*)	X			
Hardhead (*Mylopharodon conocephalus*)		X		
Sacramento pikeminnow (*Ptychocheilus grandis*)	X	X		X

Table 4.4-23 Distributional Checklist of the Fishes of the Drum Regional Bundle by Pacific Gas and Electric Company Project

Family Name Common Name (*Scientific Name*)	Drum-Spaulding FERC 2310	Narrows FERC 1403	Chili Bar FERC 2155	Potter Valley FERC 0077
Carp (*Cyprinus carpio*)		X		
Golden shiner (*Notemigonus crysoleucas*)	X	X		X
Fathead minnow (*Pimephales promelas*)				X
Lahontan redside (*Richardsonius egregius*)	X			
Catostomidae (Sucker Family)				
Sacramento sucker (*Catostomus occidentalis*)		X		X
Ictaluridae (Catfish Family)				
Brown bullhead (*Ictalurus nebulosus*)	X	X		X
Channel catfish (*Ictalurus punctatus*)		X		
White catfish (*Ictalurus catus*)		X		X
Poeciliidae (Livebearer Family)				
Mosquitofish (*Gambusia affinis*)		X		
Gasterosteidae (Stickleback Family)				
Threespine stickleback (*Gasterosteus aculeatus*)		X		X
Centrarchidae (Sunfish Family)				
Bluegill (*Lepomis macrochirus*)		X		X
Green sunfish (*Lepomus cyanellus*)	X	X		X
Warmouth (*Lepomus gulosus*)		X		
Black crappie (*Pomoxis nigromaculatus*)		X		
White crappie (*Pomoxis annularis*)		X		
Largemouth bass (*Micropterus salmoides*)	X	X		X
Smallmouth bass (*Micropterus dolomieui*)		X		
Spotted bass (*Micropterus punctulatus*)		X		
Percidae (Perch Family)				
Bigscale logperch (*Percina macrolepida*)		X		
Cottidae (Sculpin Family)				
Riffle sculpin (*Cottus gulosus*)		X	X	X
Total Fish Taxa	**14**	**22**	**3**	**21**

Bundle 9: North Yuba River

Narrows (FERC 1403)

The Narrows project lies within the Yuba River basin, in Nevada County, downstream of the confluence of the South Fork, Middle Fork, and North Fork Yuba River, and approximately 25 miles upstream of the confluence of the Yuba River with the Feather River. The drainage area within the Yuba River basin used by the Narrows project is 1,108 square miles, as measured directly below Englebright Dam at the Narrows project (USGS, 1997). A majority of the water from the South Yuba basin is diverted to the Bear and American rivers by upstream water projects owned by Pacific Gas and Electric Company and Nevada Irrigation District (NID). Water storage and diversion facilities owned and operated by the Yuba County Water Agency (YCWA)[2] and the United States Army Corps of Engineers (USCOE) regulate use of water from the three forks of the Yuba River by releases from USACE's Englebright Reservoir.

Instream Flow and Lake Level Requirements

The Narrows Project supports a wide array of fish species (Table 4.4-24). Because of the complex special-status species issues associated with the Project and power generation requirements, minimum flows associated with project facilities is also complex (Table 4.4-24).

Aquatic Habitat

Englebright Reservoir and the Yuba River are the principal water bodies of the Narrows Project. Fish habitat in the vicinity of the Project is primarily coldwater stream habitat in the Yuba River. There are known to be at least six native and 13 introduced fish species within the system (Table 4.4-24). Anadromous species in the Yuba River downstream of Englebright Dam include steelhead and fall- and spring-run chinook salmon. American shad primarily spawn downstream of Daguerre Point Dam, but have also been reported upstream of there on occasion. Englebright Dam is a complete barrier to anadromous fish within the project.

Englebright Reservoir stores up to 45,000 af of water (PG&E Co. 1999d). The gross pool elevation of Englebright is 527 feet and the long, narrow nature of the lake is reflected in its shoreline distance of 28 miles. Hilltops bordering the reservoir range from 1,100 to 1,500 feet and drop rapidly to the lake level; steep cliffs and rock outcrops are common along some shoreline portions of the reservoir (MHA Environmental 1993). Englebright is a two-story reservoir providing habitat for both coldwater and warmwater species (Table 4.4-24).

2 YCWA operates its Yuba River project (FERC 2246) consisting of the Colgate and Narrows 2 Powerhouses during normal business. Pacific Gas and Electric Company operates YCWA's facilities after hours pursuant to the Yuba County Water Agency Power Purchase Contract, dated May 13, 1966, between Pacific Gas and Electric Company and YCWA.

Table 4.4-24 Drum Regional Bundle - Narrows Project (FERC 1403) Fish Species Occurrence by Location

Location	Minimum Streamflow/ Reservoir Level Requirements[a]	Pacific lamprey	Green sturgeon	White sturgeon	American shad	Spring-run chinook salmon	Fall-run chinook salmon	Kokanee	Rainbow trout	Steelhead- Central Valley ESU	Eagle Lake trout	Brown trout	California roach	Speckled dace	Sacramento pikeminnow	Hardhead	Carp	Golden shiner	Sacramento sucker	Brown bullhead	Channel catfish	White catfish	Bluegill	Green sunfish	Warmouth	Black crappie	White crappie	Largemouth bass	Smallmouth bass	Spotted bass	Mosquitofish	Bigscale logperch	Threespine stickleback	Striped bass	Riffle sculpin
Englebright Reservoir[b]	None							X	X[c]		X	X			X	X	X		X		X	X	X	X	X	X	X	X	X	X					
Yuba River downstream of Narrows 1 Powerhouse to confluence with Feather River	10/1-3/31: 700 cfs 4/1-4/30: 1000 cfs 5/1-5/31: 2000 cfs 6/1-6/30: 1500 cfs 7/1-9/30: 450 cfs[d]	X	X	X	X	X	X		X	X			X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X

a cfs = cubic feet / second

b Owned by U.S. Army Corps of Engineers

c Under FERC License Article 403, Pacific Gas and Electric Company must stock 5,000 catchable rainbow trout annually in Englebright Reservoir.

d FERC License Article 402 identifies alternative minimum streamflows when certain conditions exist.

Special-Status Species

Special-status species refer to those species or sub-species that are listed, proposed for listing, or candidates for listing: (1) under the FESA or CESA as endangered or threatened; or (2) by a Federal or State agency as a species of special concern, sensitive species, protected, or fully protected species (PG&E Co., 1999d).

A query of the CNDDB provided information on special-status fish species that may occur in the vicinity of the project, including lands within the FERC project boundary and a one-mile buffer around it (see Table 4.4-25). The spring-run chinook salmon, steelhead and fall-run chinook salmon occur downstream of Englebright Dam (PG&E Co., 1999d).

Table 4.4-25 Special-Status Fish Species That Occur in the Drum Regional Bundle

Family Name Common Name (*Scientific Name*)	State/Federal Designations[a]	Status of Occurrence by Project			
		Narrows (FERC 1403)	Potter Valley (FERC 0077)	Drum-Spaulding (FERC 2310)	Chili Bar (FERC 2155)
Salmonidae (Salmon and Trout Family)					
Central Valley steelhead ESU[b] (*Oncorhynchus mykiss irideus*)	--/FT	Documented to occur downstream of Englebright Dam[c]	Documented to occur downstream of Scott Dam[e]		
Eagle Lake trout (*Oncorhynchus mykiss aquilarum*)	FSC			Stocked for Angling	
Coho (*Oncorhynchus kisutch*)	SE/FT		Known to occur in Outlet Creek		
Chinook salmon (*Oncorhynchus tshawytscha*)					
Spring- run	ST/FT, FSS	Documented to occur downstream of Englebright Dam[d]			
Fall-run	CSC/FC, FSS	Documented to occur downstream of Englebright Dam[c]	Documented to occur[e]	Stocked for Angling	
Cyprinidae (Minnow Family)					
Hardhead (*Mylopharodon conocephalus*)	CSC/FSS	Known to occur in Englebright Reservoir		X	X

a Designation Abbreviations:
-- = No Designation
State Designations
CSC = California Special Concern species
ST = State Threatened species
SE = State Endangered species

Federal Designations
FSS = Forest Service Sensitive species
FC = Federal Candidate species
FT = Federal Threatened species
FSC = Federal Special Concern species

b ESU = Evolutionarily Significant Unit

c Pacific Gas and Electric Company. 1989. Narrows Project, FERC 1403, Application for New License: Report E3, Fish, Wildlife and Botanical Resources.

d BEAK Consultants. 1986-88. Yuba River Fisheries Investigations. Summary Report of Technical Studies on Lower Yuba River, California.

e CDFG. 1998. California Natural Diversity Database. California Department of Fish and Game, Natural Heritage Division. Sacramento. February.

The presence of anadromous fish in the Yuba River below Englebright Reservoir that have recently been listed as threatened species can, at times, further constrain operations of Narrows 1 and 2 in addition to the FERC requirements. Minimum flows to protect fisheries resources downstream of the project are already in effect (Table 4.4-24). The required minimum flows are expected to protect spring-run chinook (proposed for State and Federal listings as endangered) that may enter the lower reaches of the Yuba River from the Feather River. Minimum flows will also protect the recently listed Central Valley steelhead (Federally listed as threatened), and Central Valley fall-run chinook (proposed for Federal listing as threatened), both of which occur in the Yuba River (PG&E Co., 1999d).

The hardhead is assigned to a Class 3 status rating by CDFG, which signifies it as a watch list species (Moyle et al, 1995). Historically, hardhead were an abundant and widespread species (Reeves, 1964). Hardhead are still a widespread species in the foothill streams; however, a combination of their specialized habitat requirements and downstream habitat alterations have led to localized, isolated populations. Damming and diversion has removed a large portion of the cool to warmwater streams that hardhead prefer (Moyle et al, 1995). Add to this pressure from introduced predators often abundant in reservoirs and as a result, hardhead are vulnerable to localized extinctions and are less abundant than they historically were, especially in the southern half of their range (Moyle et al, 1995). Englebright reservoir contains at least eight recorded centrarchid species, three of which are basses: largemouth bass, spotted bass, and smallmouth bass (see Table 4.4-20). In the past, hardhead were so plentiful in reservoirs as to be regarded as a problem species. They were assumed to compete with trout and other game fishes for food. However, most of these reservoir populations proved to be temporary, presumably the result of colonization of the reservoir by juvenile hardhead that were eliminated once introduced predators became established (Moyle et al, 1995).

Fisheries Management

CDFG currently stocks Englebright Reservoir annually with rainbow trout and eagle lake trout (CDFG, 1999). The California sport fishing regulations for year 2000 state that Englebright Reservoir is open for fishing all year and has a daily bag and possession limit of five trout per day and ten in possession. On the Yuba River downstream of Englebright Dam to Highway 20 bridge, open season is from December 1 through September 30. Only artificial lures with barbless hooks may be used. There is a zero trout or salmon daily bag and possession limit in this area.

FERC Article 15 addresses the conservation and development of fish resources within the project and calls for consultation with appropriate agencies regarding the protection and development of the natural resource associated with the project (PG&E Co., 1999d).

Under License Article 403, Pacific Gas and Electric Company must annually provide 5,000 rainbow trout (a half-pound each) to be stocked in Englebright Reservoir. Pacific Gas and Electric Company is to coordinate with CDFG on the timing and location of the stocking (FERC, 1993).

Article 404 in the FERC license requires Pacific Gas and Electric Company to fund fisheries enhancement projects, not to exceed $100,000 every five years, selected after consultation with CDFG and USFWS. Article 404 additionally requires Pacific Gas and Electric Company to provide detailed drawings and map locations of the fisheries enhancement measures (FERC, 1993).

Under Article 405, Pacific Gas and Electric Company is required within "180 days from the date of issuance of the license to file with the Commission, for approval, a plan to establish limits on the maximum rate of change in river flow (ramping rate) from the project powerhouse for the protection of fish resources in the Yuba River. Pacific Gas and Electric Company shall prepare the plan after consultation with the U.S. Fish and Wildlife Service and the California Department of Fish and Game.

Until the Commission approves the ramping rate plan, Pacific Gas and Electric Company shall not alter streamflow downstream of the powerhouse at a rate greater than 30 percent per hour or 200 cubic feet per second per hour, whichever is less" (FERC, 1993).

Bundle 10: Potter Valley

Potter Valley Project (FERC 0077)

With the completion of Cape Horn Dam, the Potter Valley Powerhouse (PVPH), diversion tunnel, and assorted support facilities in 1908, the Potter Valley Project (PVP) began to divert water from the Eel River into the headwaters of the East Branch Russian River. Prior to the completion of Scott Dam in 1922, the project operated in a run-of-the-river mode, only diverting water when it was available in the Eel River. Completion of Scott Dam created the storage capacity (Lake Pillsbury is currently 80,556 af) to operate the PVPH in a continuous power production manner. Currently, maximum diversion rates are approximately 320 cfs, equating to a maximum generation capacity of 9.4 megawatts (FERC, 2000b). An operating agreement with the USFS reduces releases from Scott Dam (and corresponding diversion rates) through Labor Day to help maintain Lake Pillsbury at elevations sufficient for recreation. Historic average diversion amounts to approximately 160,000 af per year (FERC, 2000b). Water released downstream of the PVPH is either diverted into irrigation ditches by the Potter Valley Irrigation District (PVID) or enters the East Branch Russian River.

Pacific Gas and Electric Company purchased the PVP from Snow Mountain Water and Power Company in 1930. This included the transfer of the 50-year operating license that had been granted to Snow Mountain Water and Power Company by the Federal Power Commission (now FERC) with the completion of Scott Dam in April 1922. Under this license, the minimum flow below Cape Horn Dam could remain at 2 cfs as long as Lake Pillsbury was under control (i.e., not spilling). This minimal flow likely had detrimental effects on salmonids in the upper Eel River. The original license expired in April 1972, and the project operated under annual licenses during a period of study and negotiation intended to determine an improved release schedule. Intensive studies led to a settlement agreement in November 1982 between Pacific Gas and Electric Company, Humboldt, Mendocino, and Sonoma counties, Mendocino County Russian River Flood Control and Water Conservation District, Sonoma County Water Agency, and CDFG. In October 1983, FERC incorporated the settlement agreement into a new 50-year license (FERC, 1983). Article 38 of the new license is the flow schedule in accordance with which Pacific Gas and Electric Company has been operating the PVP (Section 4.3, Hydrology and Water Quality).

Included as Article 39 in the new license were provisions for a ten-year monitoring program to assess the effects of project operations on the salmonid resources of the upper Eel River. Article 39 required that Pacific Gas and Electric Company consult with CDFG and USFWS in the design of this study. Through the course of the ten-year monitoring program, a technical review committee was established to help with changes in study design and keep resource agencies up to date with the latest study results. This committee included representatives from Pacific Gas and Electric Company, CDFG, USFWS, NMFS, and other interested parties. Work was initiated in fall 1985 and a final report published in March 1998 (SEC, 1998). Concurrently with the release of the final monitoring report, Pacific Gas and Electric Company, with the support of USFWS (Barry, 1998), NMFS (Hogarth, 1998), and CDFG (Hunter, 1998), submitted a set of recommendations to FERC for a new release schedule for the PVP that was designed to improve conditions for the anadromous fisheries on the Eel River (PG&E Co., 1998a). However, USFWS and NMFS have removed their support from this proposal. While this process remains extremely contentious and the ultimate solution is unclear, the PVP could technically have continued to operate under the provisions of Article 38. However, on February 11, 1999, the Round Valley Indian Tribes filed a motion with FERC for an order from FERC to establish interim flows in the Eel River below Cape Horn Dam (Reid, 1999). This motion created a flurry of activity, including response letters from Pacific Gas and Electric Company (Reid, 1999) and the Department of the Interior (DOI) (Fletcher, 1999). A letter from NMFS on February 23, 1999, requested that Pacific Gas and Electric Company initiate formal consultation under Section 7 of the ESA regarding PVP effects on Federally protected species in the Eel and Russian rivers and requested that FERC implement an interim flow release schedule based on Pacific Gas and Electric Company’s original (March 30, 1998) proposal with modifications to account for lack of required capital improvements

(Hogarth, 1999). A March 5, 1999, letter from FERC to Pacific Gas and Electric Company requested that Pacific Gas and Electric Company provide a description of their intentions regarding implementation of an interim flow schedule (Robinson, 1999). Pacific Gas and Electric Company voluntarily agreed to implement, beginning on April 1, 1999, an interim flow schedule based on a modified original (March 30, 1998) proposal and adjusted in consultation with NMFS, USFWS, CDFG, and the USFS (Reid, 1999).

Since Pacific Gas and Electric Company provided FERC with recommended changes to Article 38 on March 30, 1998, FERC has completed a draft environmental impact statement (DEIS) (FERC, 1999a). The conclusion of this report was that the Pacific Gas and Electric Company alternative was preferred over several other potential release schedules. However, the analysis within the DEIS generated significant amounts of controversy and comment. The resource agencies and many other interested parties submitted comments and proposals for modifications to the proposed release schedules or entirely new alternatives to those analyzed in the DEIS (FERC, 2000a). As a result of agency and public input, the Final EIS (FERC, 2000b) has been substantially revised and includes FERC recommendations for a license amendment that may become the new flow schedule for the PVP (Section 4.3, Hydrology). Because special-status fish species are found within the project (Table 4.4-23 and 4.4-24) and changes in project operations could affect these species, FERC was required to consult with NMFS under Section 7 of the ESA. As of the date of the FEIS, May 2000, a final Biological Opinion has not been received from NMFS (FERC, 2000b). The USFS also has authority under Section 4(e) of the Federal Power Act and is negotiating with Pacific Gas and Electric Company for new regulations to be added to the FERC license for the PVP (Gipsman, 2000). A recent letter from FERC to Stan Dixon of the Humboldt County board of supervisors illustrated the current status of the project (Crow, 2000). Apparently, because of the differences between the draft and final EIS (including a new preferred alternative), a new consultation with NMFS was required under Section 7 of the ESA (Crow, 2000). According to the letter, NMFS is supposed to deliver the new biological opinion for the project by October 23, 2000 (Crow, 2000).

Plans and Policies

Mendocino County General Plan

Hydrology/Water Quality. Because of the innate connection between hydrology, water quality and fisheries resources a brief summarization of the pertinent plans and policies that influence PVP operations is presented here. Within the water resources element of the Land Use section of the Mendocino County General Plan, specific goals and policies have been created with the intent to maintain and protect the hydrologic resources of the County. Within the discussion of findings, Item E relates to the reduction of flows due to diversion and discusses the County's participation in the settlement agreement for the PVP that led to the 3-year study by VTN (1982). Additionally, Item H addresses the pressures for increased export of Eel River water through new dams and diversions and indicates that the County should support the State Wild and Scenic Rivers Act.

Within the discussion of goals and policies, there are two items of specific importance to this discussion:

- Goal 5.g: The County shall cooperate in conducting studies of the effects of flow changes in the Eel River as a result of the recent Potter Valley project Agreement (Mendocino County 1993, page I-69).
- Goal 7: The County shall maintain the wild and scenic qualities of the Eel River and its major tributaries and to insure that these streams are not dammed. The policies that support this goal include one that directs the County to adopt an ordinance governing the use of the Eel River, and one that directs the County to seek State legislation to protect the Eel River (Mendocino County 1993, page I-70).

The stated objective in the open space and conservation element is to "identify and conserve rivers, streams, watersheds, coastal areas, harbors, estuaries, reservoirs, potential reservoirs, and lands adjacent thereto which are especially important for water supply, recreation, fish and shellfish production, scientific study or scenic value." (Mendocino County 1993, page VIII-10).

Fisheries. The Mendocino General Plan is one of the few general plans in the Pacific Northwest to specifically address fisheries issues. In the land use element, the discussion of fisheries issues begins with an identification of issues that includes commercial and sport fishing, fisheries enhancement, population declines, offshore oil development, aquaculture, poaching, and habitat loss. Issue 5.4 specifically addresses the reduction in streamflow due to dams and diversion that adversely affect fish habitat and migration (Mendocino County 1993, page I-25). Findings Item F discusses reduced stream flows and mentions the interim agreement that required a 3-year study of the relationship between flows and salmonid survival (conducted by VTN, 1982) (Mendocino County 1993, page I-28). Mendocino County, along with CDFG, Pacific Gas and Electric Company, and others, was a signing party to this agreement.

The two fisheries goals set forth in the plan are as follows (Mendocino County 1993, page I-29):

- Short-term: Double the number of salmon and steelhead presently within the County's streams.
- Long-term: Achieve and maintain optimum natural production of salmon and steelhead in each Mendocino County Watershed.

There are 26 specific policies intended to support these two goals and guide the County's decision-making process. Most of these focus on encouraging habitat restoration and compatible land uses, population enhancement through study and funding, and cooperation with CDFG and their management goals. There are two items that specifically address hydropower facilities and one that addresses the issue of instream flows (Mendocino County 1993, pages I-30-31):

- N: Support instream flows adequate to maintain and protect historic fishery values within all county streams;
- S: Hydropower projects shall be located, designed, and operated to fully protect salmon and steelhead habitat and populations.

Policy 5.c.ii of the water resources element instructs the County to "[e]ncourage the State to revise water rights law to reserve adequate stream flows for protection of fish and wildlife habitat and other instream uses" (Mendocino County 1993, page I-69).

The stated objective within the open space and conservation element in terms of fisheries issues is essentially the same as previously discussed for Hydrology/Water Quality. The main addition to the stated objective is to "[i]mprove stream habitat for anadromous fish." (Mendocino County 1993, Section VIII pg. 10.) Additionally, the Eel River is specifically identified within this element as critical spawning and nursery habitat for salmonids.

Mendocino National Forest Land and Resources Management Plan

Hydrology/Water Quality. The Mendocino National Forest (MNF) encompasses the headwaters of the Eel River from just below Lake Pillsbury to the origins of the river above Lake Pillsbury. The MNF is managed by the USFS which has developed a Land and Resources Management Plan (USFS, 1995) that guides activities on the forest lands. Within this document, subsections focus directly on Lake Pillsbury (Management Area 11) and the Eel River below Lake Pillsbury to the MNF boundary (Management Area 10). MNF intends to implement watershed improvements within these two areas as described by the Lake Pillsbury Basin Sediment Task Force to control sediment input to Lake Pillsbury. Additionally, minimizing sediment inputs from off-highway vehicle (OHV) use is to be a focus of activity. Management direction for Area 11 includes an article to stabilize the serpentine areas along the shoreline of Lake Pillsbury and upstream river banks in an effort to help reduce turbidity in Lake Pillsbury (USFS, 1995).

Fisheries. While the MNF management plan does not address project fisheries specifically, there are nine management goals intended to maintain and enhance riparian and aquatic ecosystems in the entire MNF. Item F addresses instream flows by directing activities to "maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitat and to retain patterns of sediment, nutrient, and wood routing." (USFS 1995, page IV-31). Additionally, riparian reserves are identified for fish-bearing streams as being the greater distance that extends from the active stream channel to the outer edge of: the inner gorge; the 100-year floodplain; the outer edge of the riparian vegetation; the distance equal to the total height of two of the tallest dominant trees in a given site class; or 300 foot slope distance (USFS 1995, page IV-32).

Project-Specific Hydrology

Eel River Downstream of the Potter Valley Project. The main stem downstream of the PVP area consists of the Eel River from the mouth to Cape Horn Dam. Major tributaries to the Eel River (upstream to downstream) include Tomki Creek, Outlet Creek, the Middle, North, and South forks of the Eel River, and the Van Duzen River. Each of these, plus innumerable smaller tributaries, all contribute water to the main stem. As a result, the effect that project releases have on the actual stage of the Eel River decreases with the distance downstream of the project. FERC license Article 38 sets the minimum flow schedule for the Eel River below Cape Horn Dam (FERC, 1983).

Main Stem Eel River Between Cape Horn and Scott Dams. The reach of the Eel River from the point of diversion, Cape Horn Dam, upstream to Scott Dam is approximately 12 miles. Van Arsdale Reservoir is included in this reach because it is more riverine than lacustrine in character as a result of sediment deposition that has reduced its storage volume to approximately 700 af (FERC, 2000b). Stream flows in this reach, and at all points downstream, are controlled during much of the year by releases from a needle valve located at the base of Scott Dam. Pacific Gas and Electric Company releases water from Lake Pillsbury in order to meet the required minimum flows in all stream reaches as mandated in the current release schedule. Additional water is released to be diverted at Cape Horn Dam and conveyed through the tunnel to the PVPH for generation. Currently, the maximum amount of water that can be released from the needle valve ranges from 14 to 400 cfs depending on reservoir elevation (PG&E Co., 1981b).

Tributaries Between the Dams

These are all relatively small tributaries to the main stem Eel River between Cape Horn and Scott dams. Species diversity is lower in these streams that in the main stem. Bucknell Creek is relatively typical of the streams for which anadromous access exists (Bucknell, Trout, Benmore, and Soda creeks). In 12 years of electroshocking surveys, only four species have been documented in this creek (SEC, 1998). Of those four, only three (Pacific lamprey (*Lamperra tridentera*), steelhead, and California roach) are found with any regularity (SEC, 1998). An additional species, Sacramento pikeminnow, have been captured in downstream migrant traps located in Bucknell Creek above the confluence with the Eel River. Most of these streams are too small to be regularly used by spawning chinook.

Alder and Dashiell creeks are relatively short and have very steep gradients. Additionally, the manner in which they join with the Eel River likely precludes fish access. Survey work has not been conducted on these streams.

Lake Pillsbury. Lake Pillsbury was created with the completion of Scott Dam in 1922 and collects runoff from a 289 square-mile watershed (FERC, 2000b). Most of the runoff from this watershed comes in the form of rain. While significant amounts of snow collect on Snow and Hull mountains above Lake Pillsbury, inflow patterns are primarily rainfall driven. Lake Pillsbury had an original storage capacity of 94,000 af. Since completion, sedimentation has reduced the capacity significantly, and in 1984, storage was estimated to be approximately 80,556 af (PG&E Co., 1999d). Maximum pool elevation is approximately 1,838.5 feet above mean sea level (msl) and minimum pool is approximately 1,795 feet msl (16,000 af). Lake Pillsbury typically reaches minimal annual storage in late fall. Pacific Gas and Electric Company implements water conservation measures when Lake Pillsbury storage drops below 16,000 af. The magnitude of fall and winter storms determine the time at which spill over the dam crest begins to occur, typically between early winter and early spring, although spill does not occur in all years (e.g. water year 1976-77, the drought of record). Spill is uncontrolled until the gates on the crest of Scott Dam are lowered. Scott Dam is topped with radial and slide gates that allow for an increase of 10 vertical feet in storage. The operational permit from Department of Safety of Dams (DSOD) held by Pacific Gas and Electric Company allows the radial gates to be closed on April 2, and they must be opened by November 1. Once the gates are closed, Pacific Gas and Electric Company carefully monitors lake elevations and adjusts the radial gate openings to prevent overtopping, maximize storage, and meet minimum stream flow requirements.

East Branch Russian River to Lake Mendocino. Three small hydroelectric facilities rely on released water from the PVPH for their water supply. They are all located on the East Branch Russian River downstream of the PVPH. They are the McFadden Farm project (FERC 4658), the Power Canal project (FERC 8936), and Hammeken's Power Canal project (FERC 9647). These are all run-of-the-river projects with no storage capacity. Generating outputs from these facilities are 348, 200, and 300 kW respectively (Humble, 2000; FERC, 2000c). Diversion of water to the East Branch Russian River has allowed the establishment of a recreational fishery. Since 1978, CDFG has supported this fishery by annually planting approximately 21,000 large catchable rainbow trout (SEC, 1996b)

Regulations Regarding Flows in the Eel River Below Cape Horn Dam

Article 38. As previously mentioned, FERC License Article 38 established the minimum streamflows for the Eel River below Cape Horn Dam. Under Article 38, flows were set based on a complex evaluation procedure. A "trigger event" is described as the occurrence of 75 cfs mean daily flow of accretion between Cape Horn and Scott dams. Once a trigger event occurred, another was not possible for seven days. Minimum releases for November and December after a trigger event were set based on the evaluation of cumulative unimpaired inflow to Van Arsdale Reservoir through the date of the trigger and ranged from a continuation of summer flows (five cfs) to 100 cfs. Minimum discharge requirements for January were also set based on evaluation of cumulative unimpaired inflow to Van Arsdale Reservoir on January 1 and ranged from five to 100 cfs. Release requirements for the remainder of the year were linked to water year classifications (WYC) of "normal," "dry," or "critical." Water year classifications for March through October are based on the actual cumulative inflow into Lake Pillsbury. Minimum flows in February or March ranged from 5 to 100 cfs depending on the water year classification. Minimum daily discharges in April and May were designed to decrease gradually from an upper value in April of 35 or 100 cfs to a lower value of 8-10 cfs by the end of May. Discharges in the summer months of June through October were generally 5 cfs.

Article 38 also set minimum daily discharges in the Eel River below Scott Dam and the East Branch of the Russian River. Between December 1 and May 31 the Eel River below Scott Dam was set to a minimum of 100, 40 or 20 cfs; from June 1 to November 30, minimum mean daily discharges were 60, 40, or 20 cfs, depending on the WYC. Similarly, the minimum discharge requirements in the East Branch of the Russian River (below the PVPH tailrace) were 35 or 20 cfs between September 16 and May 14 and 75, 40, or 20 cfs between May 15 and September 15, depending on the WYC.

To make up for unforeseen potential inadequacies in the flow schedule, Article 38 also set aside water for release, known as block water, at the discretion of CDFG. There are four allotments of water available through the year. Two thousand af are available following the first trigger event or December 1, whichever is earlier; this water must be used by January 1 or it becomes no longer available. An additional 500 af are reserved after the first trigger or January 1, whichever is earlier; the reservation for this water expires on June 16. Spring block water of 600 af is available on March 16 if cumulative inflow to Lake Pillsbury exceeds 55,000 af. If cumulative inflow to Lake Pillsbury exceeds 160,000 af an additional 900 af is made available. The reservation for most of this water expires at the end of September. However, in either case, 20 percent of the block water may be carried over into the following water year for release in October.

FERC Recommended Flows. FERC has recently published a final EIS in which they recommend a new release schedule for the PVP (FERC 2000b). While the actual computation of required minimum flows in the Eel River below Cape Horn Dam in the proposal is very complex, the general concept is relatively simple. In an effort to provide a more natural discharge pattern in the mainstem Eel River, minimum releases into the Eel River below Cape Horn Dam would be based on an established relationship between discharges in Tomki Creek and those in the mainstem Eel River. Between October 1 and June 30, minimum releases from Cape Horn Dam would be adjusted on a daily basis based on actual flows in Tomki Creek. In the fall period (October 15 to December 31), adjustments would potentially be made up to three times per day based on changes in Tomki Creek discharges. Upper and lower limits for release flows would be set based on daily cumulative inflow to Lake Pillsbury. Ramping functions would be applied to the fall and early summer periods to provide a smooth transition to and from daily adjusted flows. Between July 7 and September 30, minimum flows below Cape Horn Dam would be set to 5 cfs.

Flows in the East Branch Russian River. The PVP has a significant influence on flows in the East Branch Russian River. Since the construction of Scott Dam, the project has diverted water to the East Branch Russian River on a continuous basis. As a result, summer stream flows have been maintained at an average of 188 cfs (SEC, 1998).

Eel River Water Temperatures. Seasonal fluctuations of discharge patterns and air temperatures combine to create the temperature regimes of the Eel River. Extensive temperature monitoring has been conducted on the upper Eel River (SEC, 1998; VTN, 1982; BEAK, 1986). During periods of relatively high discharges and shorter day length, typically winter and early spring, water temperatures are relatively uniform within the project, approximately 6 to 7°C in January and February (SEC, 1998). Increasing day length and decreasing flows in the spring create warming trends apparent in data recorded over the years. Because Lake Pillsbury is stratified during the summer and releases from Scott Dam are made through the needle valve at the base of the dam, water temperatures in the main stem below Scott Dam tend to be relatively cool through the summer months. The seasonal range of water temperatures below Scott Dam (historical monthly mean data) range from the lows mentioned previously to approximately 19°C in September (SEC, 1998). This relatively cool water travels through the reach to Cape Horn Dam, warming as it progresses downstream. By the time it reaches Van Arsdale Reservoir, it has warmed significantly. Historical monthly mean data for the Eel River at Cape Horn Dam range from the lows mentioned previously to just over 20°C in July (SEC, 1998).

During the summer months, most of the water is diverted to the PVPH for electrical generation. However, by the time this water is diverted, the potential for downstream cooling (below Cape Horn Dam) appears minimal (SEC, 1998). Water temperatures in the tributaries generally reflect their smaller size and lower stream flows. However, water temperatures in the tributaries may remain cool because of heavy riparian shading and decreased exposure to solar heating.

Fisheries Resources in the Eel River

The Eel River, not including the estuary, currently supports at least 25 species of fish: 12 are native to the Eel River and 13 have been introduced (see Table 4.4-26). An additional two native and three introduced species were historically present in the basin but are now believed extinct within the basin. The list of extant species can be divided into two major groups, anadromous and non-anadromous. Those of primary management concern to this process are the anadromous salmonids, all of which are native to the Eel River.

Generally, the fish species diversity in the Eel River system decreases with distance along the main stem from the estuary or distance along the tributaries from the main stem. The major exception is Lake Pillsbury, which is far from the estuary but supports a relatively diverse population of fish, many derived from sport fishing (largemouth bass, bluegill, golden shiner, etc).

The lower Eel River, considered to be all reaches below the confluence with the Middle Fork (USGS, 2000), supports a relatively wide array of fish species. Adult salmonids pass through this reach on their fall migrations; juveniles pass on their way to the ocean in the spring. Non-salmonid species in this area include Sacramento sucker, California roach, Pacific lamprey, Sacramento pikeminnow, etc. High summer water temperatures likely limit the potential rearing within this reach for juvenile steelhead to coldwater seeps, springs, and tributaries.

The mainstem between Cape Horn and Scott dams supports a somewhat diverse fish population because of project induced stable flows. When Lake Pillsbury is not spilling, water is released from a needle valve at the base of Scott Dam. This provides relatively cold water at the upstream end of this 12-mile reach that is important in maintaining the existing coldwater fishery.

Scott Dam blocks all anadromous access to the headwaters of the Eel River above Lake Pillsbury. This area supports a resident population of rainbow trout (the non-anadromous form of steelhead). The only brook trout to be found within the project are reported from Sanhedrin Creek, one of the small, high elevation tributaries to the headwaters of the Eel River. Currently, CDFG manages Lake Pillsbury as a put-and-take recreational fishery. Between 1986 and 1990, CDFG planted over 100,000 catchable trout in Lake Pillsbury (SEC, 1998).

Table 4.4-26 Drum Regional Bundle – Potter Valley Project (FERC 0077) Fish Species Occurrence by Location

Location	Minimum Streamflow/ Reservoir Level Requirements[a]	Pacific brook lamprey	Pacific lamprey	Threadfin shad	American shad	Coho salmon	Fall-run chinook salmon	Rainbow trout	Steelhead trout	Brown trout	Brook trout	California roach	Sacramento pikeminnow	Golden shiner	Fathead minnow	Sacramento sucker	Brown bullhead	White catfish	Three-spined stickleback	Bluegill	Green sunfish	Largemouth bass
Lake Pillsbury	None	X		X				X			X	X	X	X	X	X				X	X	X
Eel River below Lake Pillsbury (Scott Dam)	Normal year: 5/15-9/15: 60 cfs; 9/16-5/14: 100 cfs Dry year: 40 cfs Critical year: 20 cfs			X			X		X			X	X	X		X			X	X	X	X
Van Arsdale Reservoir	None			X			X		X			X	X	X		X	X		X	X	X	X
Eel River below Cape Horn Dam	See footnote b				X	X	X		X			X	X			X	X	X	X	X	X	
East Branch Russian River below Potter Valley Powerhouse	Normal year: 5/15-9/15: 75 cfs; 9/16-5/14: 35 cfs Dry year: 5/15-9/15: 40 cfs 9/16-5/14: 35 cfs Critical year: 20 cfs							X		X		X	X			X				X	X	
Eel River from Scott Dam downstream to Bucknell Creek confluence	Unimpaired. Watershed lands	X	X	X	X		X		X			X	X	X	X	X	X	X	X	X	X	X
Soda Creek	Unimpaired. Watershed lands		X						X			X	X			X						
Benmore Creek	Unimpaired. Watershed lands		X						X													
Dashiell Creek	Unimpaired. Watershed lands																					
Alder Creek	Unimpaired. Watershed lands																					
Bucknell Creek	Unimpaired. Watershed lands		X						X			X	X			X						
Trout Creek	Unimpaired. Watershed lands		X						X			X										

a cfs = cubic feet/second / Water year designations are based on either cumulative inflow to Lake Pilsbury. Van Arsdale Reservoir, or the water year type in the preceding June for the months of July through October (see Section 4.3).

b The following information is summarized from FERC License Article 38:

	Normal	Dry	Critical		Normal	Dry	Critical
11/1-11/30	10-100	8-55/75	5	3/1-3/31	100(85)	35	5
12/1-12/31	10-100	8-35/55/75	5	4/1-4/30	100(85)-40	35-15	5
1/1-1/31	100	55/75	5	5/1-5/31	40-10	15-8	5
2/1-2/29	100(85)	35/75	5	6/1-10/31	5	5	5

Rainbow trout are planted through the spring to support a recreational fishery. Over the course of history, largemouth bass, bluegill, green sunfish, and numerous species of bait fish have been released into Lake Pillsbury. Currently, Lake Pillsbury supports reproducing populations of gamefish such as largemouth bass, bluegill, and rainbow trout (both wild fish from the upper watershed and surviving hatchery plants).

Salmonids. Chinook (*Oncorhynchus tshawytscha*) historically occurred in the Eel River in numbers great enough to support commercial canneries at the mouth (SEC, 1998). Ladder counts of chinook from the Van Arsdale Fisheries Station (VAFS) have ranged from a high of 1,754 in 1987 to several years when no fish reached the station (SEC, 1998). Consistent ladder counts are available from 1955/56 to present. Eel River chinook typically enter the lower river in late fall and migrate upstream to their natal streams as pulse flows from fall and winter storms allow. Spawning occurs in the main stem below Cape Horn Dam, Tomki Creek, the Eel River above Cape Horn Dam, and some of the other larger tributaries. Spawning habitat is more plentiful downstream of Cape Horn Dam and in Tomki Creek than in the Eel River above Cape Horn Dam (SEC, 1998). Juveniles emerge from the gravels and begin migrating towards the ocean immediately. Relatively low water temperatures may slow migration and, similarly, elevated stream flows may speed migration (SEC, 1998). Chinook do not over-summer in the upper Eel River, although extended use of the estuary may occur (Table 4.4-27).

Table 4.4-27 Special-status Fish Species Critical Habitat Designations

Species	Evolutionarily Significant Unit	Range	Reference
Chinook	California Coastal	Mouth to Scott Dam	FR 2000b
Steelhead	Northern California	Not designated yet	
Coho	Southern Oregon/Northern California	Mouth to Scott Dam	FR 1999b

Populations of Eel River chinook are included by the NMFS in the California Coastal ESU that was listed under the ESA as threatened in 1999 (FR, 1999a). Additionally, NMFS designated critical habitat for chinook in the Eel River includes all stream reaches up to Scott Dam (FR, 2000b).

Steelhead enter the lower Eel River in late fall and early winter after spending two to three years in the ocean. The first steelhead often reach VAFS in late December, but the run doesn’t really peak until February (SEC, 1998). Because most steelhead enter the river well into the winter storm season, upstream migration is generally not significantly hindered by low stream flows (SEC, 1998). Counts of steelhead at the VAFS ladder are available from 1922/23 to present; however, wild versus hatchery counts are only available since 1980/81. Since 1980/81, the total number of wild steelhead has ranged from a low of 19 fish in 1990/91 to a high of 1,966 fish in 1984/85.

Counts of hatchery fish ranged from a low of 11 fish in 1993/94 to a high of 7,314 fish in 1998/99.

Counts of hatchery fish are dependent to a great extent on the number of juvenile fish planted two to three years before the adult return year.

Populations of Eel River steelhead are included by the NMFS in the Northern California ESU that was listed under the ESA as threatened in 2000 (FR, 2000a). At this time, NMFS has not designated critical habitat for steelhead in the Eel River.

Coho (*O. kisutch*) are found primarily in the South Fork Eel River. A relatively small population persists in Outlet Creek near Willits, CA. The confluence of Outlet Creek and the main stem Eel River is located just upstream from Dos Rios, and approximately 30 miles below Cape Horn Dam. Coho have been recorded twice at VAFS, 47 fish in 1946/47 and one fish in 1984/85 (Tharratt, 1957; Rose, 1985).

Populations of Eel River coho are included by the NMFS in the Southern Oregon/Northern California ESU that was listed under the ESA as threatened in 1997 (FR, 1997). Additionally, NMFS designated critical habitat for coho in the Eel River includes all stream reaches up to Scott Dam (FR, 1999b).

Non-salmonid. Project water supports a large number of non-salmonids. Some of these species are native, and others have been introduced, primarily into Lake Pillsbury. These species appear in large numbers and their populations seem to be relatively stable (SEC, 1998). The two species of special interest to this discussion are Pacific lamprey and Sacramento pikeminnow.

Pacific lamprey are an anadromous species, the details of whose life history are not well known. Adults enter the Eel River in the winter and reach the fish ladder at Cape Horn Dam by early spring. Pacific lamprey are able to negotiate the ladder and reach the Eel River above Cape Horn Dam. Spawning occurs in the main stem Eel River and the tributaries below Scott Dam. Juveniles spend between three and seven years in the streambed sediments before migrating to the ocean (Moyle 1976). Because they are predatory during their pelagic life stage, their population swings often reflect those of salmonids.

Ptychocheilus grandis. Sacramento pikeminnow (commonly known as Sacramento squawfish, chappaul, Sacramento pike, hardhead and numerous other local names) is a large predatory fish that was introduced into the Eel River in the late 1970s. The precise method of introduction is unclear, but it is believed to have come from a bait-bucket release in Lake Pillsbury. The first Sacramento pikeminnow were captured at the downstream migrant trap in the tailrace of the PVPH in 1980, and distribution through the drainage appears to have been accelerated by the flood event of February 1986 (SEC, 1998). Currently, Sacramento pikeminnow is distributed through the larger sub-basins of the Eel River system.

In its native streams, Sacramento pikeminnow co-exists with salmonids (Moyle, 1976). Sacramento pikeminnow prey on salmonids, but tend to be physically separated much of the year because of physical habitat characteristics (Brown and Moyle, 1981). In the Eel River, large Sacramento pikeminnow are typically found in large, low velocity pools of the main river and reservoirs. The smaller, presumably juvenile fish are found in a wide range of habitats from riffles and runs to pools and reservoirs. In general, the Sacramento pikeminnow prefer warm waters of low velocity while the salmonids are to be found in the higher gradient cooler tributaries during the summer months. Conditions in the main stem Eel River appear to favor Sacramento pikeminnow during much of the year and the establishment of this species in the main stem between Cape Horn and Scott dams may have affected rearing densities of juvenile steelhead (SEC, 1998).

Fisheries Resources - East Branch Russian River

Steelhead. Prior to the completion of Scott Dam in 1922, the PVP was a run-of-the-river diversion, only diverting water when Eel River flows were sufficient. With the completion of Scott Dam, storage was available that allowed year round diversion, altering the natural flow regime of the East Branch Russian River. Completion of Coyote Dam and the creation of Lake Mendocino eliminated anadromous steelhead access to the East Branch Russian River in 1959. Currently, CDFG routinely plants large (2 to the pound) hatchery rainbow trout into the East Branch to support an active sport fishery. There is likely some native steelhead (now technically rainbow trout) production in some of the tributaries to the East Branch.

The diversion from the Eel River was unscreened until 1972, an action that allowed the diversion of Eel River steelhead into the East Branch Russian River. In 1972, Pacific Gas and Electric Company and CDFG reached an agreement for installation and operation of a fish screen at the intake structure at Van Arsdale Reservoir. Unfortunately, the design chosen was not well suited to the sediment loads in the Eel River and was subject to frequent failures. In 1983, after being notified that the screen was again in need of repair, CDFG concluded that the screen should be replaced with an improved design (SEC, 1998). Design work began soon thereafter; however, construction was not started until late in 1994. The new screen was completed and began operation in December 1995 (SEC, 1998). Testing of the new fish screen indicated that diversion of steelhead to the Eel River was minimal. In leakage testing, less than 2 percent of approximately 5,000 recaptured steelhead fry were trapped at the PVPH (SEC, 1996a).

Non-salmonids. Of the 48 species of fish documented to exist (or have existed) in the Russian River, only eight are native and anadromous (SEC, 1996b). Of the remaining species, 29 have been introduced, mostly because they were believed to be valuable sport or forage fish.

Bundle 11: South Yuba River

Drum-Spaulding (FERC 2310)

Drainage Basin and Water Sources. The Drum-Spaulding project extends from the crest of the central Sierra Nevada Mountain Range to Auburn, California, covering an elevational range from 300 to 8,000 feet. It begins on the South Yuba River near Donner Summit and ends at Folsom Lake on the American River. In between these two locations, water is transported through the Bear River Watershed as well as diverted from the American River Watershed. The project consists of an extensive network of hydraulically linked facilities located within the Yuba River, Bear River, Deer Creek, and American River basins, including multiple interbasin water transfers. The Yuba and Bear rivers originate on the west slope of the Sierra Nevada Mountain Range. The South Fork Yuba River begins near Soda Springs (6,768 feet elevation) in Nevada County, although headwaters reach as high as 8,000 feet near White Rock Reservoir. The Bear River originates near the 5,243-foot Emigrant Gap in Placer County. The combined drainage basins encompass approximately 305 square miles as measured at Wise Forebay.

Reservoirs. The following reservoirs are associated with the bundle: Upper Rock Lake, Lower Rock Lake, Culbertson Lake, Upper Lindsey Lake, Middle Lindsey Lake, Lower Lindsey Lake, Upper and Lower Feeley Lake, Blue Lake, Rucker Lake, Fuller Lake, Meadow Lake, Bowman Lake, White Rock Lake, Fordyce Lake, Lake Sterling, Kidd Lake, Upper Peak Lake, Lower Peak Lake, Lake Spaulding, Kelley Lake, Lake Valley Reservoir, Drum Forebay, Drum Afterbay, Alta Forebay, Deer Creek Forebay, Halsey Forebay, Halsey Afterbay, Rock Creek Reservoir, and Wise Forebay.

Instream Flow and Lake Level Requirements. The complex physical layout of the project minimum flow requirements have been established at many points to protect the fisheries resources (Table 4.4-28). Article 27 of the FERC License requires maintenance of fish handling facilities such as fish traps and fish protective devices. Additionally, minimum reservoir levels have been established, either formally through FERC-agency consultations or informally through Pacific Gas and Electric Company's management of the facilities, that help to maintain the fisheries resources of the project lakes. Fish habitat in the vicinity of the project includes cold-water stream habitat in the Yuba River, Bear River, and numerous other project streams and surrounding tributaries. In addition, Lake Spaulding, Lake Fordyce, and a large number of other project reservoirs and smaller impoundments provide habitat for lake dwelling warm and cold-water fish species (see Table 4.4-28). The South Yuba-Bear River project supports 12 native and 23 introduced fish species (see Table 4.4-28).

Table 4.4-28 Drum Regional Bundle – Drum-Spaulding Project (FERC 2310) Fish Species Occurrence by Location

Location	Minimum Streamflow/ Reservoir Level Requirements[a]	Wakasagi	Fall-run chinook salmon	Rainbow trout	Eagle Lake trout	Columbia River redband trout	Lahontan cutthroat trout	Brown trout	Brook trout	Speckled dace	Tui chub	Sacramento pikeminnow	Golden shiner	Lahontan redside	Brown bullhead	Green sunfish	Largemouth bass
Canyon Creek from Texas Creek confluence downstream to the confluence with South Fork Yuba River	None			X				X									
Upper Rock Lake[b]	None			X					X								
Texas Creek from Upper Rock Lake downstream to Lower Rock Lake	7/1-9/30: 0.10 cfs			X													
Lower Rock Lake[b]	None			X				X	X								
Texas Creek from Lower Rock Lake downstream to confluence with Canyon Creek	7/1-9/30: 0.10 cfs			X				X									
Culbertson Lake	None			X	X	X			X		X			X			X
Culbertson Lake release into unnamed tributary downstream to confluence with Texas Creek	Year round: 0.30 cfs			X													
Upper Lindsey Lake (*aka* View Lake)[b]	None			X		X	X	X	X				X				X
Lindsey Creek between Upper and Middle Lindsey Lakes	None			X				X									
Middle Lindsey Lake[b]	None			X				X	X				X		X		X
Middle Lindsey Lake release into Lindsey Creek downstream to confluence with Lower Lindsey Creek	7/1-9/30: 0.10 cfs			X				X	X				X		X		
Lower Lindsey Lake[b]	None			X		X		X	X				X		X		X
Lower Lindsey Lake release into Lindsey Creek downstream to confluence with Texas Creek	Year round: 0.20 cfs			X				X									
Upper Feeley Lake[b]	None			X					X						X		

Table 4.4-28 Drum Regional Bundle – Drum-Spaulding Project (FERC 2310) Fish Species Occurrence by Location

Location	Minimum Streamflow/ Reservoir Level Requirements[a]	Wakasagi	Fall-run chinook salmon	Rainbow trout	Eagle Lake trout	Columbia River redband trout	Lahontan cutthroat trout	Brown trout	Brook trout	Speckled dace	Tui chub	Sacramento pikeminnow	Golden shiner	Lahontan redside	Brown bullhead	Green sunfish	Largemouth bass
Upper Feeley Lake release into Lake Creek downstream to Lower Feeley Lake	Year round: 0.20 cfs			X											X		
Lower Feeley Lake (*aka* Carr Lake)[b]	None			X				X	X				X		X		
Lower Feeley Lake release into Lake Creek downstream to confluence with Fall Creek	Year round: 0.20 cfs			X				X	X				X				
Blue Lake[b]	None			X	X	X		X							X		
Blue Lake release into Rucker Creek downstream to Rucker Lake	Year round: 0.20 cfs			X				X									
Rucker Lake[b]	None			X				X							X		
Rucker Lake release into Rucker Creek downstream to Bowman Canal Diversion	Year round: 0.20 cfs			X				X									
Rucker Creek downstream Bowman Canal Diversion downstream to confluence with South Fork Yuba River	None			X				X									
Fuller Lake	None			X				X	X						X		
Unnamed creek out of Fuller Lake downstream to confluence with Jordan Creek	None			X				X									
Jordan Creek from end of unaffected reach to confluence with South Fork Yuba River	None			X				X									
Clear Creek to confluence with Fall Creek	None			X				X									
Fall Creek from Lake Creek confluence to confluence with South Fork Yuba River	None			X				X									
White Rock Lake[b]	None			X		X			X		X						
White Rock Creek from White Rock Lake to confluence	None			X													

Table 4.4-28 Drum Regional Bundle – Drum-Spaulding Project (FERC 2310) Fish Species Occurrence by Location

Location	Minimum Streamflow/ Reservoir Level Requirements[a]	Wakasagi	Fall-run chinook salmon	Rainbow trout	Eagle Lake trout	Columbia River redband trout	Lahontan cutthroat trout	Brown trout	Brook trout	Speckled dace	Tui chub	Sacramento pikeminnow	Golden shiner	Lahontan redside	Brown bullhead	Green sunfish	Largemouth bass
with North Creek																	
North Creek from confluence with White Rock Creek to Fordyce Lake	None			X													
Lake Sterling[b]	None			X		X		X	X		X						
Unnamed creek from Lake Sterling to Fordyce Lake	None			X				X									
Meadow Lake[b]	690 af			X			X		X								
Unnamed creek from Meadow Lake to Fordyce Lake	None			X													
Fordyce Lake	None			X		X		X	X								
Fordyce Creek from Fordyce Lake to Lake Spaulding	Year round: five cfs; three cfs when Fordyce Lake is at lowest winter storage of 3000 af			X				X									
Upper Peak Lake[b]	None			X											X		
Lower Peak Lake[b]	None			X											X		
Unnamed creek from Lower Peak Lake to confluence with South Fork Yuba River	None			X													
Kidd Lake[b]	None			X					X						X		
Unnamed creek between Kidd Lake and confluence with South Fork Yuba River	None			X													
South Fork Yuba River from the confluence with unnamed creek from Kidd Lake to Lake Spaulding	None			X				X									
Lake Spaulding	None	X	X	X				X	X	X	X	X		X	X	X	X
South Fork Yuba River from Spaulding 2 Powerhouse to	Year round: one cfs			X				X									

Table 4.4-28 Drum Regional Bundle – Drum-Spaulding Project (FERC 2310) Fish Species Occurrence by Location

Location	Minimum Streamflow/ Reservoir Level Requirements[a]	Wakasagi	Fall-run chinook salmon	Rainbow trout	Eagle Lake trout	Columbia River redband trout	Lahontan cutthroat trout	Brown trout	Brook trout	Speckled dace	Tui chub	Sacramento pikeminnow	Golden shiner	Lahontan redside	Brown bullhead	Green sunfish	Largemouth bass
Langs Crossing																	
South Fork Yuba River from Langs Crossing to Englebright Reservoir	Year round: five cfs			X				X									
Bear River 0.1 mile from DFG Bear River fish planting base	Year round: five cfs			X				X									
Bear River downstream of Upper Boardmen Canal Diversion Dam to Drum Powerhouse	Year round: one cfs or natural flow, whichever is less			X				X									
Deer Creek Forebay	None																
South Fork Deer Creek from Deer Creek Powerhouse to Scotts Flat Reservoir	None			X				X									
Kelly Lake[b]	None			X		X									X		
Unnamed creek from Kelly Lake to confluence with North Fork of the North Fork American River	None			X													
Lake Valley Reservoir	None			X	X			X	X		X				X		
Lake Valley Reservoir release into North Fork of the North Fork American River[c] to Lake Valley Diversion Dam	10/1-5/31: one cfs 6/1-9/30: three cfs			X				X	X						X		
North Fork of the North Fork American River below Lake Valley Diversion Dam to confluence with North Fork American River confluence	10/1-5/31: one cfs 6/1-9/30: three cfs			X				X							X		
North Fork American River from confluence with North Fork of the North Fork American River to North Fork Lake	None			X				X									
Drum Forebay	Normal water-years: 3/1-9/30: ten cfs; 10/1-2/28-29: five cfs; Dry water-years: five cfs year round																

Table 4.4-28 Drum Regional Bundle – Drum-Spaulding Project (FERC 2310) Fish Species Occurrence by Location

Location	Minimum Streamflow/ Reservoir Level Requirements[a]	Wakasagi	Fall-run chinook salmon	Rainbow trout	Eagle Lake trout	Columbia River redband trout	Lahontan cutthroat trout	Brown trout	Brook trout	Speckled dace	Tui chub	Sacramento pikeminnow	Golden shiner	Lahontan redside	Brown bullhead	Green sunfish	Largemouth bass
Canyon Creek downstream Drum Forebay to Towle Canal Diversion Dam	Year round: one cfs			X													
Canyon Creek downstream of Towle Canal Diversion Dam to confluence with North Fork American River	one cfs or the natural flow, whichever is less			X													
Alta Forebay	None																
Little Bear River from Alta Powerhouse to Dutch Flat Powerhouse	Year round: three cfs			X													
Bear River downstream of Drum Afterbay to Dutch Flat Afterbay	Normal water-years: 3/1-9/30: ten cfs 10/1-2/28: five cfs Dry water-years: five cfs year round			X				X									
Bear River downstream of Dutch Flat Afterbay to Rollins Reservoir	5/1-10/31: ten cfs 11/1-4/30: five cfs			X				X									
Downstream of Halsey Forebay or Afterbay	None																
Bear River downstream of Rollins Reservoir to Lake Combie	Normal water-years: 5/1-10/31: 75 cfs 11/1-4/30: 20 cfs Dry water-years: 5/1-10/31: 40 cfs 11/1-4/30: 15 cfs			X				X									
Halsey Forebay	None																
Unnamed creek from Halsey Forebay to confluence with Dry Creek	None																
Dry Creek from confluence with unnamed creek to Halsey Afterbay	None																

Table 4.4-28 Drum Regional Bundle – Drum-Spaulding Project (FERC 2310) Fish Species Occurrence by Location

Location	Minimum Streamflow/ Reservoir Level Requirements[a]	Wakasagi	Fall-run chinook salmon	Rainbow trout	Eagle Lake trout	Columbia River redband trout	Lahontan cutthroat trout	Brown trout	Brook trout	Speckled dace	Tui chub	Sacramento pikeminnow	Golden shiner	Lahontan redside	Brown bullhead	Green sunfish	Largemouth bass
Halsey Afterbay (*aka* Christian Valley Reservoir)	None																
Dry Creek downstream from Halsey Afterbay to confluence to Coon Creek	None																
Rock Creek Lake	None																
Rock Creek from Rock Creek Lake downstream to confluence with Dry Creek	None																
Wise Forebay	None																
Coon Creek from Dry Creek confluence to East Side Canal	None		X	X									X				
Auburn Ravine from of Wise Canal to confluence with East Side Canal	None		X	X									X				
Downstream of Newcastle Powerhouse	Year round: five cfs																
South Canal from Newcastle Powerhouse to Folsom Reservoir	None																
Clear Creek (near Fall-Lakes Creek)	Unimpaired. Watershed lands.							X									
Fall Creek	Unimpaired. Watershed lands.			X				X									
Headwaters of Trap Creek	Unimpaired. Watershed lands.																
Trap Creek (diversion below Bowman-Spaulding Tunnel)	Unimpaired. Watershed lands.																
Rucker Creek downstream Rucker Lake	Unimpaired. Watershed lands.							X									
Rucker Creek below Bowman-Spaulding Canal diversion	Unimpaired. Watershed lands.							X									
Jordan Creek headwaters to confluence with Lake Spaulding spillway	Unimpaired. Watershed lands.																
Jordan Creek downstream from conduit (below Fuller Lake) flows into South Yuba River Canal	Unimpaired. Watershed lands.																

Table 4.4-28 Drum Regional Bundle – Drum-Spaulding Project (FERC 2310) Fish Species Occurrence by Location

Location	Minimum Streamflow/ Reservoir Level Requirements[a]	Wakasagi	Fall-run chinook salmon	Rainbow trout	Eagle Lake trout	Columbia River redband trout	Lahontan cutthroat trout	Brown trout	Brook trout	Speckled dace	Tui chub	Sacramento pikeminnow	Golden shiner	Lahontan redside	Brown bullhead	Green sunfish	Largemouth bass
North Fork of the North Fork American River flowing from Lake Valley Dam	Unimpaired. Watershed lands.			X				X									
Bear River headwaters to Upper Boardmen Canal Diversion Dam	Year-round: five cfs			X				X									
Stump Canyon	Unimpaired. Watershed lands.																
Steephollow Creek upstream confluence with Bear River	Unimpaired. Watershed lands.							X									
Rock Creek above Rock Creek Lake	Unimpaired. Watershed lands.																

a Minimum stream flow/lake level requirement are listed under the mandated FERC license. Formal agreements made with CDFG are also listed.

b Article 39 was amended April 16, 1998 for the Texas-Fall Creek watershed minimum flow releases to read as the following:

Release Point	Period	Target Flow	Allowable Minimum
Upper Rock Lake	7/1-9/30	.25	.10
Lower Rock Lake	7/1-9/30	.25	.10
Middle Lindsey Lake	7/1-9/30	.25	.10
Lower Lindsey Lake	All Year	.50	.20
Feeley Lake	All Year	.50	.20
Carr Lake	All Year	.50	.20
Blue Lake	All Year	.50	.20
Rucker Lake	All Year	.50	.20
Culbertson Lake	All Year	.75	.30

c Culbertson Lake was chemically treated in 1957 tui chub and green sunfish.

In addition to the FERC regulations, the California State Water Resources Control Board (SWRCB) granted permit 20253 on August 3, 1988 that established minimum instream flows in north fork of the North Fork American River below Lake Valley Diversion Dam (PG&E Co., 1989d).

Aquatic Habitat. Fish habitat in the vicinity of the project includes coldwater stream habitat in the Yuba River, Bear River, and numerous other project streams and surrounding tributaries. In addition, Lake Spaulding, Lake Fordyce, and a large number of other project reservoirs and smaller impoundments provide warmwater and coldwater lake habitat. Several species of trout are found in the large high-country reservoirs (PG&E Co., 1994d). The Drum-Spaulding project contains a variety of fish species including rainbow and brown trout, largemouth bass, smallmouth bass, bullhead, and various species of sunfish (FPC, 1969). Trout are typically the dominant species in the project streams. Minimum flows in portions of the project have been established to protect fisheries resources. Article 27 of the FERC License requires maintenance of fish handling facilities such as fish traps and fish protective devices.

Unless otherwise noted, the following background information was provided from Pacific Gas and Electric Company's three study of the Texas-Fall Creeks minimum flow (PG&E Co., 1995b). Texas Creek below Upper Rock Lake is located at an elevation of 6,700 feet. The stream is characterized by a rocky, steep channel, limited riparian vegetation, and correspondingly very little shade. Because Upper Rock Lake is a broad shallow impoundment and subject to solar heating, Texas Creek is likely subject to elevated summer stream temperatures. The stream generally is poor trout habitat with little spawning gravel. No fish were found in this reach during the 1995 survey. However, Texas Creek below Lower Rock Lake, located at an elevation of 6,615 feet, supports a native fishery. The stream channel is deeply carved with numerous falls and cascades.

Lindsey Creek below Middle Lindsey Lake is located at an elevation of 6,430 feet. The upper section has a low gradient, with braided channels running through thick alder groves. The lower section is a steep bedrock channel with falls and cascades. Golden shiners, rainbow trout, and brook trout were observed in this stream reach. However, due to the wide, shallow nature of Middle Lindsey Lake, water temperatures in the upper reaches of the stream may be too warm for trout. Lindsey Creek below Lower Lindsey Lake is located at an elevation of 6,225 feet. Riparian vegetation along this reach is extremely dense making access to the stream difficult. Lindsey Creek does support a population of large brown trout.

Lake Creek below Feeley Lake is located at an elevation of 6,700 feet. This stream drops steeply between Feeley and Carr Lakes and is surrounded by dense riparian vegetation. Lake Creek below Carr Lake is located at an elevation of 6,650 feet. The first 0.25 mile below the dam has a low gradient with long, sand-bottomed pools. Rainbow, brook, and brown trout, and golden shiner inhabit this stream. The brown and rainbow trout were found in the lowest 0.25-mile section of the stream.

Rucker Creek below Blue Lake is located at an elevation of 5,910 feet. The stream is a high gradient with numerous cascades and pools in a densely forested area. About 1,100 feet above its mouth at Rucker Lake, a water supply diversion dam blocks any upstream fish movement; however, no fish were observed in the stream during survey efforts. The lack of spills from Blue Lake in recent years may explain the absence of fish. Rucker Creek below Rucker Lake is located at an elevation of 5,550 feet. Green sunfish and brown bullhead were observed during survey efforts. In spite of relatively warm stream temperatures and potential competition with green sunfish, this stream section appears to maintain rainbow and brown trout populations.

At the upper end of the Drum-Spaulding system, Fordyce Creek flows into Fordyce Lake (spillway elevation 6,405 feet). Water is released from Fordyce Lake into Fordyce Creek. FERC License Article 39 stipulates that a minimum flow of 5 cfs must be met unless storage in Fordyce Lake falls below 3,000 af. When this occurs three cfs is the minimum flow (PG&E Co., 1999d). Annual average discharge from Fordyce Creek into Lake Spaulding is approximately 131 cfs (PG&E Co. 1999d). Lake Spaulding serves as the primary water regulation and storage reservoir for the upper portion of the Drum-Spaulding Project (PG&E Co., 1999d). Lake Spaulding (spillway elevation 5,000 feet) has a storage capacity of 74,773 af. The reservoir itself sustains habitat for both cold and warm-water fish species (Table 4.4-28). Located immediately below Lake Spaulding are Spaulding 1 and 2 powerhouses. Water enters both of these directly from Lake Spaulding. Discharged water from Spaulding 1 enters the Drum Canal which supplies water to the lower portion of the Drum-Spaulding Project. Water discharged from Spaulding 2 enters the South Yuba Canal and is then conveyed 20 miles to the Deer Creek Powerhouse. Water is also released from Spaulding 2 to meet required minimum instream flows in the South Yuba River. FERC License Article 39 requires a minimum flow of 1 cfs below the Spaulding 2 Powerhouse and 5 cfs at Langs Crossing approximately one mile downstream.

Lake Valley Reservoir and Kelly Lake located in the American River Watershed are part of an interbasin water transfer. Water released from Lake Valley Reservoir is diverted at the Lake Valley Diversion Dam into the Lake Valley Canal, eventually discharging into the Drum Canal. The Drum Canal is located downstream of Lake Spaulding (PG&E Co., 1999d). Lake Valley Reservoir has a drainage area of approximately 4.75-square miles and maximum water surface elevation of 5,853 ft at the dam crest. The capacity of the reservoir is approximately 7,964 af (PG&E Co., 1989d). Lake Valley Reservoir mainly sustains a coldwater fishery (Table 4.428). A SWRCB permit (#20253) requires Pacific Gas and Electric Company to "conduct fish population sampling in the vicinity of the Lake Valley Diversion Dam to assess whether or not significant numbers of fish are being diverted into Lake Valley Canal" (PG&E Co, 1989d).

The headwaters of the Bear River are physically close to Lake Spaulding; only a small ridge separates the two basins. It is because of this physical relationship that it is feasible to transport water from the Drum and Spaulding canals to the Deer Creek and Drum powerhouses on the upper Bear River. FERC License Article 39 sets minimum flow requirements in the Bear River below the

Drum Afterbay of 10 cfs March through September and 5 cfs October through February (PG&E Co., 1999d). Agreements between Pacific Gas and Electric Company and CDFG also establish a minimum flow in Little Bear River below the Alta Powerhouse of 1 cfs or the unimpaired flow in Canyon Creek, whichever is less (PG&E Co., 1999d). Additionally, the South Yuba Canal spills excess water into the Bear River. This release is used to make up the FERC required minimum flow of 5 cfs. Water released from the Dutch Flat and Chicago Park powerhouses enters Rollins Reservoir. Rollins Reservoir stores up to approximately 66,000 af of water and controls releases into the Bear River from this point downstream (PG&E Co., 1999d).

Fisheries resources in this area are not well documented. No reports of surveys describing the aquatic habitat of the Bear River Watershed have been found during this effort. Fish species reported within the project area include brown and rainbow trout (Table 4.4-25). Rollins Reservoir is primarily a cold-water fishery.

Special-Status Species

The Drum-Spaulding Project supports a wide array of fish species, 12 native and 23 introduced fish species (see Table 4.4-28). Fish species found within the project include rainbow and brown trout, largemouth bass, smallmouth bass, bullhead, and various species of sunfish (FPC, 1969). Several species of trout are found in the large high-country reservoirs (PG&E Co., 1994d). Trout are typically the dominant species in the project streams. However, no special-status species have been reported from the streams above Englebright Reservoir (Table 4.4-25).

A query of the California Native Diversity Database for the project, covering the area within the FERC project boundary and a one-mile buffer around it, produced no sighting records of any special-status species (CNDDB, 2000).

Fisheries Management

CDFG currently stocks certain reservoirs and stream reaches throughout the Drum-Spaulding Project (Table 4.4-28). The project is regulated by guidelines found in the Sierra District of the California sport fishing regulations 2000 guidelines. The daily bag and possession limits, unless otherwise provided, mean the total number of trout and salmon in combination. The regulations state that all lakes and reservoirs except those listed by name in the Special Regulations are open to fishing all year with a daily bag limit of five fish per day and a possession limit of ten. The regulations state that all streams except anadromous waters and those listed by name in the Special Regulations have an open fishing season beginning the last Saturday in April through November 15. The daily bag limit is five per day and a possession limit of ten. At Bear River and tributaries from Highway 20 south (downstream) 2.5 miles to the abandoned concrete dam (the Boardman Diversion Dam) open season is from the last Saturday in April through November 15 with a maximum size limit of 14 inches total length. The daily bag limit is five per day and a possession limit of ten.

Bundle 12: Chili Bar

Chili Bar (FERC 2155)

Drainage Basin and Water Sources. The Chili Bar Project is located on the South Fork American River (SFAR) in El Dorado County. The headwaters of the SFAR originate near Echo Summit at an elevation of approximately 7,500 feet. The drainage area within the SFAR watershed that is used by the Chili Bar project is 598 square miles, as measured directly below the project dam (USGS, 1997).

The lands within the project boundary experience a typical Mediterranean-type climate: warm, dry summers alternate with cool, wet winters. Most precipitation occurs between November and May in the form of thunderstorms in lower elevations. Average temperature ranges between 57.6 and 110°F (14.2 to 43.3°C) with an average precipitation of 43.97 inches (PG&E Co., 1999d).

Reservoirs. Chili Bar Reservoir is the only reservoir owned by Pacific Gas and Electric Company (PG&E Co., 1999d).

Instream Flow and Lake Level Requirements. Minimum flow requirements below Chili Bar Dam have been set by FERC to 100 cfs (Table 4.4-26). FERC Article 27 amended ramping rate requirements and states that “controllable discharge changes shall be gradual and no greater than 550 cfs per hour from 100 to 1,000 cfs, and not to exceed one foot in elevation during any one hour period above 1,000 cfs, except during natural spill conditions" (FERC, 1992c). River stage changes are measured at a control point downstream from Chili Bar Dam by the stream gauge installed under the supervision of the USGS.

Aquatic Habitat. Information regarding fisheries resources within the Chili Bar Project is limited. There are both cold water and warm water fish species within the project area (Table 4.4-29). Because Chili Bar Project has not recently been re-licensed, Pacific Gas and Electric Company has not conducted any recent fisheries studies in the project area (PG&E Co., 1999d). Fish identified below the Chili Bar Powerhouse include introduced kokanee and brown trout, and the native rainbow trout and riffle sculpin (Table 4.4-29).

Special-Status Species. Fish identified below the Chili Bar Powerhouse include introduced kokonee and brown trout and native rainbow trout and riffle sculpin (Table 4.4-29). The hardhead is the special-status species that has been documented as occurring within the Chili Bar project. A query of the CNDDB for the project, covering the area within the FERC project boundary and a one-mile buffer around it, produced no sighting records of special-status fish species (CNDDB, 2000) (Table 4.4-25).

Fisheries Management. The CDFG currently does not stock any waters in the Chili Bar project. The project is covered by regulation for the Sierra District of the California sport fishing regulations 2000 guidelines. The daily bag and possession limits, unless otherwise provided, mean

Table 4.4-29 Drum Regional Bundle - Chili Bar Project (FERC 2155) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Requirements	Kokanee	Rainbow trout	Brown trout	California roach	Hardhead	Sacramento pikeminnow	Riffle sculpin
South Fork American River downstream of White Rock Powerhouse[a]	None		X	X	X	X	X	
Chili Bar Reservoir	None		X	X			X	
South Fork American River downstream of Chili Bar Powerhouse	Year round: 100 cfs	X	X	X	X	X	X	X

a FERC License Article 27 amending ramping rate requirements states controllable discharge changes shall be gradual and no greater than 550 cfs per hour from 100 to 1000 cfs, and not to exceed one foot in elevation during any one hour period above 1000 cfs, except during natural spill conditions.

the total number of trout and salmon in combination. The regulations state that all lakes and reservoirs except those listed by name in the Special Regulations are open for fishing all year with a daily bag limit of five per day and a possession limit of ten fish. The regulations state that all streams except anadromous waters and those listed by name in the Special Regulations have an open season beginning the last Saturday in April through November 15. The daily bag limit is five per day and a possession limit of ten fish.

The segment of river between Chili Bar Dam and Folsom Lake State Recreation area, a 19 mile long reach, is considered to have Outstandingly Remarkable Values (ORVs) (California Segments, 2000). This river section contains both recreation and history ORVs. This segment is the most popular boating stream in California (Section 4.6, Recreation). It also is widely used for fishing, swimming, camping, and gold panning. This segment of river flows through Marshal Gold Discovery State Park. This was the 1848 discovery site that ignited the California Gold Rush (California Segments, 2000).

4.4.4.4 Motherlode Regional Bundle

Regional Setting

The Motherlode Regional Bundle is located in Amador, Calaveras, Alpine, Tuolumne, Merced and Mariposa counties. The closest towns to the Motherlode Regional Bundle are Jackson, Sonora and, Murphys. The system is located on four rivers: the North Fork Mokelumne; South Fork Stanislaus; Middle Fork Stanislaus; and the Merced. Lying southwest of Lake Tahoe and northwest of Mono Lake, the Motherlode Region drains the area west of Mt. Reba-Bear Valley (PG&E Co., 1999c) along the western slope of the Sierra Nevada Mountain Range from 8,500 feet to 600 feet in elevation. The area contains 27 dams, 257,117 af of usable reservoir storage, 17.6 miles of canals, 20.2 miles of flumes, 27.7 miles of tunnels, and eight powerhouses (PG&E Co., 1999c).

Pacific Gas and Electric Company owns approximately 6,900 acres in the Motherlode Regional Bundle (PG&E Co., 1999c). These lands are typically located in remote areas that are rich in biological resources. There are four FERC-licensed projects within the region: the Mokelumne River project (FERC 0137), the Spring Gap-Stanislaus project (FERC 2130), the Phoenix project (FERC 1061), and the Merced Falls project (FERC 2467). These projects lie across two national forests, the Eldorado (Amador Ranger District) and the Stanislaus (Calaveras, Summit, and MiWok Ranger Districts) national forests.

A variety of fish and other species are found in the Motherlode Watershed (Table 4.4-30). Several sensitive species are found in project waters, including the Kern Brook lamprey (*Lampeira hobbsi)*, Lahontan cutthroat trout (*O. clarki henshaw*), hardhead, and the San Joaquin roach (*Hesperoleucus symmetricus symmetricus)*.

This section discusses local regulations and policies pertaining to aquatic resources found in the region, instream flow/lake level requirements, current fisheries management practices, and special-status species found within the project.

Local Regulations and Policies

The Motherlode Regional Bundle is located in Amador, Calaveras, Alpine, Tuolumne, Merced, and Mariposa counties. Each county's General Plan strives to maintain the quantity and quality of water resources for multiple beneficial uses, including fisheries and aquatic resources. The above counties by their policies attempt to maintain and enhance habitat for fish and wildlife species. The counties strive to maintain good water quality, minimize water pollution and minimize erosion caused by development. Specifics of each general plan are addressed in more detail at the FERC project level if appropriate.

Portions of the Motherlode Regional Bundle assets are either adjacent to or completely surrounded by the El Dorado National Forest and Stanislaus National Forest. Both El Dorado and Stanislaus national forests are managed by the USFS and have Land and Resource Management Plans (LRMPs). The LRMPs provide direction for planning and conducting resource management activities on National Forest land. The goals of these plans are, among others, to monitor and protect habitat for Federally-listed threatened, endangered, and candidate species, provide for continued use and new development of hydroelectric facilities, and expand recreational fisheries opportunities. The LRMP goals for both National Forests generally relating to lands and land use include: (1) maintain and enhance habitat for fish and wildlife; (2) maintain stable watershed conditions by limiting the area, degree of soil disturbance, and amount of vegetation removal; (3) maintain water quality of streams and lakes according to the identified beneficial uses

Table 4.4-30 Distributional Checklist of the Fishes of the Motherlode Regional Bundle by Pacific Gas and Electric Company Project

Species	Mokelumne River (FERC 0137)	Spring Gap-Stanislaus (FERC 2130)	Phoenix (FERC 1951)	Merced Falls (FERC 2467)
Petromyzontidae (Lamprey Family)				
Kern Brook lamprey (*Lampetra hubbsi*)				X
Clupeidae (Herring Family)				
Salmonidae (Salmon and Trout Family)				
Chinook salmon (*Oncorhynchus tshawytscha*)				
Kokanee (*Oncorhynchus nerka kennerlyi*)	X	X		
Rainbow trout (*Oncorhynchus mykiss irideus*)	X	X	X	X
Eagle Lake trout (*Onchorhynchus mykiss aquilaram*)	X			
Columbia River redband trout (*Oncorhynchu mykiss gairdneri*)	X			
Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*)	X			
Brown trout (*Salmo trutta*)	X	X	X	
Brook trout (*Salvelinus fontinalis*)	X	X		X
Lake trout (*Salvelinus namaycush*)	X			
Cyrinidae (Minnow Family)				
California roach (*Hesperoleucus symmetricus symmetricus*)	X	X	X	
Hitch (*Lavinia exilicauda*)	X	X	X	
Speckled dace (*Rhinichthys osculus*)	X			
Tui chub (*Gila bicolor*)	X	X		
Hardhead (*Mylopharodon conocephalus*)	X	X		
Sacramento pikeminnow (*Ptychocheilus grandis*)	X	X		
Carp (*Cyprinus carpio*)	X			
Lahontan redside (*Richardsonius egregius*)	X			
Fathead minnow (*Pimephales promelas*)				
Catostomidae (Sucker Family)				
Sacramento sucker (*Catostomus occidentalis)*	X	X	X	
Ictaluridae (Catfish Family)				
Brown bullhead (*Ictalurus nebulosus*)		X	X	
Channel catfish (*Ictalurus punctatus*)	X			
White catfish (*Ictalurus catus*)	X		X	X

Table 4.4-30 Distributional Checklist of the Fishes of the Motherlode Regional Bundle by Pacific Gas and Electric Company Project

Species	Mokelumne River (FERC 0137)	Spring Gap-Stanislaus (FERC 2130)	Phoenix (FERC 1951)	Merced Falls (FERC 2467)
Centrarchidae (Sunfish Family)				
Green sunfish (*Lepomus cyanellus*)	X	X	X	X
Black crappie (*Pomoxis nigromaculatus*)	X			X
Largemouth bass (*Micropterus salmoides*)			X	
Redeye bass (*Micropterus coosae*)			X	
Cottidae (Sculpin Family)				
Riffle sculpin (*Cottus gulosus*)	X	X		
Total Fish Taxa	**22**	**13**	**10**	**6**

established by the California State Water Resources Control Board's Regional Basin Plans; (4) direct improvement and maintenance activities to enhance fisheries resources.

Bundle 13: Mokelumne River

Mokelumne River (FERC 0137)

The Mokelumne River project, which includes the Tiger Creek Hydro Service Center, lies within the North Fork Mokelumne River (NFMR) Basin, in Alpine, Amador, and Calaveras counties. The Mokelumne River originates on the west slope of the central Sierra Nevada. The Mokelumne River's main artery is the NFMR, which begins at an elevation of about 9,700 feet near Arnot Peak (elevation 10,054 feet) and Hiram Peak (elevation 9,793 feet). It is the largest of the Mokelumne River branches. The NFMR reach occupies 60 miles from its source to the Electra Powerhouse Diversion Dam (elevation 2,047 feet). The drainage area within the NFMR basin utilized by the project amounts to 365 square miles, as determined directly below the most downstream diversion facility, Electra diversion dam (USGS, 1997). Many of the project's storage and diversion reservoirs are located on tributaries that flow south to the NFMR.

Reservoirs. The following reservoirs are associated with the bundle: Upper Blue Lake, Lower Blue Lake, Twin Lakes, Meadow Lake, Upper Bear River Reservoir, Lower Bear River Reservoir, Salt Springs Reservoir, Tiger Creek Regulator, Forebay and Afterbay, Lake Tabeaud, Electra Diversion Reservoir, and Electra Afterbay.

Instream Flow and Lake Level Requirements. The complex physical layout of the Mokelumne River Project, the presence of special-status species issues, and power generation requirements have resulted in complex minimum flows associated with project facilities (Table 4.4-31). An agreement reached in 1996 between CDFG and Pacific Gas and Electric Company established minimum flows

Table 4.4-31 Motherlode Regional Bundle - Mokelumne River (FERC 0137) Fish Species Occurrence by Location

Location	Minimum Stream Flow/ Reservoir Level Required[a]	Kokanee	Rainbow trout	Eagle Lake trout	Columbia River redband trout	Lahontan cutthroat trout	Brown trout	Brook trout	Lake trout	California roach	Hitch	Speckled dace	Tui chub	Hardhead	Sacramento pikeminnow	Carp	Lahontan redside	Sacramento sucker	Channel catfish	White catfish	Green sunfish	Black crappie	Riffle sculpin
Upper Blue Lake	None		X		X	X		X															
Upper Blue Lake release to Middle Blue Creek downstream to Lower Blue Lake	Normal year: 5/1-10/31: two cfs Dry year: two cfs or natural flow Normal or dry year: 1/1-4/30: two cfs or natural flow		X			X	X	X				X					X						
Lower Blue Lake	None		X	X	X	X		X															
Lower Blue Lake release to Blue Creek downstream to Deer Creek confluence	Normal year: 5/1-10/31: 15 cfs Dry year: 7.5 cfs Normal or dry year: 11/1-4/30: two cfs or natural flow		X			X	X	X				X					X						
Deer Creek from Blue Creek confluence to North Fork Mokelumne River confluence	None		X				X																
North Fork Mokelumne River from Deer Creek confluence downstream to Meadow Creek confluence	None		X			X	X	X															

Table 4.4-31 Motherlode Regional Bundle - Mokelumne River (FERC 0137) Fish Species Occurrence by Location

Location	Minimum Stream Flow/ Reservoir Level Required[a]	Kokanee	Rainbow trout	Eagle Lake trout	Columbia River redband trout	Lahontan cutthroat trout	Brown trout	Brook trout	Lake trout	California roach	Hitch	Speckled dace	Tui chub	Hardhead	Sacramento pikeminnow	Carp	Lahontan redside	Sacramento sucker	Channel catfish	White catfish	Green sunfish	Black crappie	Riffle sculpin
Twin Lake	1,207 af					X		X				X											
Meadow Lake	1,207 af		X			X		X															
Meadow Lake release to Meadow Creek downstream to North Fork Mokelumne River confluence	5/1-10/31: five cfs 11/1-4/30: two cfs or natural flow					X		X															
North Fork Mokelumne River from Meadow Creek confluence downstream to Salt Springs Reservoir	None		X			X	X	X															
Cole Creek from Bear River Tunnel to Tiger Creek Tunnel	Year round: two cfs or natural flow		X																				
Cole Creek downstream of Tiger Creek Tunnel to confluence with North Fork Mokelumne River	Year round: two cfs or natural flow		X																				
Upper Bear Reservoir	500 af		X		X																		
Lower Bear Reservoir	3,300 af	X	X	X			X	X	X				X										

Table 4.4-31 Motherlode Regional Bundle - Mokelumne River (FERC 0137) Fish Species Occurrence by Location

Location	Minimum Stream Flow/ Reservoir Level Required[a]	Kokanee	Rainbow trout	Eagle Lake trout	Columbia River redband trout	Lahontan cutthroat trout	Brown trout	Brook trout	Lake trout	California roach	Hitch	Speckled dace	Tui chub	Hardhead	Sacramento pikeminnow	Carp	Lahontan redside	Sacramento sucker	Channel catfish	White catfish	Green sunfish	Black crappie	Riffle sculpin
Lower Bear Reservoir release to Bear River downstream to Tiger Creek Canal Diversion	Normal year: 5/1-10/31: four cfs 11/1-4/30: two cfs Dry year: Year round: two cfs-		X				X																
Bear River from Tiger Creek Canal Diversion downstream to North Fork Mokelumne River confluence	Normal year: 3/1-6/30: tem cfs 7/1 – 2/28: four cfs Dry year: Year round: four cfs		X				X																
Salt Springs Reservoir	4,993 af		X				X			X	X		X							X	X		
Salt Springs Reservoir release to North Fork Mokelumne River downstream to confluence with Bear River	Normal year: 3/1-10/31: 30 cfs 11/1-2/28: 20 cfs Dry year: Year round: two cfs; Unimpaired watershed lands:		X				X																

Table 4.4-31 Motherlode Regional Bundle - Mokelumne River (FERC 0137) Fish Species Occurrence by Location

Location	Minimum Stream Flow/ Reservoir Level Required[a]	Kokanee	Rainbow trout	Eagle Lake trout	Columbia River redband trout	Lahontan cutthroat trout	Brown trout	Brook trout	Lake trout	California roach	Hitch	Speckled dace	Tui chub	Hardhead	Sacramento pikeminnow	Carp	Lahontan redside	Sacramento sucker	Channel catfish	White catfish	Green sunfish	Black crappie	Riffle sculpin
North Fork Mokelumne River from Bear River confluence downstream to Panther Creek confluence	Normal year: 5/1-10/31: 40 cfs 11/1-4/30: 20 cfs Dry year: Year round: 20 cfs		X				X																
Beaver Creek from Tiger Creek Canal to Bear River confluence	Year round: 0.5 cfs or natural flow		X				X																
East Panther Creek from Tiger Creek Canal downstream to West Panther Creek confluence	Normal year: 5/1-10/31: three cfs or natural flow 11/1-4/30: 1.5 cfs or natural flow Dry year: Year round: 1.5 cfs or natural flow		X				X																
West Panther Creek from Tiger Creek Canal downstream to East Panther Creek confluence	Year round: 1.5 cfs or natural flow		X				X																
Panther Creek from the confluence of East and West Panther creeks downstream to the North Fork Mokelumne River confluence	East and West Panther creeks combined flows																						
Tiger Creek Regulator	100 af		X				X																

Table 4.4-31 Motherlode Regional Bundle - Mokelumne River (FERC 0137) Fish Species Occurrence by Location

Location	Minimum Stream Flow/ Reservoir Level Required[a]	Kokanee	Rainbow trout	Eagle Lake trout	Columbia River redband trout	Lahontan cutthroat trout	Brown trout	Brook trout	Lake trout	California roach	Hitch	Speckled dace	Tui chub	Hardhead	Sacramento pikeminnow	Carp	Lahontan redside	Sacramento sucker	Channel catfish	White catfish	Green sunfish	Black crappie	Riffle sculpin
Tiger Creek Forebay	None		X				X																
North Fork Mokelumne River from Panther Creek confluence downstream to Tiger Creek Afterbay	None		X				X																
Tiger Creek from Tiger Creek Regulator Afterbay to Tiger Creek	Normal year: 5/1-10/31: ten cfs 11/1-4/30: five cfs Dry year: Year round: five cfs		X				X																
Tiger Creek Reservoir	None		X				X																
North Fork Mokelumne River from Tiger Creek Afterbay to Electra Diversion Dam	Normal year: 3/1-6/30: 50 cfs 7/1-10/31: 22 cfs maximum and 18 cfs minimum 11/1-2/28: ten cfs Dry year: Year round: ten cfs		X				X								X			X					

Table 4.4-31 Motherlode Regional Bundle - Mokelumne River (FERC 0137) Fish Species Occurrence by Location

Location	Minimum Stream Flow/ Reservoir Level Required[a]	Kokanee	Rainbow trout	Eagle Lake trout	Columbia River redband trout	Lahontan cutthroat trout	Brown trout	Brook trout	Lake trout	California roach	Hitch	Speckled dace	Tui chub	Hardhead	Sacramento pikeminnow	Carp	Lahontan redside	Sacramento sucker	Channel catfish	White catfish	Green sunfish	Black crappie	Riffle sculpin
Mokeluemne River from Electra Diversion Dam downstream to Electra Powerhouse	Normal year: 5/1-10/31: 15 cfs 11/1-4/30: ten cfs Dry year: Year round: ten cfs		X				X			X		X			X			X					X
Lake Tabeaud	None		X	X			X	X								X						X	
Mokelumne River from Electra Powerhouse downstream to Pardee Reservoir	None	X	X				X							X	X	X		X	X				
Unnamed creek from Granite Lake to Upper Blue Lake	Unimpaired. Watershed lands																						
Deer Creek	Unimpaired. Watershed lands		X				X																
Cole Creek	Unimpaired. Watershed lands		X				X																
Little Bear River tributary to Lower Bear Reservoir	Unimpaired. Watershed lands		X				X																
Unnamed creek flowing to Lower Bear Reservoir	Unimpaired. Watershed lands																						

Table 4.4-31 Motherlode Regional Bundle - Mokelumne River (FERC 0137) Fish Species Occurrence by Location

Location	Minimum Stream Flow/ Reservoir Level Required[a]	Kokanee	Rainbow trout	Eagle Lake trout	Columbia River redband trout	Lahontan cutthroat trout	Brown trout	Brook trout	Lake trout	California roach	Hitch	Speckled dace	Tui chub	Hardhead	Sacramento pikeminnow	Carp	Lahontan redside	Sacramento sucker	Channel catfish	White catfish	Green sunfish	Black crappie	Riffle sculpin
Shriner Lake	Unimpaired. Watershed lands		X				X																
North Fork Mokelumne River	Unimpaired. Watershed lands		X				X																
Camp Creek	Unimpaired. Watershed lands		X				X																

a cfs = cubic feet/second
af = acre-feet

within the project that are generally higher than minimum flows set by FERC (Table 4.4-31) (PG&E Co., 1996c). Water year classifications (WYC) of normal or dry are based on cumulative precipitation through April or May at Salt Springs Reservoir (PG&E Co., 1996c). WYCs are used to determine the minimum streamflow requirements at locations throughout the system. A summary of these requirements in presented below:

- Minimum flows in Blue Creek from Upper Blue Lake to the confluence with Deer Creek range from 15 to two cfs or natural (unimpaired) flow depending on the location. Year round FERC recommended minimum flows in Blue Creek are two cfs.
- Minimum flows in Meadow Creek from Meadow Lake ranges from one cfs to five cfs or natural flow depending on the WYC and the specific location. FERC minimum flow requirements within this reach are two cfs or natural flow year round for a normal or dry year (PG&E Co., 1996c).
- The NFMR above Salt Springs Reservoir is not subject to the 1996 Agreement for minimum flows. In the NFMR below the Salt Springs reservoir minimum flows are set to between five and 30 cfs depending on the WYC and the specific location (PG&E Co., 1996c).
- Minimum flows in Cole Creek from Cole Creek Lakes to the confluence with the NFMR are either two cfs or natural flow, whichever is less. FERC has the same minimum flow requirements (Woodward-Clyde, 1987).
- Minimum flows in the Bear River from Lower Bear Reservoir to the confluence with the NFMR range from two to four cfs based on the WYC (PG&E Co., 1996c). FERC has no minimum flows in the reach below Tiger Creek Canal and the same requirements as the 1996 Agreement above the Tiger Creek Canal (PG&E Co., 1996c).
- Minimum flows are set to 0.5 cfs year round regardless of WYC in Beaver Creek below the Tiger Creek Canal Diversion. FERC has no flow requirements for this reach (PG&E Co. and CDFG, 1996).
- In East Panther Creek below Tiger Creek Canal, the agreement requires between 1.5 and three cfs depending on the WYC (PG&E Co., 1996c). FERC has no flow requirements for this reach.
- In Tiger Creek below the Tiger Creek Regulator Reservoir minimum flows range between five and ten cfs depending on the time of year and the WYC (PG&E Co., 1996c). FERC has no minimum flow requirements for this reach.
- Minimum flows in the NFMR below Tiger Creek Afterbay range from TEN to 22 cfs depending on the season, specific location, and the WYC (PG&E Co., 1996c). These requirements are the same as those mandated by FERC.

In addition to the minimum streamflow requirements discussed above, the agreement between Pacific Gas and Electric Company and CDFG stipulates minimum storage volumes in Twin Lakes, Upper and Lower Bear reservoirs, Salt Springs Reservoir, and in Tiger Creek Regulator (PG&E Co., 1996c). In general, these minimum flows are greater than those required by FERC and have been developed in concert with CDFG to protect the fisheries resources found within the Mokelumne River Project.

Fish Fauna. There are known to be 12 native and ten introduced fish in the Mokelumne River Project (Table 4.4-31). The species composition and relative abundance of the fish community in the tributaries leading into, and including, the North Fork Mokelumne River was dominated by trout, particularly brook trout, rainbow trout and brown trout. The only reach where trout were not included in the dominant assemblage of species was in the mainstem Mokelumne River above the Electra Powerhouse. At this section, Sacramento pikeminnow, Sacramento sucker, California roach and speckled dace were abundant and rainbow trout were found to be relatively uncommon.

Aquatic Habitat. Salt Springs Reservoir, Lower Bear River Reservoir, and numerous Mokelumne River project impoundments provide reservoir habitat for coldwater species. Rainbow, brown, brook, and cutthroat trout dominate the fish communities of both streams and reservoirs within the project, especially in the upper reservoirs (Amador Co., 1987). Many of the populations are self-sustaining, but are augmented by CDFG stocking programs. No anadromous fish presently utilize project waters, although introduced kokanee salmon migrate from Pardee Reservoir upstream into the segment of river above and below the Electra Powerhouse. Fish ladders are not provided on project facilities (PG&E Co., 1981b), but fish passage openings through the stoplogs at Electra Afterbay Dam are designed to increase the opportunity for upstream passage of migrating fish (PG&E Co., 1996c). Non-game fish species in the project include Sacramento sucker, Sacramento pikeminnow, tui chub, and hitch (Amador County, 1987).

The Mokelumne River and its tributaries provide primarily coldwater stream habitat. However, warmwater habitat also occurs in the river near Electra Powerhouse. In its first mile, the NFMR has a very steep gradient of about 1,100 feet per mile. The average gradient in the next ten miles is about 160 feet per mile, and in the following 27 miles to Salt Springs Reservoir, the average gradient is 111 feet per mile.

Garcia and Associates (2000) studied the distribution and abundance of benthic macroinvertebrate fauna and fish populations within the NFMR drainage. Specific reaches were studied and are assumed as being representative throughout the project. The following descriptions were provided from Garcia and Associates study unless otherwise noted. For each reach, information is provided about the habitat for the Benthic Macroinvertebrate (BMI) sampling and the fish sampling locations. For each of the regulated sites, flows are indicated from the 1996 Pacific Gas and Electric Company/CDFG Fish & Wildlife Agreement (PG&E Co., 1996c).

Within the Blue Creek and Meadow Creek drainage basins, the Upper and Lower Blue lakes and Twin and Meadow lakes are classical examples of glacial step lakes. These lakes are covered by ice and a deep snowpack in winter. Blue Creek between Upper and Lower Blue lakes contains an average stream gradient of 53 feet per mile. Riparian cover consists mainly of scattered willow shrubs. Substrate of the Upper Blue Creek sample site consisted of rubble (25 percent), gravel (30 percent) and sand (30 percent). The fish habitat within this section was composed of low-gradient riffle (40 percent), pool (ten percent), and grassy meadow run (50 percent). Fishing pressure was assumed to be moderate to heavy because the site was near a readily accessible campground (Garcia and Associates, 2000). Blue Creek upstream of the confluence with Deer Creek has a stream gradient of two percent. Dense foliage hangs over the stream margins providing shade to the creek. The substrate composition within the sample site consisted mainly of rubble (20 percent), gravel (30 percent), and boulder (30 percent). The site consisted of low-gradient riffle (60 percent) run (20 percent) habitats, and ended at a large cascade pool (20 percent). The area is difficult to access; therefore, fishing pressure was assumed to be light or non-existent (Garcia and Associates, 2000).

Meadow Creek between Twin and Meadow lakes is at an elevation of 8,080 feet with an average stream gradient of 185 feet per mile (Horciza, 1998, pg. 9). The site included low-gradient riffle (ten percent), pool (20 percent), and grassy meadow run (70 percent) habitats. The substrate within this site consisted of gravel (40 percent) and sand (40 percent). This section was located next to a road, and fishing pressure was assumed to be moderate. Meadow Creek downstream of Meadow Lake is located at an elevation of 7,560 feet with a stream gradient of three percent. The substrate consisted of rubble (35 percent), sand (30 percent), and boulder (20 percent). The stream reach consisted of low-gradient riffle (50 percent), pool (20 percent), and meadow run (30 percent) habitats. Access is difficult and so fishing pressure is presumed to be virtually non-existent.

The sampling site on the NFMR was located at an elevation of 4,080 feet with a stream gradient of two percent. The site substrate was composed primarily of boulder (65 percent) and the stream reach consisted of riffle (65 percent), run (20 percent), and pool (15 percent) habitats. Difficult access was assumed to limit fishing pressure.

The site on the NFMR below the Salt Springs reservoir reach is located at the confluence with Cole Creek at an elevation of 3,360 feet. Stream gradient within the area is one percent and this site consisted primarily of boulder (60 percent) substrate. The stream reach consisted of pool (20 percent), run (20 percent), and riffle (60 percent) habitats. This site is easy to access, so fishing pressure is presumed to be moderate to heavy.

Cole Creek originates at the outflow of Cole Creek Lakes at an elevation of 8,000 feet and flows about ten miles to the confluence with the NFMR. The average gradient of Cole Creek in its first 2.5 miles is approximately 280 feet per mile. In the next 1.5 miles, the average gradient is a steep 730 feet per mile. The next seven miles consist of an average gradient of 100 feet per mile, which then increases to an average gradient of 940 feet per mile to the Tiger Creek Canal Diversion (Horciza, 1998, pg. 11). The substrate consists mostly of bedrock and boulders with some sand and gravel along the stream margins. Cascades and pools are the dominant habitat types.

The Bear River above the Tiger Creek Canal is located at an elevation of 3,760 feet. The substrate consisted of boulder (60 percent) and bedrock (20 percent). The site consisted of a boulder riffle (40 percent), pool (50 percent), and run (ten percent) habitats. Fishing pressure was assumed to be light in this area. Lower Bear River upstream NFMR and below Tiger Creek Canal is located at an elevation of 3,100 feet. The majority of the substrate consisted of boulder and rubble material. The site pool (20 percent), run (20 percent), and riffle (60 percent) habitats were found on the site. Fishing pressure was presumed to be moderate.

The Beaver Creek headwaters are at an elevation of 5,600 feet and the creek flows over four miles to the NFMR. The stream has a steep gradient and the habitat reflects this, consisting primarily of cascades and short pools, with few riffles. The substrate is primarily bedrock and boulder with some sand and silt in the short pools and along the stream margins. The stream is heavily shaded throughout (Woodward-Clyde, 1987).

The headwaters of West Panther Creek originate at an elevation of about 5,800 feet and flow some six miles in a southwesterly direction to join East Panther Creek and to form the Panther Creek mainstem. The mainstem then continues 1.5 miles to the confluence with the NFMR. West Panther Creek has a moderate gradient with steep hillsides along the stream. The channel is heavily shaded. The habitat consists of alternating pools and riffles with some cascades. The substrate is largely boulder, cobble, and gravel with some bedrock outcrops; some sand and silt is present in the slower reaches of the stream (Woodward-Clyde, 1987).

The headwaters of East Panther Creek originate at an elevation of about 6,200 feet and flow about seven miles to its confluence with West Panther Creek. The gradient of the stream is moderate and much of the stream is heavily shaded. The habitat consists mostly of alternating pools and riffles. The substrate is composed primarily of cobble and gravel along with some boulders and occasional outcrops of bedrock. Sand and silt are present in the deeper pools and along the stream margins.

Tiger Creek below Tiger Creek Regulator Reservoir is located at an elevation of 3,480 feet and flows through a moderate gradient of three percent to the confluence with the NFMR. The substrate consists primarily of rubble (40 percent) and bedrock (20 percent) materials. The composition of habitat is low-gradient riffle (50 percent), run (30 percent), and pool (20 percent). The site is adjacent to a road and therefore, fishing pressure was assumed to be moderate to heavy.

The NFMR below Tiger Creek Afterbay site is located at an elevation of 2,100 feet. Stream gradient in the area is 1 percent and riparian cover is limited due to the bedrock composition of the riverbanks. The substrate was composed of equal portions of bedrock (35 percent), boulder (30 percent), and rubble (20 percent). The instream habitat consisted mostly of pool (75 percent), run (20 percent), and riffle (five percent). Fishing pressure was presumed to be moderate because the area was relatively easy to access.

The NFMR below West Point Powerhouse site is located at 1,920 feet. Stream gradient in the area is two percent and riparian cover is low because of the bedrock composition of the riverbanks. The substrate was composed of approximately equal parts boulder (35 percent) and rubble (30 percent) materials. The instream habitat consisted of pool (40 percent), run (35 percent), and riffle (25 percent). Fishing pressure was presumed to be low because of relatively difficult access.

The Mokelumne River above Electra Powerhouse site is located at an elevation of 800 feet. A stream gradient of one percent typifies this reach. Riparian vegetation was sparse through the reach. The substrate was composed of boulder (40 percent) and rubble (25 percent). Instream habitat consisted of pool (70 percent) and riffle (30 percent). The site was relatively easy to access; however, because of a low abundance of popular sport fish, fishing pressure is likely low.

Special-Status Species. Three special-status species are located in project waters: Lahontan cutthroat trout, hardhead, and San Joaquin roach (Table 4.4-32). Each of these species is discussed below.

Populations of Lahontan cutthroat trout occur in Marchall Canyon creek on the Stanislaus National Forest. However, streams in which the trout reside are all well upstream of project facilities.

Therefore, Lahontan cutthroat trout are not directly affected by the operations of the Mokelumne River project.

Hardhead is a CDFG species of special concern and a USFS sensitive species (CNDDB, 2000). In the Mokelumne River Project, hardhead can be found downstream of the Electra Powerhouse on the NFMR. Historically, hardhead was an abundant and widespread species (Reeves, 1964). In general, hardhead is less abundant than it once was, especially in the southern half of its range. Hardhead prefer large to medium-sized, cool to warm-water streams with natural flow. However, these types of streams are increasingly dammed and diverted, thus removing habitat, isolating upstream areas, and creating temperature and flow regimes unfavorable for hardhead. Consequently, populations are decreasing or disappearing throughout its range. The combination of habitat alteration and specialized habitat requirements has led to localized, isolated populations that are exposed to localized extinctions (Moyle, et al 1995).

In the past, hardhead has been sufficiently plentiful in reservoirs. They were assumed to compete with trout and other game fish and were regarded as undesirable. Most of the reservoir populations proved to be temporary, presumably the result of colonization of the reservoir by juvenile hardhead before introduced predators became established (Moyle et al, 1995).

The California roach is divided into eight different populations depending on its region of residence. The San Joaquin roach is found in the tributaries of the San Joaquin River south of the Consumnes River. Within the NFMR, San Joaquin roach can be found above the Electra Powerhouse and in Salt Springs Reservoir. The San Joaquin roach is assigned to a Class 3 status rating (Moyle et al, 1995). Watch list 3 species are those that were historically more abundant or have limited distributions. California roach usually prefer small, warm intermittent streams, and dense populations are frequently found in isolated pools (Moyle et al, 1995). Most populations flourish in mid-elevation streams in the Sierra foothills and in the lower reaches of some coastal streams.

Table 4.4-32 Special-Status Fish Species That Occur in the Motherlode Regional Bundle

Family Name Common Name (*Scientific Name*)	State/Federal Designations[a]	Status of Occurrence by Project			
		Mokelumne (FERC 137)	Spring Gap-Stanislaus (FERC 2130)	Phoenix (FERC 1061)	Merced Falls (FERC 2467)
Petromyzontidae (Lamprey Family)					
Kern Brook lamprey (*Lampetra hubbsi)*	CSC/FSC				Downstream of Merced Falls Reservoir in the Merced River[c]
Salmonidae (Salmon and Trout Family)					
Lahontan cutthroat trout (*Oncorhynchus clarki henshawi)*	--/FT	Stocked for Angling[b]			
Cyprinidae (Minnow Family)					
Hardhead (*Mylopharodon conocephalus*)	CSC/FSS	Known to occur in the Mokelumne River downstream of Electra Powerhouse	Known to occur upstream of Lyons Reservoir in the South Fork Stanislaus River		

a Designation Abbreviations:
-- = No designation
State Designations
CSC = California Special Concern species
Federal Designations
FSS = Forest Service Sensitive species
FT = Federal Threatened species
FSC = Federal Special Concern species

b Response to August 19, 1997 Additional Information Request (AIR), Federal Energy Regulatory Commission (FERC) Prepared April 1998, Item #7.

c Pacific Gas and Electric Company, 1999. PEA Volume 6.

Surveys conducted by Moyle and Nichols (1974), and repeated by Brown and Moyle (1993), indicate an abundance of the roach in many areas, yet it has declined in many others since 1970 (Moyle et al, 1995). Populations of this subspecies are becoming increasingly isolated due to the construction of dams, diversions, artificial barriers, predation, and habitat destruction (Moyle et al, 1995).

Fisheries Management. California Department of Fish and Game currently stocks Lahontan cutthroat, brown, rainbow, and eagle lake trout for recreational purposes (Table 4.4-31). The Mokelumne River project is covered by the Sierra District in the California sport fishing regulations year 2000 guidelines. The daily bag and possession limits, unless otherwise provided, mean the total number of trout and salmon in combination. The regulations state that all lakes and reservoirs except those listed by name in the Special Regulations are open all year for sport fishing with a daily bag limit of five fish per day and a possession limit of 10 fish. The regulations state that all streams except anadromous waters and those listed by name in the Special Regulations have an open fishing season beginning the last Saturday in April through November 15; the daily bag limit is five fish per day and a possession limit of ten fish.

In 1982 and 1993, the Stanislaus National Forest proposed the North Fork Mokelumne River as a Wild and Scenic river from Highland Lakes to Salt Springs Reservoir, a distance of 27 miles (USFS, 1991). The area from Salt Springs Reservoir downstream to Bruce Crossing, a distance of ten miles, was potentially classified as a wild river section in 1993. Bruce Crossing down to the Stanislaus National Forest boundary at Section 19, T.7N, R.14 E., M.D.M. a distance of seven miles, was potentially classified as a wild river section in 1993 (California Segments, 2000). To date, Congress has not classified the latter areas as Wild and Scenic. However, Stanislaus National Forest is currently required to manage the proposed area as if it were a Wild and Scenic river (Maschi, 2000).

Bundle 14: Stanislaus River

The Stanislaus River bundle consists of two FERC licenses: the Spring Gap-Stanislaus project (FERC 2130), and the Phoenix Project (FERC 1061). The Spring Gap-Stanislaus project consists of Relief Reservoir, Strawberry Reservoir (Pinecrest), and Stanislaus Forebay on the Middle Fork Stanislaus River. The Phoenix project consists only of Lyons Reservoir on the South Fork Stanislaus River.

Spring Gap-Stanislaus (FERC 2130)

The Spring Gap-Stanislaus project is located in Tuolomne County. This project lies within the Middle Fork and South Fork Stanislaus Rivers, two branches of the Stanislaus River that drain the western slope of the Sierra Nevada mountain range. The project consists of two hydroelectric generating facilities, with powerhouses located on the Middle Fork Stanislaus River (MFSR), the Stanislaus River, and an interbasin transfer between the South Fork and Middle Fork Stanislaus River.

The bulk of this project’s facilities are located between the low San Joaquin Valley and the high Sierra Nevada Mountains and capture water in the MFSR. The headwaters of the MFSR lie along the Sierra Nevada crest at an elevation of approximately 10,000 feet. Project facilities are located in the lower portion of the MFSR basin, with a drainage area of 332 square miles, as determined directly downstream of the Sand Bar Diversion Dam (USGS, 1997). The Spring Gap facility captures water in the South Fork Stanislaus River (SFSR) basin and diverts it to the MFSR. The headwaters of the SFSR lie in the Emigrant Wilderness at an elevation of approximately 8,200 feet. The drainage area for the portion of the basin captured by the Spring Gap facility is 48.5 square miles, as determined from a point directly downstream of the Philadelphia Diversion Dam (USGS, 1997).

Instream Flow and Lake Level Requirements. The physical layout of the Spring Gap-Stanislaus Project, the presence of special-status species, and power generation requirements have resulted in complex minimum flows associated with project facilities (Table 4.4-33). A summary of these requirements for minimum discharges are presented below:

- Below Relief Reservoir, minimum flows range from five to ten cfs depending on the time of year.
- Below Beardsley Reservoir, minimum streamflows range between 50 and 135 cfs depending on the type of water year (PG&E Co., 1999c).
- Below the Sand Bar Diversion Dam FERC mandated minimum flows range from 25 to 50 cfs depending on the time of year.
- The Philidelphia reach, located downstream of the Philadelphia Diversion Dam on the SFSR is subject to FERC license required minimum flows between three and six cfs.

Reservoirs within the project are also subject to FERC regulations regarding minimum storage. Pinecrest Lake has a FERC specified minimum pool elevation of 5,508.7 feet, approximately ten feet above the Strawberry Dam outlet structure. Similarly, Relief Reservoir minimum pool elevation is set to five feet above the outlet structure.

Fish Fauna. Fish populations supported by project waters are mostly of coldwater species. Some warmwater habitat is present within the lower elevation areas. The higher elevation reaches usually provide the coldwater habitat, such as the reaches from Relief Reservoir to about 6.5 miles downstream of Sand Bar Diversion Dam on the MFSR, and from Pinecrest Lake downstream to midway between Philadelphia Diversion Dam and Lyons Reservoir (see Table 4.4-33).

Warmwater habitat is present in Pinecrest Lake, the lower elevation reaches of the MFSR just above the confluence with NFSR, the lower elevation reaches of SFSR just above Lyons Reservoir, and the Stanislaus River above New Melones Reservoir (see Table 4.4-33). There are known to be seven native and six introduced fish species in the Spring Gap-Stanislaus project (see Table 4.4-29).

CDFG stocking records indicate that rainbow trout have been stocked in this reservoir and that rainbow and brook trout have been stocked in Upper and Lower Relief lakes. The reach downstream of Relief Reservoir to Donnells Reservoir is heavily stocked by CDFG with catchable rainbow and brown trout to support a recreational fishery.

Fish populations were monitored each year by CDFG in the Beardsley Afterbay reach from 1984 to 1989. Since 1989, CDFG has conducted population surveys at this site every three years. Rainbow trout, brown trout, and riffle sculpin were the only species reported (PG&E Co., 1999c). On October 4, 1985, the CDFG Commission designated the MFSR from Beardsley Afterbay Dam to Sandy Bar Diversion Dam a “Wild Trout Stream” due to the excellent rainbow and brown trout fishery. The Spring Gap reach (Spring Gap Powerhouse to Sandy Bar Diversion Dam) is expected to support fish populations similar to those in the Beardsley Afterbay reach (Beardsley Afterbay Dam to Sandy Bar Diversion Dam).

Table 4.4-33 Motherlode Regional Bundle - Spring Gap-Stanislaus Project (FERC 2130) Fish Species Occurrence by Location

Location	Minimum Stream Flow/Reservoir Level Required[a]	Kokanee	Rainbow trout	Brown trout	Brook trout	California roach	Hitch	Tui chub	Hardhead	Sacramento pikeminnow	Sacramento sucker	Brown bullhead	Green sunfish	Riffle sculpin
Strawberry (Pinecrest) Reservoir	5508.7 af; after 9/15 drawn down to minimum storage[b]	X	X	X	X	X	X	X			X	X	X	
South Fork Stanislaus River from Strawberry Dam downstream to Philadelphia Diversion Dam	None; three cfs; voluntary minimum release		X	X										
South Fork Stanislaus River from Philadelphia Diversion Dam downstream to Lyons Reservoir	5/1-10/31: six csf 11/1-4/30: six csf		X	X		X			X		X	X		
Relief Reservoir	five feet above outlet structure[c]		X		X									
Middle Fork Stanislaus River from Relief Reservoir downstream to confluence to Donnells Reservoir	Normal year: 5/1-10/31: ten csf 11/1-4/30: five csf Dry year and year round: five csf		X	X										X
Deadman Creek	Unimpaired. Watershed lands		X											
Middle Fork Stanislaus River from Beardsley Afterbay downstream to Spring Gap Powerhouse	Norm year: 135 cfs[g] Dry year: 50 cfs		X	X										X
Middle Fork Stanislaus River from Spring Gap Powerhouse to Sand Bar Diversion Dam	Variable up to 60 cfs		X	X										
Middle Fork Stanislaus River from Sand Bar Diversion Dam downstream to the confluence with the North Fork Stanislaus River[h]	Normal year: 5/1-10/31: 50 cfs 11/1-4/30: 25 cfs Dry year and Year round: 25 cfs		X	X		X				X	X			X
Confluence of the North Fork Stanislaus River and Middle Fork Stanislaus River downstream to the Stanislaus Powerhouse Afterbay	None		X	X		X				X	X			

Table 4.4-33 Motherlode Regional Bundle - Spring Gap-Stanislaus Project (FERC 2130) Fish Species Occurrence by Location

Location	Minimum Stream Flow/Reservoir Level Required[a]	Kokanee	Rainbow trout	Brown trout	Brook trout	California roach	Hitch	Tui chub	Hardhead	Sacramento pikeminnow	Sacramento sucker	Brown bullhead	Green sunfish	Riffle sculpin
North Fork Stanislaus River from Stanislaus Powerhouse Afterbay to South Fork Stanislaus River confluence	None		X	X		X				X	X			
Stanislaus River from South Fork Stanislaus River confluence to New Melones Lake	None		X	X		X				X	X			

a cfs = cubic feet/second
af = acre-feet

b FERC License Article 29 states: "The licensee shall, consistent with operational demands, maintain the maximum water surface elevation in Strawberry Reservoir during the period from June 1 to September 15 and maintain a minimum pool of about ten acres with a depth of not less than ten feet at all other times, except under emergency conditions".

c The reservoir is filled during spring runoff and is full or near full by June and/or July. After July, the reservoir is drawn down uniformly to minimum pool level by late December. There are no specific agreements that govern the rate at which Pacific Gas and Electric Company draws Relief Reservoir down in the fall or refills it in the spring.

d Stream flows typically exceed 100 cfs during the summer months due to releases from Relief Reservoir.

g Outside of the zone of potential effect. FERC addressed aquatic resources in this reach of the Middle Fork Stanilaus River when it issued the Sand Bar Project license to Tri-Dams in 1986.

h FERC established a 50 cfs summertime minimum release from the Sand Bar Diversion Dam designed to maintain acceptable temperatures for trout in the upper two-thirds of the diverted reach of the Middle Fork Stanilaus River.

Monitoring of the Sandy Bar Dam reach (Sandy Bar Diversion Dam to NFSR) from 1984-1989 was conducted by CDFG. (Pert, 1991) studied the short and long-term response of fishes to altered flow regimes in the Middle Fork Stanislaus River. Results of this effort documented use of the area by six species: rainbow trout, brown trout, riffle sculpin, Sacramento pikeminnow, Sacramento sucker and California roach (Pert, 1991).

Fish species documented by CDFG in Pinecrest Lake include rainbow trout, brown trout, brown bullhead, golden shiner, hitch, Sacramento sucker, and kokanee. Brown trout stocking was discontinued around 1942 and kokanee were first planted in 1944. In 1968, Pinecrest Lake was treated with rotenone to remove large populations of roach, chubs, hitch, golden shiners, and brown bullheads that were to adversely affect angling quality in Pinecrest Lake. In 1986, introduction of chinook salmon to Pinecrest Lake was approved by CDFG; however, there are no records that indicate that this plant was ever made. CDFG records also indicate a "chub" or "roach" was present; however, CDFG notes are unclear regarding which species are actually present. Some subspecies of the California roach are currently considered a special-status species. Although it is unclear if this species resides in the Pinecrest Lake, FERC guidelines appear to be sufficient for maintenance of suitable habitat for the fish.

Aquatic Habitat. Unless otherwise noted, the following background information was provided from the First Stage Consultation Document for the Spring Gap-Stanislaus project (PG&E Co., 1999h). Relief Reservoir is located on Summit Creek at an elevation of 7,343 feet. The reservoir is near the headwaters of the MFSR on the northern edge of the Emigrant Wilderness. The reservoir has a surface area of 223 acres, a gross storage capacity of 15,558 acre-feet, and drains 24.3-square miles. The reservoir is generally operated to capture spring runoff and is subsequently drawn down each year throughout the summer and fall. The normal minimum pool is at 7,213 feet elevation, which is approximately 5 feet above the outlet structure of the reservoir. Relief Reservoir is open to year-round fishing and has a daily bag and possession limit of five trout.

Middle Fork Stanislaus River. The Relief reach is approximately 15.8 miles long and extends from the Relief Dam (elevation 1,343 feet) along Summit Creek and the MFSR stream to Donnells Reservoir (elevation 4,916 feet). The reach has a moderate overall gradient of 2.9 percent.

The Beardsley Afterbay reach is approximately 1.6 miles long and extends from Beardsley Afterbay Dam (elevation 3,120 feet) to Spring Gap Powerhouse (elevation 2,980 feet). The reach has an overall gradient of 1.7 percent and is outside the area of Zone of Potential Effect (ZPE). CDFG sport fishing regulations indicate that the reach downstream of Beardsley Afterbay Dam is open to fishing from the last Saturday in April through November 15, and only artificial lures with barbless hooks may be used. Trout must be a minimum size of 14 inches (total length) and a bag limit of two trout.

The Spring Gap reach is approximately 2.6 miles long and extends from the Spring Gap Powerhouse (elevation 2,980 feet) on the MFSR downstream to Sand Bar Diversion Dam (elevation 2,752 feet). The reach has an overall gradient of 1.8 percent. Water discharges from Spring Gap Powerhouse into the MFSR range from 0 to 60 cfs, depending on water availability, instream flow releases below Philadelphia Diversion Dam, and power generation needs. The discharges from Spring Gap Powerhouse into the MFSR are in addition to the minimum instream flow requirements below Beardsley Afterbay.

The Sand Bar Dam reach is approximately 12.3 miles long and extends from Sand Bar Diversion Dam (elevation 2,275 feet) on the MFSR to the confluence with the NFSR (elevation 1,230 feet). The overall gradient is approximately 2.3 percent.

South Fork Stanislaus River. Pinecrest Lake is located at an elevation of 5,617 feet on the SFSR near the town of Strawberry. The reservoir has a surface area of 300 acres, a gross storage capacity of 18,312 af, and drains 26.6-square miles. The reservoir is generally operated to capture spring runoff and is usually as operational throughout the summer for recreation. After September 15, the reservoir can be drawn down to its minimum storage to prepare for winter storms and following spring snowmelt. Pinecrest Lake is not normally drawn down to minimum pool; the degree to which it is drawn down is primarily governed by Pacific Gas and Electric Company’s forecast of precipitation and snowmelt runoff.

Pinecrest reach is approximately 3.9 miles long and extends from the base of Strawberry Dam (elevation 5,499 feet) on the SFSR to Philadelphia Diversion Dam (elevation 4,949 feet). Overall gradient is approximately 2.7 percent. Trout fishing in this segment is open year-round with a daily bag and possession limit of five fish.

Philadelphia reach is approximately 8.5 miles long and extends from Philadelphia Diversion Dam (elevation 4,949 feet) on the SFSR to the upper end of Lyons Reservoir (elevation 4,229 feet). Overall gradient is approximately 1.6 percent. Trout fishing in this stream segment is open year-round with a daily bag and possession limit of five fish.

Special-Status Species

Three special-status species could occur in the Stanislaus River project: Lahontan cutthroat trout, hardhead, and San Joaquin roach (Table 4.4-32).

Protected populations of Lahontan cutthroat trout occur on Disaster Creek, a tributary to the Clarks Fork, which is a tributary to the MFSR. This is within the vicinity of the project; however, the streams where the populations reside are upstream of the project and not directly affected by the operations of the Stanislaus River project.

Hardhead is a CDFG species of special concern and a USFS sensitive species (CNDDB, 2000). In the Stanislaus-Spring Gap Project, hardhead can be found in the upper sections of the SFSR above Lyons Reservoir. Historically, hardhead was an abundant and widespread species (Reeves, 1964). In general, hardhead is less abundant than it once was, especially in the southern half of its range. Hardhead prefer large to medium-sized, cool to warm-water streams with natural flow. However, these types of streams are increasingly dammed and diverted, thus removing habitat, isolating upstream areas, and creating temperature and flow regimes unfavorable for hardhead. Consequently, populations are decreasing or disappearing throughout its range. The combination of habitat alteration and specialized habitat requirements has led to localized, isolated populations that are exposed to localized extinctions (Moyle et al, 1995).

In the past, hardhead has been sufficiently plentiful in reservoirs. They were assumed to compete with trout and other game fish and were regarded as an undesirable. Most of the reservoir populations proved to be temporary, presumably the result of colonization of the reservoir by juvenile hardhead before introduced predators became established (Moyle et al, 1995).

The California roach is divided into eight different populations depending on the region in which it resides. The San Joaquin roach is found in the tributaries of the San Joaquin River from the Consumnes River south. In the project area, they can be found in Strawberry Reservoir and the lower MFSR below Sandy Bar Diversion. San Joaquin roach is assigned to a Class 3 status rating which signifies it as a watch list species. (Moyle, et al, 1995). Watch list 3 species are those that were historically more abundant or have limited distributions. California roach prefer small, warm intermittent streams, and concentrated populations are frequently found in isolated pools (Moyle, et al, 1982.). Most populations flourish in mid-elevation streams in the Sierra foothills and in the lower reaches of some coastal streams.

Surveys conducted by Moyle and Nichols, (1974) and repeated by Brown and Moyle (1993) indicate that this subspecies is abundant in many areas, yet it has declined in other areas since 1970. (Moyle et al, 1995.) Populations of this subspecies are becoming increasingly isolated due to the construction of dams, diversions, artificial barriers, predation, and habitat destruction. (Moyle et al, 1995).

Fisheries Management

The CDFG currently stocks rainbow trout in selected areas within the Stanislaus River project (Table 4.4-33). The introduction of non-native fish species most likely has had significant impacts, as noted by Moyle et al, (1995), on the abundance and distribution of fish in the Sierra Nevada. CDFG has heavily stocked the MFSR and SFSR over the past 60 years. In the past 30 years alone, CDFG has stocked over 5 million fish in the MFSR and SFSR (about 50,000 fish per mile). CDFG records reveal that from 1970 through 1998, more than 3.75 million trout and kokanee were planted in the MFSR or its major tributaries and forks (Table 4.4-33). This number consisted of more than 2.6 million catchable and 877,000 fingerling rainbow trout; 14,000 catchable, 90,000 sub-catchable, and 135,000 fingerling brown trout; and 50,000 fingerling kokanee. (PG&E Co., 1999). Records indicate that most of these fish are planted above Donnells Reservoir.

The Stanislaus Spring-Gap Project is covered by regulations in the Sierra District in the California sport fishing regulations year 2000 guidelines. The daily bag and possession limits, unless otherwise provided, mean the total number of trout and salmon in combination. The regulations state that all lakes and reservoirs except those listed by name in the Special Regulations are open to sport fishing all year with a daily bag limit of five per day and a possession limit of 10 fish. The regulations state that all streams except anadromous waters and those listed by name in the Special Regulations are open for fishing beginning the last Saturday in April through November 15. The daily bag limit is five per day and a possession limit of 10 fish. The Stanislaus River, Middle Fork (Tuolumne Co.) from Beardsley Dam downstream to the USFS footbridge at Spring Gap has an open sport fishing season from the last Saturday in April through November 15. The minimum size limit is 14 inches total length, and only artificial lures with barbless hooks may be used. The daily bag limit is two fish. Beardsley Afterbay is open all year with a minimum size limit of 14 inches total length and only artificial lures with barbless hooks may be used. The daily bag limit is two fish. The USFS footbridge at Spring Gap to New Melones Reservoir including Sand Bar Forebay has an open fishing season starting the last Saturday in April through November 15. The daily bag limit is two fish.

Middle Fork Stanislaus River (MFSR) Wild Trout Management Plan 1986. The Wild Trout section of the MFSR is 4.2 miles long between Beardsley Lake Afterbay and Sand Bar Flat Diversion Dam and ranges in elevation from 3,140 to 2,560 feet. Operation of the project facility directly affects the Wild Trout section. Other streams that could be protected as designated Wild Trout Streams in the future are the entire Middle Fork of the Stanislaus River (from Donnells Lake to New Melones Reservoir) and the Clarks Fork (USFS, 1991). According to the Draft Middle Fork Stanislaus Wild Trout Management Plan:

> The purpose of the Wild Trout Program is to preserve streams in which the trout fisheries are naturally sustained by wild strains of trout rather than being artificially sustained by domesticated, catchable-sized trout. Program emphasis is placed on protecting and enhancing the aquatic habitat to perpetuate natural reproduction as well as to maintain the natural character of the streamside environment in order to provide for a quality angling experience.
>
> It is the purpose of this plan to provide management direction and guidelines for maintaining (or improving where necessary) the integrity and quality of the aquatic and streamside habitat for which the MFSR was designated.
>
> In order to maintain a natural, self-sustaining wild trout fishery in the MFSR, water quality and fish habitat should be at or near "optimum" levels for a mid-elevation stream. (CDFG unpublished draft.)

The Wild Trout section is comprised mostly of natural populations of rainbow trout and introduced brown trout. Riffle sculpin are also found in small numbers.

Other sections of the Middle Fork Stanislaus River are also proposed to be designated Wild and Scenic Rivers. The reach from Relief Reservoir to the Clark Fork confluence is 12 miles long and in 1993 it was proposed to be a Designated Recreational River. This segment also contained Outstandingly Remarkable Values (ORVs) for its scenery, recreation, and geology. The section of river from Sand Bar Flat Diversion Dam to the North Fork Stanislaus confluence, a length of ten miles, was proposed to be a designated Wild River. This segment contained ORVs for its scenery, recreation and wildlife (California Segments, 2000).

Phoenix (FERC 1061)

The Phoenix project is situated approximately ten miles northeast of the city of Sonora in Tuolumne County, California. The Phoenix project uses water within the SFSR drainage, one of the three primary tributaries of the Stanislaus River that drain the west slope Sierra Nevada Mountain Range in Tuolumne County. The headwaters of the SFSR lie in the Emigrant Wilderness at an elevation of approximately 8,200 feet. The drainage area for the portion of the basin upstream of the project water storage facility, Lyons Dam (elevation 4,200 feet), is 66.8 square miles (USGS 1997). Because the project lies downstream of Pacific Gas and Electric Company's Spring Gap-Stanislaus Project (FERC 2130), which diverts water from the SFSR to the MFSR, the volume of water used by the project is not proportional to the size of the upstream basin. Lyons Dam creates Lyons Reservoir on the SFSR. With a 6,224 af usable storage capacity, this reservoir is the source of water for the project. Water is released at the dam into the Main Tuolumne Canal, 15.4 miles of conduit flowing into a header box, penstock, and ultimately Phoenix Powerhouse (elevation 2,600 feet). (FERC, Exhibit E, no date)

The change in terrain and elevation contributes to the variation of precipitation in the region. Precipitation amounts are highest in January and lowest in July. Over 95 percent of the annual average precipitation falls during the period from October through May. Infrequent widely-scattered thunderstorms occur during the summer months and are characterized by intense periods of rainfall for short durations over relatively small areas. Winter precipitation is widespread and prolonged due to the passage of the frontal systems. (FERC, Exhibit E, no date)

The principal water bodies of the Phoenix project are Lyons Reservoir and the South Fork Stanislaus River (SFSR). Lyons reservoir is located in a steep V-shaped canyon underlain by Mesozoic granitic rocks. The SFSR below Lyons reservoir is situated in a deep canyon down to the confluence with the Stanislaus River.

Instream Flow and Lake Level Requirements

FERC License Articles stipulate minimum instream flows with which Pacific Gas and Electric Company must comply. Article 105 establishes minimum flows in the SFSR below Lyons Reservoir that vary from 5 to 10 cfs depending on the type of water year as established by CDWR. Other FERC License articles include Article 404 which mandates a minimum release of 2 cfs or natural inflow to the Philadelphia Diversion, whichever is less. Article 405 limits ramping rates in the SFSR below Lyons Reservoir that must not exceed 50 cfs 50 percent of the existing flow per hour. These ramping rates apply to controlled flows and not to spill conditions. Article 404 is an interesting requirement because flows into the Philadelphia Diversion are partly a function of the operations of Pinecrest Reservoir and the Stanislaus-Spring Gap Project (FERC, 2130).

Fish Fauna

The Phoenix project contains four native and six introduced species of fish (see Table 4.4-34). At least nine species of fish inhabit Lyons Reservoir: brown trout, rainbow trout, hitch, California roach, Sacramento sucker, white catfish, brown bullhead, green sunfish, and largemouth bass (see Table 4.4-34). The upper section of the South Fork Stanislaus River (approximately 3.6 miles downstream from Lyons Reservoir) is dominated by brown and rainbow trout. Sacramento suckers, brown bullhead, and California roach also inhabit this section. Redeye bass (*Micropterus wosae)* dominate the lower section of the South Fork Stanislaus River. California roach, hardhead, and Sacramento sucker also inhabit this section.

Table 4.4-34 Motherlode Regional Bundle - Phoenix Project (FERC 1061)
Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Required[a]	Rainbow trout	Brown trout	California roach	Hitch	Sacramento sucker	Brown bullhead	White catfish	Green sunfish	Largemouth bass	Redeye bass
Lyons Reservoir	None	X	X	X	X	X	X	X	X	X	
South Fork Stanislaus River from Lyons Reservoir to the Main Tuolumne Canal Diversion	Normal year: 10/1-10/31: eight cfs; 11/1-6/30: ten cfs; 7/1-7/30: eight cfs; 8/1-9/30: five cfs; Dry year: five cfs; Year round:										
South Fork Stanislaus River from Tuolumne Canal Diversion downstream to confluence with Stanislaus River	None	X	X	X		X	X				X

a cfs = cubic feet/second

Aquatic Habitat

When Lyons Reservoir becomes thermally stratified during the summer, the trout probably concentrate in the deep water or hypolimnion, where temperatures below 68°F (20°C) occur. Lower temperatures are more suitable to trout (Brown, 1974). CDFG stocked largemouth bass in the Lyons Reservoir in 1975 or 1976 in an effort to develop a warmwater fishery that could utilize the warm surface water or epilimnion (FERC, Exhibit E, no date). Green sunfish and California roach can also be found in Lyons Reservoir (Table 4.4-34).

The South Fork Stanislaus River downstream of Lyons Reservoir can be divided into two sections for descriptive purposes. The upper section extends from the dam to a point approximately 3.6 miles downstream, where the river enters a steep-sided canyon. A thick forest exists in the upper section, and the river is well shaded. The lower section is about 14.9 miles long, extending from the head of the canyon downstream to the confluence with the Stanislaus River. The entire lower section is in this canyon, with little riparian vegetation to shade the stream. Due to high water temperatures, the lower section provides poor trout habitat. Maximum water temperatures were recorded as high as 81.8°F (27.7°C) in early August, which is near the lethal limit for trout (Brown, 1974).

Special-Status Species

Two special-status species could occur in the Phoenix project: hardhead and San Joaquin roach (Table 4-4-32).

Hardhead is a CDFG species of special concern and a USFS sensitive species (CNDDB, 2000). In the Phoenix Project, hardhead can be found in the SFSR above Lyons Reservoir, and likely in the reservoir itself in small numbers. Historically, hardhead was an abundant and widespread species (Reeves 1964). In general, hardhead is less abundant than it once was, especially in the southern half of its range. Hardhead prefer large to medium-sized, cool to warm-water streams with natural flow. However, these types of streams are increasingly dammed and diverted, thus removing habitat, isolating upstream areas, and creating temperature and flow regimes unfavorable for hardhead. Consequently, populations are decreasing or disappearing throughout its range. The combination of habitat alteration and specialized habitat requirements has led to localized, isolated populations that are exposed to localized extinctions (Moyle et al, 1995).

In the past, hardhead has been sufficiently plentiful in reservoirs. They were assumed to compete with trout and other game fish and were regarded as an undesirable. Most of the reservoir populations proved to be temporary, presumably the result of colonization of the reservoir by juvenile hardhead before introduced predators became established (Moyle et al, 1995).

California roach is divided into eight different populations depending on the region in which it resides. San Joaquin roach is found in the tributaries of the San Joaquin River from the Consumnes River south (Moyle et al, 1995). Within the project, roach are found in Lyons Reservoir and the lower SFSR (see Table 4.4-32). San Joaquin roach is assigned to a Class 3 status rating which signifies it as a watch list species (Moyle et al, 1995). Watch list 3 species are those that were historically more abundant or have limited distributions. California roach prefer small, warm intermittent streams, and concentrated populations are frequently found in isolated pools (Moyle et al, 1982). Most populations flourish in mid-elevation streams in the Sierra foothills and in the lower reaches of some coastal streams.

Surveys conducted by Moyle and Nichols (1974) and repeated by Brown and Moyle (1993) indicate that this subspecies is abundant in many areas, yet it has declined from many others since 1970 (Moyle et al, 1995). Populations of this subspecies are becoming increasingly isolated due to the construction of dams, diversions, artificial barriers, predation, and habitat destruction (Moyle et al, 1995).

Fisheries Management

CDFG currently stocks Lyons Reservoir with rainbow trout.

Lyons Reservoir Aquatic Habitat Enhancement Plan. Under License Article 408 for the Phoenix project (FERC 1061) Pacific Gas and Electric Company is required to prepare a fisheries enhancement plan. Pacific Gas and Electric Company, therefore, submitted the Lyons Reservoir Aquatic Habitat Enhancement Plan, which states (PG&E Co., 1994c):

> The purpose of the plan is to improve fishing opportunities for largemouth bass and other warmwater species in Lyons reservoir. Largemouth bass were selected

because they are a desired game fish and their reproductive success and concentrations can be increased when structural elements are added to their habitat. The plans calls for adding structures to the reservoir to concentrate catchable sized fish along the bank near the hiking trail.

Pacific Gas and Electric Company proposes to use logs and rocks to form the structures. Logs of variable length will be selected from logging operation slash on nearby private timberlands. Pacific Gas and Electric Company proposed to install structures in the cove section of the reservoir along the hiking trail. The structures would be put in place in the 68 to 75 foot elevation band. This elevation band is five to 12 feet deep during most of the spring and summer and is the preferred depth of bass in their reservoir (FERC, 1994). Using natural materials and varying sizes of structural configurations will achieve the most natural appearance possible.

A primary consideration in locating the structures is the protection of spawning nests from wind driven wave action. Studies have shown bass nests constructed in areas less than 5 feet deep that were not submerged structures were destroyed by waves. To further enhance the protective benefits of the Lyons Reservoir structures, they will be placed in coves and other protected areas. In addition to protecting nests from destructive wave action, the structures are expected to increase the survival of young largemouth bass by creating hiding cover from predators and by increasing productivity and, ultimately, the food supply for small fish.

Largemouth bass spawn on a wide variety of substrates at an average depth of three feet and prefer nesting areas less than 7 feet deep. However, active nests have been found as deep as 25 feet in some rapidly rising reservoirs. It is assumed bass in Lyons Reservoir usually spawn in May and June as the surface water temperature warms to around 15 degrees C. A profile taken in the reservoir's middle on June 17, 1994 showed temperatures ranging from 20.5 degrees C at the surface to 12.0 degrees C on the bottom at 64 feet deep. Dissolved oxygen (DO) values from the same profile ranged from 9.1 to 6.8 mg/l, indicating D.O. is not limiting fish distribution in the reservoir (PG&E Co., 1994c).

Bundle 15: Merced River

Merced Falls (FERC 2467)

The Merced Falls Project is on the Merced River along the border of Mariposa and Merced counties. While the Merced River headwaters reach elevations of up to 11,000 feet in the Sierra Nevada Mountain Range, the project is located in the lower reaches of the river as it flows into California's San Joaquin Valley. The drainage area above the project is 1,061 square miles, as measured from a point directly downstream of the Merced Falls.

The project lies directly downstream of two large reservoirs owned by the Merced Irrigation District (MID). MID's Exchequer Reservoir (Lake McClure) has a usable storage capacity of 1,024,000 af (PG&E Co., 1998g) providing the major storage and regulation capacity within the system. Pacific Gas and Electric Company has a power purchase contract with MID which enables

Pacific Gas and Electric Company to use MID water from the reservoirs to generate power at Merced Falls Powerhouse. Pacific Gas and Electric Company has a nonconsumptive right to divert up to 2,200 cfs from the Merced River (PG&E Co., 1929). Pacific Gas and Electric Company has no storage rights, so all water entering the Merced Falls Reservoir passes directly from the river, through the powerhouse and back into the river (PG&E Co., 1929). The Merced Falls Reservoir is the only Pacific Gas and Electric Company reservoir on the system and has a usable storage capacity of 603 af. The Merced Powerhouse (3.5 MW) is operated by Pacific Gas and Electric Company as base-load, run-of-the-river facility using water from the reservoir (PG&E Co., 1999c).

Instream Flow and Lake Level Requirements

The FERC License for Merced Falls Project contains several articles that establish minimum flows and facility operations. MID's upstream facilities at the Exchequer Project (FERC 2179) is primarily responsible for releasing minimum flows in the river. Merced Falls License Article 38 requires that Pacific Gas and Electric Company release water in a manner consistent with the requirements for the Exchequer Project. Merced Falls Project Article 35 requires that inflow shall match outfall when flood flows are being released from upstream projects. Because Pacific Gas and Electric Company has no storage rights on the Merced River, water is diverted to the powerhouse from the river and released back into the river.

Aquatic Resources

Table 4.4-35 illustrates the aquatic resources and minimum stream flow/lake level requirements associated with Bundle 15 (Merced River project). The table lists reaches within the bundle that potentially can be impacted from hydrodivestiture. Each reach identifies aquatic species occurring within the bundle and lists minimum stream flow/ lake level requirements, if any. Fish habitat in the vicinity of the Merced Falls Project is primarily coldwater stream habitat in the Merced River and surrounding tributaries. Merced Falls Reservoir also provides additional fisheries habitat for lake dwelling species. There are known to be three native and five introduced fish species in the Merced Falls Project (Table 4.4-35) (CDFG, 2000d). Species include Kern Brook lamprey, Rainbow trout, Crappie, and Green sunfish (Table 4.4-35).

Special-Status Species

For the protection and preservation of fish and wildlife resources of the Merced Falls Project, Pacific Gas and Electric Company coordinates instream flow releases, with those from MID’s upstream reservoirs (PG&E Co., 1999c). A query of the CNDDB, which covered the area within the FERC project boundary and a one-mile buffer around it, resulted in Kern Brook lamprey, a State and Federal species of concern, in the Merced River near Merced Falls Project. This is the only special-status species identified in the Merced River project.

The World Conservation Monitoring Center also lists the Kern Brook lamprey as a lower risk taxon near threatened (CDFG, 2000c). According to Fish Species of Special Concern in California

Table 4.4-35 Motherlode Regional Bundle - Merced Falls Project (FERC 2467) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Required[a]	Kern Brook lamprey	Rainbow trout	Brook trout	White catfish	Green sunfish	Black crappie
Merced Falls Reservoir	three cfs thru fish ladder		X	X	X	X	X
Merced River below Merced Falls Reservoir	Articles 35, 38,40,41, 42[b]	X	X				

a cfs = cubic feet/second

b Article 35 stipulates that when maximum flood control releases are made from MID's upstream Exchequer Project (FERC 2179), the outflow from the Merced Falls Project shall not exceed inflow. While minimum flow releases required at the powerhouse range from 15 to 75 cfs depending upon season and water year type, mean monthly flows measured directly below the powerhouse have ranged from 398 to 2318 cfs between 1925-1966. FERC license Article 38 requires Pacific Gas and Electric Company to release minimum flows from the dam to Merced River that are consistent with those designated in Articles 40, 41, and 42 of the FERC license held by MID for the Exchequer Project. In addition, a 1997 FERC order recommends the continuation of minimum flows.

(Moyle et al, 1995) by CDFG:

> The Kern Brook lamprey was first discovered in the Friant-Kern Canal, but it has also been found in the lower reaches of the Merced River, Kaweah River, Kings River, and San Joaquin River (Brown & Moyle, 1993). Since the species was first discovered in 1976, attempts to fully document its range have been only partially successful. However, data collected to date suggest that this species is a San Joaquin endemic (Brown & Moyle, 1993). Populations of this species are thinly scattered throughout the San Joaquin drainage and isolated from one another (Moyle et al, 1995). Such a fragmented distribution makes local extirpations likely, without hope of recolonization, followed by eventual extinction of the species. The probability of local extirpation is increased by the fact that all known populations are located below dams, where stream flows are regulated without regard to the needs of the lampreys. Fluctuations or sudden drops in flow may isolate or dry up ammocoetes. Gravel needed for spawning may be eliminated or compacted, so adults cannot use it. Ammocoetes may also be carried to "dead-end" habitats such as the Friant-Kern siphons. Clearly, management of flows in the lower reaches of rivers of the San Joaquin drainage will need to consider the needs of this lamprey in order for the species to persist (Moyle et al., 1995).

Fisheries Management

California Department of Fish and Game currently stocks brook trout in Merced Falls Reservoir (Table 4.4-32) (CDFG, 1999). The regulations State that Merced Falls Reservoir is open to sport fishing all year with a daily bag limit of five fish per day and a possession limit of ten fish.

4.4.4.5 Kings Crane-Helms Regional Bundle

Regional Setting

The Pacific Gas and Electric Company hydropower projects of the Kings Crane-Helms Regional Bundle are situated in four river basins. Crane Valley Project (FERC 1354) is primarily located in the Willow Creek Basin, a tributary of the San Joaquin River. Kerckhoff Project (FERC 0096) is on the mainstem of the San Joaquin River downstream of the Crane Valley Project. Helms Pumped Storage (FERC 2735), Haas-Kings River (FERC 1988), and Balch (FERC 0175) projects are primarily located in the North Fork Kings River Basin. Tule River Project (FERC 1333) is situated on the North Fork of the Middle Fork Tule River and the Kern Canyon Project (FERC 0178) lies along a 1.8-mile reach of the Kern River.

Most of the streams and reservoirs of the Kings Crane-Helms Bundle are located in the Sierra Nevada foothills between elevations of about 500 and 4,000 feet above sea level. The principal exception is the upper portion of the Helms and Haas-Kings Projects, which includes Courtright Lake at an elevation of 8,100 feet, Lake Wishon at an elevation of 6,550 feet, and the North Fork Kings River downstream of Lake Wishon to Black Rock Reservoir. Chilkoot Lake in the Crane Valley Project sits at 7,497 feet (Resource Insights, 2000).

The climate in the region of the Kings Crane-Helms bundle, like that in most of California, includes hot, dry summers and cool, wet winters. For example, in the vicinity of the Tule River Project, 80 percent of the mean annual precipitation occurs between November and March (FERC, 1991b). However, much of the precipitation in the basins accumulates through the winter as snow, which results in high streamflows during spring and early summer when the snow melts. Winter rainstorms occasionally produce flood flows. Streamflows are typically lowest from late summer through fall. Seasonal and annual variations in streamflow are very high except in highly regulated stream reaches.

Aquatic habitats in the Kings Crane-Helms region include coldwater and warmwater streams and reservoirs. Courtright, Wishon, and Black Rock reservoirs are cold, unproductive, high elevation lakes inhabited by trout species, whereas Bass Lake is more productive and supports both cold and warmwater fish species. The high elevation streams (about 3,000 feet and higher) tend to support coldwater fish species, particularly trout, and the lower streams (about 1,500 feet and lower) support warmwater fish species. The streams between these elevations are transitional, providing habitat for both cold and warmwater species. However, the relationship between elevation and type of fish species assemblage is only approximate and is strongly influenced locally by flow releases and diversions due to project operations. Table 4.4-36 provides a checklist for the fish species located in each FERC license area within the Kings Crane-Helms Regional Bundle.

Table 4.4-36 Distributional Checklist of the Kings Crane-Helms Regional Bundle by Pacific Gas and Electric Company Project

Family Name Common Name (*Scientific Name*)	Crane Valley (FERC 1354)	Kerckhoff (FERC 0096)	Helms Pumped Storage (FERC 2735)	Haas-Kings (FERC 1988)	Balch (FERC 0175)	Tule River (FERC 1333)	Kern Canyon (FERC 0178)
Petromyzontidae (Lamprey Family)							
Kern Brook lamprey (*Lamperta hubbsi*)		X		X			
Clupeidae (Herring Family)							
American shad (*Alosa sapidissima*)		X					
Osmeridae (Smelt Family)							
Wakasagi (*Hypomesus nipponensis*)	X	X					
Salmonidae (Salmon and Trout Family)							
Kokanee (*Oncorhynchus nerka kennerlyi*)	X						
Rainbow trout (*Oncorhynchus mykiss irideus*)	X		X	X	X	X	
Brown trout (*Salmo trutta*)	X		X	X	X	X	
Brook trout (*Salvelinus fontinalis*)	X		X	X			
Cyrinidae (Minnow Family)							
San Joaquin roach (*Hesperoleucus symmetricus* ssp.1)				X			
Hitch (*Lavinia exilicauda*)	X						
Hardhead (*Mylopharodon conocephalus*)	X	X		X			X
Sacramento pikeminnow (*Ptychocheilus grandis*)	X	X		X		X	X
Goldfish (*Carassius auratus*)	X						
Golden shiner (*Notemigonus crysoleucas*)	X						
Catostomidae (Sucker Family)							
Sacramento sucker (*Catostomus occidentalis*)	X	X		X		X	X
Ictaluridae (Catfish Family)							
Brown bullhead (*Ictalurus nebulosus*)	X						X

Table 4.4-36 Distributional Checklist of the Kings Crane-Helms Regional Bundle by Pacific Gas and Electric Company Project

Family Name Common Name (*Scientific Name*)	Crane Valley (FERC 1354)	Kerckhoff (FERC 0096)	Helms Pumped Storage (FERC 2735)	Haas-Kings (FERC 1988)	Balch (FERC 0175)	Tule River (FERC 1333)	Kern Canyon (FERC 0178)
Channel catfish (*Ictalurus punctatus*)	X						
White catfish (*Ictalurus catus*)							X
Poeciliidae (Livebearer Family)							
Mosquitofish (*Gambusia affinis*)	X						
Gasterosteidae (Stickleback Family)							
Threespine stickleback (*Gasterosteus aculeatus*)		X					
Centrarchidae (Sunfish Family)							
Bluegill (*Lepomis macrochirus*)	X						X
Green sunfish (*Lepomus cyanellus*)	X			X		X	
Warmouth (*Lepomus Lepomis gulosus*)	X						
Black crappie (*Pomoxis nigromaculatus*)	X						
White crappie (*Pomoxis annularis*)	X						X
Largemouth bass (*Micropterus salmoides*)	X						
Smallmouth bass (*Micropterus dolomieui*)	X						
Spotted bass (*Micropterus punctulatus*)	X						
Cottidae (Sculpin Family)							
Prickly sculpin (*Cottus asper*)	X	X		X			
Total Fish Taxa	**23**	**8**	**3**	**10**	**2**	**5**	**7**

All of the streams in this bundle region are relatively fast flowing streams, but include a variety of fish habitat types. Most of the streams include both high gradient reaches with bedrock channels and lower gradient alluvial channels. The high gradient reaches typically consist of alternating pools and cascades, often with little riparian vegetation, while the lower gradient reaches contain more riffle habitat and often more riparian vegetation. Riffle habitat typically provides better spawning and foraging conditions for most fish species. Riffle habitats are generally more affected than the high gradient habitats by changes in streamflow.

Human activities have profoundly affected fish populations in all of the streams of the Kings Crane-Helms region. Most importantly, exotic species have been introduced in all of the streams, particularly as a result of stocking game species. Before stocking, some of the high elevation stream reaches probably had no fish because cascades prevented upstream passage. Water development projects, including the hydropower projects, have greatly altered fish habitat by creating reservoirs and changing flow and water temperature regimes in the streams. Spring-run chinook salmon annually spawned in the San Joaquin River within the Kerckhoff and Crane Valley projects before 1956, when construction of Friant Dam blocked their upstream migration. In recent years, CDFG and the USFS have begun to shift emphasis towards management for native species as opposed to exotic game species.

Local Regulations and Policies

Operations of hydroelectric projects have the potential to impact aquatic biological resources. Therefore, an extensive regulatory system has been established to protect these resources and minimize impacts. The primary regulatory agency with authority to protect and conserve biological resources at hydroelectric projects is the FERC. The FERC license for each project contains specific conditions and standards to protect aquatic resources, including fish populations, aquatic habitat and water quality. Specific conditions for each project are included below with the setting descriptions for the projects.

Bundle 16: Crane Valley

Crane Valley (FERC 1354)

The principal water bodies of the Crane Valley Project are Crane Valley Reservoir (Bass Lake) and Willow Creek. Bass Lake, at an elevation of 3,376 feet, receives most of its water directly from North Fork Willow Creek (NFWC) and other tributaries of the lake, but receives about 30 percent of its water from South Fork Willow Creek (SFWC) via the Browns Creek Diversion and Conduit (USFS, 1999). Floodwater damaged the Brown's Creek Diversion in January 1998. The conduit is not operating, but Pacific Gas and Electric Company is currently repairing it. Chilkoot Lake, a small reservoir upstream of Bass Lake, is ephemeral and contains no fish.

Instream Flow and Lake Level Requirements. Maximum lake levels in Bass Lake are influenced by the Miller-Lux Agreement, which specifies that any Bass Lake storage above 60 percent of maximum by September 15 or above 50 percent of maximum by November 1 is subject to call by the U.S. Bureau of Reclamation (USBR). However, the USBR has allowed variances from this agreement in recent years to permit Pacific Gas and Electric Company to maintain high lake levels for recreation until the early fall season. Minimum lake levels may be determined by requirements to maintain sufficient volume of cold water for salmonid species in the reservoir (see below).

Streamflow in NFWC is highly regulated by operations at the Bass Lake Dam and diversions to several powerhouses. There are no minimum instream flow requirements on any streams in the Crane Valley Project, but Pacific Gas and Electric Company makes voluntary minimum flow releases of 1 cfs into NFWC below Bass Lake. Seepage through Bass Lake Dam contributes less than 0.3 cfs of this flow (PG&E Co., 1995a). Pacific Gas and Electric Company also makes voluntarily releases into SFWC below the Browns Creek Diversion Dam, bypassing 4 cfs or the natural flow above the dam, whichever is less.

Manzanita Lake, a 26-acre impoundment on NFWC about 3.5 miles downstream of Bass Lake, sits at an elevation of about 2,815 feet. No water is released from Manzanita Lake into NFWC, but leakage from the dam may provide a minimum flow during the late summer and early fall.

NFWC joins SFWC about three miles downstream of Manzanita Lake and the flow from both forks is diverted just above their confluence. The streamflow in Willow Creek, below this confluence, may disappear entirely during the summer months. Willow Creek flows 6.3 miles from the NFWC – SFWC confluence to its confluence with the San Joaquin River, at an elevation of 1,240 feet. Flows in SFWC and Willow Creek may be very high during the winter and spring months, but flow in NFWC is low except during occasional spills from Bass Lake (Biosystems, 1985a; FERC, 1992b).

The flow diverted from NFWC, SFWC, and Manzanita Lake passes through a complex system of canals, flumes, forebays, and powerhouses before spilling into Corrine Lake, which is the forebay of the Wishon Powerhouse. The Wishon Powerhouse is the most downstream facility of the Crane Valley Project. Corrine Lake has a surface elevation of 2,401 feet and surface area of 7 acres. The canals and forebays provide limited fish habitat, although Corrine Lake has a put-and-take fishery, and several fish species have been found in the Browns Creek Conduit Spill Channel, which enters Bass Lake, and the San Joaquin 1A Conduit, which conveys water to Corrine Lake.

Fish Fauna. Crane Valley Project has a high diversity of fish species, including six native and 16 exotic species (Table 4.4-37). The native species of the Project basin are most prevalent in Willow Creek below the confluence of NFWC and SFWC. Hardhead, which has been designated a California State Species of Special Concern and a USFS sensitive species, occurs in this reach. Sacramento sucker, which is also a native species, is the most abundant species in this reach as well as in NFWC downstream of Bass Lake and SFWC downstream of the Peckinpah Creek confluence (PG&E Co., 1986a). Although rainbow trout are native to the region, the strain of rainbow trout present in this basin as well as those present in the other basins of the Kings Crane-Helms region have been greatly modified by interbreeding with exotic strains that CDFG has planted in project waters for many years. The exotic species are primarily limited to the system lakes, particularly Bass Lake, where they are important game species. The principal management species in Bass Lake are the coldwater species, rainbow and brown trout and kokanee salmon, and the warmwater species, largemouth bass and spotted bass. The CDFG stocks the lake with large numbers of catchable sized rainbow trout through the summer months and plants 50,000 fingerling kokanee

Table 4.4-37 Kings Crane-Helms Regional Bundle - Crane Valley Project (FERC 1354) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Required[a]	Wakasagi	Kokanee	Rainbow trout	Brown trout	Brook trout	Hitch	Hardhead	Sacramento pikeminnow	Goldfish	Golden shiner	Sacramento sucker	Brown bullhead	Channel catfish	Mosquitofish	Bluegill	Green sunfish	Warmouth	Black crappie	White crappie	Largemouth bass	Samllmouth bass	Spotted bass	Prickly sculpin
Chilkoot Lake	None			X	X	X																		
Chilkoot Creek	None			X	X	X																		
North Fork Willow Creek upstream of Bass Lake	Unimpaired watershed lands			X	X	X																		X
South Fork Willow Creek upstream of Browns Creek Diversion	Unimpaired, Watershed lands			X	X																			
Brown's Creek Canal	None	X	X	X	X												X							
Crane Valley Reservoir (*aka* Bass Lake)	Storage 60 percent of maximum by 9/1 and 50 percent by 11/1	X	X	X	X		X			X	X		X	X		X	X	X	X	X	X		X	
San Joaquin 3 Forebay	None																							
North Fork Willow Creek from Bass Lake to Manzanita Lake	Year round: one cfs (by informal agreement)	X		X			X					X					X					X		
Manzanita Lake	None			X			X				X	X				X			X		X			
San Joaquin 2 Forebay	None																							
South Fork Willow Creek from Browns Creek Diversion to South Fork Diversion	Year round: four cfs (by informal agreement)			X	X							X					X							
North Fork Willow Creek from Manzanita Lake to North Fork Diversion	None	X		X			X					X					X							
Willow Creek from confluence North Fork and South Fork	None	X		X	X			X	X		X	X			X		X							

Table 4.4-37 Kings Crane-Helms Regional Bundle - Crane Valley Project (FERC 1354) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Required[a]	Wakasagi	Kokanee	Rainbow trout	Brown trout	Brook trout	Hitch	Hardhead	Sacramento pikeminnow	Goldfish	Golden shiner	Sacramento sucker	Brown bullhead	Channel catfish	Mosquitofish	Bluegill	Green sunfish	Warmouth	Black crappie	White crappie	Largemouth bass	Samllmouth bass	Spotted bass	Prickly sculpin
Willow Creek downstream to San Joaquin River																								
San Joaquin 1A Ditch downstream of San Joaquin 1A Intake	None	X		X								X												
Corrine Lake	None			X												X	X				X			

a cfs = cubic feet/second

each spring (FERC, 1992b; CDFG, 2000a). The kokanee do not attain catchable size until the following summer (Biosystems, 1985a).

Three trout species, rainbow, brown, and brook trout, occur in the Willow Creek basin streams. All three of these species inhabit NFWC and its tributaries upstream of Bass Lake. The CDFG regularly plants catchable rainbow trout in the NFWC upstream of the lake (CDFG, 2000a). Rainbow and brown trout also occur in Brown's Creek Canal and SFWC, and rainbow trout occur in NFWC downstream of Bass Lake. The trout are more abundant in SFWC than in NFWC because of superior habitat conditions (PG&E Co., 1986a). Warm summer water temperatures and low flows generally exclude trout from lower Willow Creek.

Aquatic Habitat. Bass Lake and Willow Creek provide the most important fish habitat in the Crane Valley Project. Manzanita Lake and Corrine Lake, which are largely used for put-and-take fisheries, and other Project forebays and canals are much less important habitat.

Bass Lake has a surface area of 1,165 acres and maximum depth of 110 feet at its highest lake level (CVPC, 1997). Between 1979 and 1996, annual fluctuations in surface elevation of the lake ranged between about 18 and 30 feet. Lake levels were generally lowest during November through January and highest during June and July. As noted earlier, late summer and early fall lake levels are potentially determined by the Miller-Lux Agreement, although the USBR has allowed variances from this agreement in recent years.

Shallow water areas in the lake provide spawning and rearing habitat for warmwater fishes such as bass and sunfish. A number of coves around Bass Lake and the area near the inlet of Slide Creek in the upper portion of the lake contain shallow, weedy areas suitable for spawning and rearing. These areas are flooded in the spring and early summer when these fish spawn and rear. The current management practice of maintaining high lake levels into the early fall benefits these fish.

Coldwater species are able to survive in Bass Lake because the lake is thermally stratified in the summer. Late summer temperatures in the epilimnion of the lake frequently exceed 77°F (25°C) which is approaching the lethal limit for kokanee and trout (Biosystems, 1985a; PG&E Co., 1986a). Therefore, during the summer and early fall these fish move into the hypolimnion, which remains cold. Despite the suitable temperature environment in the hypolimnion, these fish may experience stress from low levels of dissolved oxygen (DO). The DO levels in the hypolimnion generally fall below 4 milligrams per liter during the summer (Biosystems, 1985a). The current management practice of maintaining high lake levels into the early fall probably increases the volume of the hypolimnion, which should benefit the coldwater species. Ongoing relicensing negotiations have reached agreement on a minimum storage level of 5,888 af (equivalent to a depth of 55 feet) designed to provide adequate cold water fishery habitat, and this minimum may eventually be incorporated into the project license (PG&E Co., 1999a; CVPC, 1997).

Rainbow trout, brown trout, and kokanee probably spawn in the streams that flow into Bass Lake, including NFWC. kokanee have been observed to spawn in the Brown's Conduit Spill Channel where it enters Bass Lake (PG&E Co., 1986a).

The Willow Creek basin provides stream habitat for both coldwater and warmwater fish species. The tributaries of Willow Creek, including NFWC and SFWC, provide coldwater habitat for trout, whereas the mainstem Willow Creek provides habitat for warmwater species, including green sunfish and several native species. The lower reaches of the tributaries and upper reaches of the mainstem provide transitional habitat that supports species such as Sacramento sucker and hitch as well as some trout.

Habitat in NFWC below Bass Lake is strongly affected by operations of the project. Sandy sediments have accumulated in many reaches because of the low frequency of flushing flow events in this highly regulated stream segment (Biosystems, 1985b). These sediments have reduced the quality of spawning habitat and of habitat for aquatic insects, which are the major prey of most of the fish species (PG&E Co., 1985a). NFWC has a moderate channel slope (50 to 200 feet per mile). Pools are the dominant habitat type (PG&E Co., 1995a). At the 1-cfs level of flow release from Bass Lake, trout habitat availability is relatively low. Summer water temperatures in portions of this stream segment often exceed the upper limit of the optimal temperature range for trout which is 68°F (20°C). This is particularly true upstream of Manzanita Lake, which is less well shaded than the reach below Manzanita Lake. Pools may provide important refuges from high temperatures, but availability of such refuges has probably diminished because sedimentation has reduced pool depths. (PG&E Co., 1986a).

Fish habitat in SFWC below the Browns Creek Diversion Dam is less affected by the project than that in NFWC. This stream segment provides coldwater habitat between the dam and the confluence with Peckinpah Creek, and warmwater habitat below this location. Summer temperatures in the lower portion of the upper reach exceed the optimal range for trout during hot, dry years (PG&E Co., 1995a). Most of SFWC is composed of pool and pocket water habitat, although pool-cascade habitat extends for a mile immediately below the Browns Creek Diversion Dam and a large pool occupies the final half-mile of stream above the SFWC Diversion Dam. Boulders, cobble, bedrock, and sand are the dominant substrates (PG&E Co., 1995a). Instream flow studies conducted in 1984 indicated that in the coldwater stream segment above Peckinpah Creek, habitat availability for most life stages of rainbow and brown trout increased rapidly with increases in streamflow up to about 10 cfs (PG&E Co., 1986a). In the warmwater reach below Peckinpah Creek, habitat availability for most life stages increased with streamflows up to about 5 cfs. Summer flows in SFWC are generally well below optimal levels for trout. Spawning conditions in the stream are better for rainbow trout than for brown trout because rainbow trout spawn during March and April, when flows are generally high, whereas brown trout spawn during October and November, when flows are usually low. However, spawning substrates are limited and most young trout are probably recruited from the stream above Browns Creek Diversion (FERC, 1992b).

Willow Creek below the confluence of NFWC and SFWC provides warmwater habitat that supports a number of native and exotic species. The stream includes a 4.5-mile segment upstream of the Whiskey Creek confluence that has very little streamflow during the summer and early fall, and a 1.8-mile segment between the confluence and the San Joaquin River that provides better streamflow conditions. As noted earlier, the Project diverts essentially all flow during summer through fall from NFWC and SFWC at their confluence. Consequently, portions of Willow Creek are reduced to a series of poorly connected pools. Wide, shallow, unshaded channels meander through sandy substrates in this reach and the pools become stagnant and contain large amounts of algae. Cattle in the area degrade the streambanks and aggravate the habitat conditions. Sacramento suckers and green sunfish dominate this stream segment. (PG&E Co., 1986a).

Flow from Whiskey Creek provides superior habitat conditions for the lower segment of Willow Creek. Pool-riffle-run and pool-cascade habitat types dominate this segment and there is sufficient flow to prevent stagnation. Late summer-early fall water temperatures in this segment are generally too high for trout, although trout have been collected in the reach immediately downstream of Whiskey Creek. Suckers are the most abundant species (PG&E Co., 1986a).

Special-Status Species. The only special-status fish species documented within the Crane Valley Project is hardhead (CNDDB, 2000) (Table 4.4-38). Hardhead is a CDFG species of special concern and a USFS sensitive species (CNDDB, 2000). Historically, hardhead was an abundant and widespread species (Reeves, 1964). In general, hardhead is less abundant than it once was, especially in the southern half of its range. Hardhead prefer large to medium-sized, cool to warm-water streams with natural flow. However, these types of streams are increasingly dammed and diverted, thus removing habitat, isolating upstream areas, and creating temperature and flow regimes unfavorable for hardhead. Consequently, populations are decreasing or disappearing throughout its range. The combination of habitat alteration and specialized habitat requirements has led to localized, isolated populations that are exposed to localized extinctions (Moyle et al, 1995).

In the past, hardhead were sufficiently plentiful in reservoirs that they were assumed to compete with trout and other game fish and were regarded as undesirable. Most of the reservoir populations proved to be temporary, presumably the result of colonization of the reservoir by juvenile hardhead before introduced predators became established (Moyle et al, 1995).

Fisheries Management Issues. The principal fisheries management issues for the Crane Valley Project are minimum flow releases, management for native species and protecting coldwater fish habitat in Bass Lake. Other issues that may be important are fish rescues and entrainment.

There are no minimum instream flow requirements on any streams in the Crane Valley Project. However, Pacific Gas and Electric Company makes voluntary minimum flow releases of 1 cfs into

Table 4.4-38 Special-Status Fish Species That Occur in the Kings Crane-Helms Regional Bundle

Family Name Common Name (Scientific Name)	State/Federal Designations[a]	Status of Occurrence by Project				
		Crane Valley (FERC 1354)	Kerckhoff (FERC 0096)	Haas-King (FERC 1988)	Kern Canyon (FERC 0175)	Tule River (FERC 1333)
Petromyzontidae (Lamprey Family)						
Kern Brook lamprey (*Lampetra hubbsi)*	CSC/FSC		Known from San Joaquin River	Known from North Fork Kings River		
Cyprinidae (Minnow Family)						
San Joaquin roach (*Hesperoleucas symmetricus mitrulus*)	CSC/--			Known from North Fork Kings River		Known from Tule River and tributaties
Hardhead (*Mylopharodon conocephalus*)	CSC/FSS	Known from Willow Creek	Known from Kerckhoff Lake and San Joaquin River	Known from North Fork Kings River	Known from Kern River	

a Designation Abbreviations:
-- = No designation
State Designations
CSC = California Special Concern species
Federal Designations
FSS = Forest Service Sensitive species
FSC = Federal Special Concern species

the NFWC below Bass Lake for the protection of fisheries resources (PG&E Co., 1999a). Pacific Gas and Electric Company also makes voluntary flow releases of four cfs into SFWC below the Brown's Ditch Diversion Dam. Habitat and water temperature studies demonstrate that maintaining these flow releases greatly benefits fish populations in NFWC and SFWC (PG&E Co., 1986a). While these flow releases are not required under the current FERC license, it is anticipated that they will become part of the new FERC license for the project.

The CDFG manages lower Willow Creek and the adjoining Horseshoe Bend reach of the San Joaquin River as a native warmwater fishery (USFS, 2000). Species inhabiting this reach includes hardhead, which has been designated a California State Species of Special Concern and a USFS sensitive species, as well as a number of other native fish species. As described earlier, flows in this stream segment are often very low and, during summer and fall, portions of the stream may be reduced to a series of very warm, stagnant pools. Greater flow releases would reduce water temperatures and improve pool continuity and fish passage in this reach. However, flow increases would also increase the risk of further introduction of exotic species from the upper part of the Willow Creek basin, particularly Bass Lake and Manzanita Lake, into native fishery reaches (USFS, 2000).

As indicated in the aquatic habitats section above, when the storage volume of Bass Lake falls below about 5,888 af, the volume of cold, well-oxygenated hypolimnetic water required for the coldwater fishery may be threatened. The Crane Valley Project Committee (CVPC) has recommended, as a fisheries management goal, to maintain the reservoir above this level. Ongoing relicensing negotiations have reached agreement on a minimum storage level of 5,888 af (equivalent to a depth of 55 feet) designed to provide adequate cold water fishery habitat, and this minimum may eventually be incorporated into the project license (PG&E Co., 1999a; CVPC, 1997).

There are no fish screens or bypass structures at any of the diversions in the Crane Valley Project, so mortality resulting from the entrainment of small fish into the canals and powerhouses may be significant. Entrainment may be particularly important at the Brown Creeks Diversion Dam because young trout in SFWC are probably recruited primarily from upstream of the dam (FERC, 1992b). Pacific Gas and Electric Company sometimes voluntarily conducts fish rescue operations when canals are dewatered for maintenance activities (PG&E Co., 1999b).

Bundle 17: Kerckhoff

Kerckhoff (FERC 96)

The Kerckhoff Project includes two water bodies, Kerckhoff Reservoir and the San Joaquin River downstream of the reservoir. Kerckhoff Dam sits on the mainstem San Joaquin River, about two miles downstream of the A. G. Wishon Powerhouse of the Crane Valley Project and about three miles downstream of Powerhouse No. 4, the lowermost facility of Southern California Edison Company's Big Creek Project. Kerckhoff Reservoir is about 2.5 miles long, so the A. G. Wishon Powerhouse discharges directly into the upper end of the reservoir. The reservoir receives nearly all of its flow from the A. G. Wishon Powerhouse and the San Joaquin River.

Instream Flow and Lake Level Requirements. Kerckhoff Reservoir is the forebay for the Kerckhoff Project's two powerhouses. Kerckhoff 1 is 3.2 miles downstream of the reservoir and has a flow capacity of 1,735 cfs, while Kerckhoff 2 is 4.1 miles downstream of the reservoir and has a capacity of 4,800 cfs. Kerckhoff Reservoir's storage capacity, 4,252 af, is small relative to the capacity of the powerhouses or relative to the volume of flow it receives from the upstream hydropower facilities projects. Consequently, the Kerckhoff Project is able to regulate the amount of water available for power production on a daily basis only. It operates in a daily peaking mode, but for time periods longer than about a day it operates as a run-of-the-river facility.

The water leaving Kerckhoff 1 discharges into the San Joaquin River upstream of Millerton Lake, a large storage reservoir operated by the USBR. The upstream extent of Millerton Lake varies several miles depending on storage volume. The elevation of the Kerckhoff 2 tailrace is 543 feet, so Kerckhoff 2 discharges directly into the upper portion of the lake when the lake level is greater than 543 feet, or discharges into the river upstream of Millerton Lake when the lake elevation is below 543 feet (USFWS, 1991). Except during the May 15 through June 30 period of minimum flows for American shad (*Alosa sapiddissima*) spawning, Kerckhoff 2 operates as a peaking plant, with peak throughput in the afternoon and evening. Kerckhoff 1 normally operates only when flows are high and Kerckhoff 2 is already operating at full capacity, during annual maintenance shut-down of Kerckhoff 2, or when releases from Kerckhoff 1 are needed to satisfy instream flow requirements.

To protect fish habitat and other beneficial uses of the bypassed reach of the San Joaquin River downstream of Kerckhoff Dam, FERC License Article 45 requires a minimum instream flow release from the dam of 25 cfs during normal water years and 15 cfs during dry water years. Additional releases may be made following consultation with the CDFG to maintain water temperatures at or below 80.6°F (27°C) upstream of Kerckhoff 1 Powerhouse. A 1993 FERC order also establishes a flow regime from May 15 through June 30 to enhance spawning conditions for American shad during their upstream spawning migration within Millerton Lake and into the San Joaquin River. The FERC order requires alternative daily flow regimes depending on the level of Millerton Lake. When the lake elevation is below 545 feet, the order requires minimum releases of 775 cfs between the hours of 10 PM and 2 AM and 400 cfs during the rest of the day from Kerckhoff 2, or a 400 cfs release from Kerckhoff 1. When the lake elevation is at or above 545 feet, the order requires minimum releases of 1,200 cfs between the hours of 10 PM and 2 AM and 775 cfs during the remaining hours from Kerckhoff 2, or a 400 cfs release from Kerckhoff 1. This flow regime is designed to enhance flow cues in the upper end of Millerton Lake that trigger and guide upstream spawning migrations by American shad. The shad generally spawn during the middle of the night (PG&E Co., 1986b).

Fish Fauna. The Kerckhoff Project area has a diverse fauna of native fishes, including six species (Table 4.4-39). Several exotic species also occur within project waters. Sacramento sucker, a native species, was the most abundant species in the reservoir in gill netting surveys conducted between 1964 and 1975. Four of the other native species, hardhead, Sacramento pikeminnow, three-spine stickleback and prickly sculpin, also occur in the reservoir.

Both native and exotic fish species inhabit the 7.5 mile stretch of the San Joaquin River between Kerckhoff Dam and the Kerckhoff 1 Powerhouse. According to observations from 1968 and 1976, three native species inhabit the reach: Sacramento sucker, hardhead, and Sacramento pikeminnow (PG&E Co., 1977). A fourth native species, Kern Brook lamprey, may also occur in this reach (Moyle et al., 1995). However, the most abundant fish in the reach was smallmouth bass, an exotic species.

The reach of the San Joaquin River between the Kerckhoff powerhouses and Millerton Lake is primarily inhabited by exotic fish species, some of them visiting temporarily from Millerton Lake. In addition, beds of the large freshwater clam, *Margaritifera* spp. are found on the river bottom in this reach. Resident fish of the reach include smallmouth bass and sunfish. The species of greatest management interest in the reach are American shad and striped bass (*Morone saxatilis*), which seasonally visit from Millerton Lake. American shad, a native species of the Atlantic coast of North America, was accidentally introduced into Millerton Lake in 1955 and 1957 (Moyle, 1976).

Table 4.4-39 Kings Crane-Helms Regional Bundle - Kerckhoff Project (FERC 0096) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Required[a]	Kern Brook lamprey	Wakasagi	American shad	Hardhead	Sacramento pikeminnow	Sacramento sucker	Threespined stickleback	Striped bass	Green sunfish	Smallmouth bass
Kerckhoff Lake	None		X		X	X	X	X	X		
San Joaquin River between Kerckhoff Dam and Kerckhoff 2 Powerhouse	Normal years: 25 cfs Dry years: 15 cfs Water >27°C: variable temperature releases 5/15-6/30: variable shad releases	X		X	X	X	X				X
San Joaquin River between Kerckhoff 2 Powerhouse and Millerton Lake	None	X		X					X	X	X

[a] cfs = cubic feet/second

American shad are normally anadromous; the Millerton Lake population is the only known landlocked population. The shad make spawning runs out of Millerton Lake into the San Joaquin River during May through June or July, when water temperatures are suitable 57-63°F (14-17°C) (PG&E Co., 1990a). Eggs are released near the water surface in flowing water and drift downstream with the current. Hatching usually occurs within a week of spawning. Eggs that enter quiet water settle to the bottom, where their survival is poor. Therefore, successful spawning requires a sufficiently long reach of appropriate riverine habitat conditions.

Striped bass are also native to the Atlantic coast and are also anadromous. Striped bass have been stocked in Millerton Lake at irregular intervals since 1955 (PG&E Co., 1986b). The species has been observed in the San Joaquin River near the Kerckhoff powerhouses, but it is not known if they spawn in the river.

Aquatic Habitat. Kerckhoff Reservoir is a long (about 2.5 miles), narrow reservoir, with a surface area of 160 acres and surface elevation of about 985 feet. The upstream half of the reservoir is very shallow due to the deposition of silt. The reservoir is periodically dredged or sluiced to reduce the sediment. The lower end of the reservoir is in a steep-walled canyon with a shoreline of mostly granitic bedrock and little useful habitat for fish. The reservoir has a small volume relative to the amount of water that moves through it. Consequently, the flushing rate is generally greater than once per day. The surface elevation typically fluctuates about 2 to 5 feet on a daily basis. Kerckhoff Dam spills during periods of large upstream releases from the Crane Valley Project and, more importantly, Edison's Big Creek Project. The spills are most frequent during the spring and early summer (PG&E Co., 1977).

Water temperatures in Kerckhoff Reservoir generally remain cool through the summer. The Horseshoe Bend reach of the San Joaquin River, whose downstream end lies less than a mile upstream of Kerckhoff Reservoir, is managed by CDFG as a native warmwater fishery (SCE Co., 1997). However, Big Creek 4 Powerhouse discharges into the San Joaquin River below Horseshoe Bend, which reduces water temperatures of the river and the reservoir (USFS, 2000). Water temperatures measured in the reservoir during late spring and summer in 1976 never exceeded 68°F (20°C), and would therefore be considered coldwater habitat (PG&E Co., 1977). The rapid flushing rate of the reservoir keeps it from thermally stratifying.

The nine-mile segment of the San Joaquin River between Kerckhoff Dam and Kerckhoff 2 Powerhouse is characterized by a nearly flat gradient, long narrow pools up to a half mile long, and a bedrock channel containing large boulders. The river in this segment has very little riffle habitat, gravel or riparian vegetation. Streamflow usually results from the minimum releases from Kerckhoff Dam: 15 cfs during dry water years and 25 cfs during normal water years. When the Kerckhoff 1 Powerhouse is operating, flows downstream of the powerhouse are much higher. Kerckhoff Dam occasionally spills during spring and early summer. Under these circumstances, flows through the entire segment may be very high (> 1,000 cfs). As noted previously, habitat downstream of Kerckhoff 2 may be riverine or lacustrine, depending on the level of Millerton Lake. This powerhouse is operated as a peaking plant, so daily flow fluctuations are very large.

Summer water temperatures in the river increase greatly between Kerckhoff Dam and the Kerckhoff powerhouses. In 1976, water temperatures increased as much as 17°F (8.3°C) between the dam and a site one half mile upstream of Kerckhoff 1. The water temperatures at the lower site exceeded 75°F (24°C) for several weeks. As noted above, up to 50 cfs of flow must be released into the river from Kerckhoff Dam whenever water temperatures in the river reach 80.6°F (27°C) or above. Temperatures in this range are too high for coldwater fish species, but are quite suitable for warmwater species. The water that flows through the Kerckhoff 1 and 2 powerhouses is conveyed from Kerckhoff Reservoir rapidly and through dark tunnels and is little warmer than the reservoir. Therefore, operation of the powerhouses reduces water temperatures downstream.

Special-Status Species. The only special-status fish species known to occur within the Kerckhoff Project is hardhead (CNDDB, 2000), but another special-status fish species, Kern Brook lamprey, also likely occurs in the project (Table 4.4-38) (Moyle et al, 1995). Hardhead is a State species of special concern and a USFS sensitive species. Within the project hardhead can be found in both the Kerckhoff Reservoir and the San Joaquin River below the reservoir (PG&E Co., 1977). Historically, hardhead was an abundant and widespread species (Reeves, 1964). In general, hardhead is less abundant than it once was, especially in the southern half of its range. Hardhead prefer large to medium-sized, cool to warm-water streams with natural flow. However, these types of streams are increasingly dammed and diverted, thus removing habitat, isolating upstream areas, and creating temperature and flow regimes unfavorable for hardhead. Consequently, populations are decreasing or disappearing throughout its range. The combination of habitat alteration and specialized habitat requirements has led to localized, isolated populations that are exposed to localized extinctions (Moyle et al., 1995).

In the past, hardhead were sufficiently plentiful in reservoirs that they were assumed to compete with trout and other game fish and were regarded as undesirable. Most of the reservoir populations proved to be temporary, presumably the result of colonization of the reservoir by juvenile hardhead before introduced predators became established (Moyle et al, 1995).

Lamprey larvae (ammocoetes) believed to be Kern Brook lamprey have been collected in the San Joaquin River between Kerch River between Kerckhoff Dam and Millerton Lake. According to *Fish Species of Special Concern in California* by CDFG:

> The Kern Brook lamprey was first discovered in the Friant-Kern Canal, but it has also been found in the lower reaches of the Merced River, Kaweah River, Kings River, and San Joaquin River (Brown & Moyle, 1993). Since the species was first discovered in 1976, attempts to fully document its range have been only partially successful. However, data collected to date suggest that this species is a San Joaquin endemic (Brown & Moyle, 1993). Populations of this species are thinly scattered throughout the San Joaquin drainage and isolated from one another (Moyle et al, 1995). Such a fragmented distribution makes local extirpations likely, without hope of recolonization, followed by eventual extinction of the species. The probability of local extirpation is increased by the fact that all known populations are located below dams, where stream flows are regulated without regard to the needs of the lampreys. Fluctuations or sudden drops in flow may isolate or dry up ammocoetes. Gravel needed for spawning may be eliminated or compacted, so adults cannot use it. Ammocoetes may also be carried to “dead-end” habitats such as the Friant-Kern siphons. Clearly, management of flows in the lower reaches of rivers of the San Joaquin drainage will need to consider the needs of this lamprey in order for the species to persist (Moyle et al, 1995).

Fisheries Management. The principal fisheries management issue for the Kerckhoff Project concerns spawning migration conditions for American shad in Millerton Lake. The shad rely on minimum current velocities to guide their upstream spawning migration into the San Joaquin River. Studies have shown that American shad generally initiate spawning activities at current velocities between 0.7 and two feet per second (0.2 and 0.6 meters per second) (PG&E Co., 1992a). When the lake level of Millerton Lake is high, the Kerckhoff 2 Powerhouse discharges into the lake. The water of the lake has a strong “backwater effect” on the powerhouse discharge that reduces downstream current velocities, adversely affecting the spawning migration conditions for shad (PG&E Co., 1992a). High discharge flows are needed to overcome this backwater effect. The minimum discharge flow regimes for the May 15 through June 30 period previously discussed are designed to provide flows sufficiently high to produce suitable current velocities for the spawning shad.

A second management issue for the Kerckhoff Project concerns Pacific Gas and Electric Company’s plans to sluice accumulated sediments through a low-level outlet in Kerckhoff Dam (PG&E Co., 1998b). Large amounts of sediment have accumulated during storm flows near the intakes of the Kerckhoff powerhouses. Pacific Gas and Electric Company has proposed to remove these sediments by opening the low-level outlet during periods of very high San Joaquin River flow (> 12,000 cfs). The high flows would dilute the sediments and flush them from the river channel below the dam. Resource agency staff have expressed concern that Pacific Gas and Electric Company's proposal does not adequately evaluate the potential presence of toxic materials in the sediments or potential adverse effects of sediment deposition on downstream flora, fauna, and habitat (USBR, 1998).

There are no fish screens or bypass structures at the diversion intakes to the Kerckhoff powerhouses, so mortality resulting from the entrainment of small fish may be significant.

Bundle 18: Kings River

Helms Pumped Storage (FERC 2735)

Haas-Kings River (FERC 1988)

Balch (FERC 0175)

Kings River Bundle consists of three major hydropower projects, the Helms Pumped Storage Project, the Haas-Kings River Project, and the Balch Project. All three projects are located in the North Fork Kings River Basin. The projects are so highly interconnected and interdependent that it is difficult to evaluate effects of the operations of one of the projects without considering the operations of the others. Therefore, the projects are described and evaluated in this section as a single bundle. Joint treatment of the three projects is also appropriate because it is highly likely that they would be jointly transferred in divestiture.

The principal water bodies of the Kings River Projects are the North Fork Kings River (NFKR), Dinkey Creek and four reservoirs: Courtright Reservoir, Wishon Reservoir, Black Rock Reservoir and Balch Afterbay. Courtright and Wishon are shared by two of the projects, the Helms Pumped Storage Project and the Haas-Kings River Project, and all three projects use water stored in these reservoirs. Courtright Reservoir is located at an elevation of 8,100 feet, while Wishon Reservoir is at an elevation of 6,550 feet. The Helms Storage Project circulates water between the reservoirs. It pumps water upstream from Wishon Reservoir to Courtright Reservoir when energy demand is low (generally, during the night), and generates power by running the water back from Courtright to Wishon through the Helms Powerhouse when energy demand is high (generally, during afternoon and evening). Wishon Reservoir also serves as the forebay for the Haas Powerhouse, which belongs to the Haas-Kings River Project. Haas Powerhouse discharges into Black Rock Reservoir, which serves as the forebay for the Balch Project powerhouses. Black Rock Reservoir sits at an elevation of 4,089 feet. The Balch 1 and 2 Powerhouses discharge into the Balch Afterbay, which belongs to the Haas-Kings River Project. Balch Afterbay, which is at 1,703 feet of elevation, also serves as the forebay for the Kings River Powerhouse, which is the terminal facility of the Haas-Kings River Project. The Kings River Powerhouse discharges into the mainstem of the Kings River, downstream of its confluence with the NFKR at an elevation of about

950 feet. When Pine Flat Reservoir has a high lake level, it extends upstream to the powerhouse tailrace and beyond.

Instream Flow and Lake Level Requirements. The Kings River Projects affect a major portion of the NFKR. Courtright Reservoir sits on Helms Creek, which runs 2.7 miles before joining NFKR a half mile upstream of Wishon Reservoir. The NFKR then runs about eight miles from Wishon Reservoir to Black Rock Reservoir, 4.5 miles from Black Rock Reservoir to Balch Afterbay, and 5.2 miles from Balch Afterbay to the mainstem Kings River. Except during periods of high runoff, particularly during snowmelt in the spring and early summer, the projects divert much of the flow from all these segments of the river. Therefore, streamflow levels are largely determined during much of the year by FERC minimum flow requirements. FERC Article 40 of the Haas-Kings River Project license requires minimum releases from Courtright Reservoir into Helms Creek of four cfs during June through November and 2.5 cfs during the rest of the year. The same FERC Article requires minimum releases from Wishon Reservoir into the NFKR of 15 cfs during June through November and 7.5 cfs during the rest of the year, except for dry water years when the requirement is 7.5 cfs all year. FERC Article 38 of the Balch Project license requires minimum releases from Black Rock Reservoir into the NFKR of 5 cfs during June through November and 2.5 cfs during the rest of the year, except for dry water years when the requirement is 2.5 cfs all year. This Article also requires minimum releases below Balch Afterbay of 15 cfs from June through November and ten cfs during the rest of the year, except for dry water years when the requirement is ten cfs all year. Finally, FERC Article 40 of the Haas-Kings River Project license also has minimum streamflow requirements for Dinkey Creek, a tributary of the NFKR downstream of Balch Afterbay, and for the NFKR below its confluence with Dinkey Creek. The Article requires minimum releases from the Balch Afterbay to maintain flow in the NFKR downstream of the confluence with Dinkey Creek at or above 35 cfs during June through November and 25 cfs during the rest of the year. During dry water years the streamflow requirement is 25 cfs all year. To help maintain cool water temperatures in the lowermost segment of the NFKR, the Article requires a release of five cfs into Dinkey Creek from the Dinkey Creek siphon if the natural flow in Dinkey Creek is 60 cfs or less.

Fish Fauna. The Kings River Projects have relatively limited fish fauna, particularly given the length of river and variety of reservoirs within Project boundaries (Tables 4.4-40, Helms Pumped Storage Project, 4.4-41 Haas-Kings Project, and 4.4-42 Balch Project). This is largely due to the high elevation and coldwater temperatures of most of the project water bodies. Except for the reach of the NFKR and Dinkey Creek downstream of Balch Afterbay, all of the Project streams and reservoirs only provide coldwater habitat. Coldwater fish fauna in the Sierra foothills are generally much less diverse than warmwater fish fauna.

Table 4.4-40 Kings Crane-Helms Regional Bundle - Helms Pumped Storage Project (FERC 2735) Fish Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Required[a]	Rainbow Trout	Brown Trout	Brook Trout	Golden shiner
Helms, Dusy and Nelson Creeks upstream of Courtright Lake	Unimpaired watershed lands	X	X	X	
Courtright Lake	Maintain high lake level in summer	X	X	X	
Helms Creek downstream of Courtright Lake to North Fork Kings River	6/1 – 11/30: four cfs 12/1 – 5/30: 2.5 cfs	X	X	X	
North Fork Kings River upstream of Wishon Lake	Unimpaired watershed lands	X	X		
Wishon Lake	Maintain high lake level in summer	X	X	X	X

a cfs = cubic feet / second

Table 4.4-41 Kings Crane-Helms Regional Bundle-Haas-Kings River Project (FERC 1988) Fish Species Occurrence by Location

Location	Minimum Streamflow/ Reservoir Level Required[a]	Kern Brook lamprey	Rainbow trout	Brown trout	Brook trout	San Joaquin roach	Hardhead	Sacramento pikeminnow	Golden shiner	Sacramento sucker	Smallmouth bass
Helms, Dusy and Nelson Creeks upstream of Courtright Lake	Unimpaired watershed lands		X	X	X						
Courtright Lake	Maintain high summer weekend lake levels		X	X	X						
Helms Creek downstream of Courtright Lake to North Fork Kings River	6/1–11/30: four cfs 12/1-5/30: 2.5 cfs		X	X	X						
North Fork Kings River upstream of Wishon Lake	Unimpaired watershed lands		X	X							
Wishon Lake	None		X	X	X				X		
North Fork Kings River between Wishon Lake and Black Rock Reservoir	Normal years: 6/30–11/30: 15 cfs 12/1–5/30: 7.5 cfs Dry years: 7.5 cfs Year round		X	X							
Balch Afterbay	None		X	X							
North Fork Kings River between Balch Afterbay and Dinkey Creek	Normal year: 6/30–11/30: 15 cfs 12/1–5/30: ten cfs Dry years: ten cfs Year round		X	X		X	X	X		X	
Dinkey Creek	five cfs from siphon when flow <60 cfs		X							X	

Table 4.4-41 Kings Crane-Helms Regional Bundle-Haas-Kings River Project (FERC 1988) Fish Species Occurrence by Location

Location	Minimum Streamflow/ Reservoir Level Required[a]	Kern Brook lamprey	Rainbow trout	Brown trout	Brook trout	San Joaquin roach	Hardhead	Sacramento pikeminnow	Golden shiner	Sacramento sucker	Smallmouth bass
North Fork Kings River between Dinkey Creek and Kings River confluence	Normal years: 6/1–11/30: 35 cfs 12/1–5/30: 25 cfs Dry years: 25 cfs Year round	X	X			X	X	X		X	X

a cfs = cubic feet/ second

Table 4.4-42 Kings Crane-Helms Regional Bundle - Balch Project (FERC 0175) Fish Species Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Required[a]	Rainbow Trout	Brown Trout
Black Rock Reservoir	None	X	X
North Fork Kings River between Black Rock Reservoir and Balch Afterbay	Normal year: 6/1-11/30: five cfs 12/1-5/30: 2.5 cfs Dry year: 2.5 cfs year round	X	X
Weir Creek	None	No Fish	No Fish
Black Rock Creek	None	No Fish	No Fish

a cfs = cubic feet/ second

The native species of the Kings River basin include rainbow trout in coldwater habitats and Sacramento sucker, Sacramento pikeminnow, hardhead, California roach, and prickly sculpin in the warmer habitats. Kern Brook lamprey likely also occur in the warmwater habitat. The principal exotic species of the basin are brown trout, brook trout, and smallmouth bass.

The three trout species, rainbow, brown, and brook trout, are the only fish species that inhabit Courtright and Wishon reservoirs and their tributaries. Juvenile golden shiners were found in Wishon Reservoir in 1972 and 1975 (PG&E Co., 1986c), where anglers illegally using them as bait might have accidentally introduced them. All three trout species were stocked in both reservoirs between 1958 and 1971, but only rainbow trout have been stocked recently. In 1994, the CDFG stocked almost 26,000 catchable-size rainbow trout in Courtright Reservoir and over 25,000 catchable-size rainbow trout in Wishon Reservoir. Creel censuses have been annually conducted in both reservoirs since 1984, when the Helms Pump Storage Project began operating (PG&E Co., 1994a). Catch per unit effort of trout (total number of trout caught divided by total number of angler hours) has varied from about 0.4 to about 0.7 over this period. Relatively few of the censused fish were wild trout, but most of the wild trout were rainbows. The major tributaries of Courtright and Wishon reservoirs have resident populations of the three trout species and some provide spawning habitat for trout migrating from the reservoirs (PG&E Co., 1986c).

Rainbow and brown trout inhabit the Kings River and its tributaries in the 8-mile segment of the NFKR between Wishon Reservoir and Black Rock Reservoir (PG&E Co., 1986c). Brook trout reside in the upper elevation tributaries only. CDFG sporadically stock trout in this segment of the river (PG&E Co., 1999a). Fish population surveys conducted between 1985 and 1988 found brown trout more abundant than rainbow trout in this river segment (EA, 1988). Trout biomass estimates ranged from about 1 to 128 pounds per acre.

Black Rock Reservoir contains populations of rainbow and brown trout that may be recruited from upstream populations in the river when high flows wash juvenile trout downstream (PG&E Co., 1986c). Angler success in this reservoir is generally low.

Rainbow trout and brown trout are the only fish species that reside in the 4.5-mile segment of the NFKR between Black Rock Reservoir and Balch Afterbay. Fish population surveys conducted in 1985 through 1987 found about equal numbers and biomasses of the two species (EA, 1988). Total biomass estimates ranged from 14 to 64 pounds per acre. Two small tributaries of this segment of the NFKR, Black Rock Creek and Weir Creek, are diverted into the Balch Tunnel. No fish have been found in either creek (PG&E Co., 1986c). Brown and rainbow trout reside in Balch Afterbay and are probably recruited from upstream populations. Fishing is prohibited in the afterbay (PG&E Co., 1986c).

The NFKR below Balch Afterbay provides transitional habitat between cold and warm water. In fish population surveys conducted during 1985 through 1987, the upper segment, which extends two miles from Balch Afterbay to the confluence with Dinkey Creek, contained fewer rainbow and brown trout than did the NFKR upstream of the afterbay (PG&E Co., 1986c; EA, 1988). However, this segment contained a high biomass of Sacramento suckers. Hardhead were also present. The lower river segment, which extends 3.2 miles from the Dinkey Creek confluence to the confluence with the mainstem Kings River, contained a few rainbow trout, but much larger numbers of Sacramento pikeminnow, Sacramento suckers and smallmouth bass. Prickly sculpin were also abundant. Surveys conducted in 1968 and 1970 also found California roach and hardhead in this river segment. Dinkey Creek below the Dinkey Creek siphon contains Sacramento suckers and a few rainbow trout. Kern Brook lamprey may inhabit the mainstream Kings River above the Pine Flat Reservoir (Moyle et el, 1995).

Aquatic Habitat. The Kings River Projects contain a wide diversity of aquatic habitats, including low elevation rivers, high mountain streams, small reservoirs, and relatively large, high elevation reservoirs.

Courtright Reservoir is the most upstream water body in the Kings River Projects system. Its surface area is 1,632 acres. Wishon Reservoir has a surface area of 1,025 acres. During summer, both reservoirs are deep, but they are almost entirely drained during the winter season. Surface elevation during a normal year drops a total of 164 feet in Courtright Reservoir and 110 feet in Wishon Reservoir. These changes result in a 93 percent reduction is surface area and a 96 percent reduction in volume for Courtright Reservoir and a 42 percent reduction in a surface area and 69 percent reduction in volume for Wishon Reservoir. The elevations of these reservoirs also fluctuate on a daily basis. Both reservoirs rise or fall as much as one foot per hour over a six-hour period of operation because of the daily cycling of water between the reservoirs by the Helms Pumped Storage Project (PG&E Co., 2000e). These rapid and extreme lake level fluctuations and the steep gradient of much of the shoreline preclude development of shallow water habitat in the reservoirs. Article 44 of the Helms Pumped Storage Project license requires Courtright Reservoir to be maintained as high as possible on weekends during the recreation season for the benefit of recreational users of the project. Article 36 of the Ilas-Kings River Project license provides a similar requirement for both reservoirs.

Courtright and Wishon Reservoirs are both relatively infertile, as is typical of high, deep mountain lakes. Both reservoirs become thermally stratified during the late spring or early summer as the surface waters warm and cold snowmelt water entering the lake sinks to the hypolimnion (PG&E, 1990b). Water temperature never exceeded 68°F (20°C) in either reservoir during monitoring conducted from 1972 through 1984 (FERC and USFS, 1996). Therefore, the two reservoirs provide coldwater habitat suitable for trout.

The major tributaries of Courtright Reservoir, Helms Creek (above the reservoir), Dusy Creek, and Nelson Creek, provide important spawning habitat for trout from the reservoir as well as habitat for trout that are year round residents of the streams. Rainbow trout spawn in the spring and probably use all three tributaries for spawning (FERC and USFS, 1996). Brook and brown trout spawn in the fall and probably use Helms and Dusy creeks. Flows in Nelson Creek are too low in the fall for trout spawning migrations. Dusy Creek contains several miles of excellent spawning habitat and is considered the most productive spawning stream of Courtright Lake. Limited access to these tributaries results in low fishing pressure.

Helms Creek below Courtright Reservoir generally has poor trout habitat. The stream is very steep and the bedrock channel offers little cover or habitat for food production (PG&E Co., 1986c). Historic high flow releases from the reservoir scoured the stream bottom, but these large releases were eliminated following completion of the Helms Pumped Storage Project in 1984.

The NFKR, Short Hair Creek, and Woodchuck Creek are the major tributaries of Wishon Reservoir. The NFKR has good trout habitat with numerous riffles and pools and pockets of good spawning habitat. This stream provides some spawning habitat for trout from Wishon Reservoir, but it has an impassable waterfall within a quarter mile of the reservoir. Short Hair and Woodchuck creeks have steep gradients, numerous falls, and few riffles. They are impassable to spawning trout. These two streams support resident populations of rainbow, brown and brook trout, but the trout are small because of poor habitat conditions.

Below Lake Wishon, the three principal tributaries of the NFKR are Rancheria, Long Meadow, and Teakettle creeks. Rancheria Creek is steep, with numerous natural barriers (FERC and USFS, 1996). The 1985-1988 fisheries surveys found large numbers of trout fry and suggested that this stream provides important spawning and rearing habitat (EA, 1988). The other two creeks have variable trout habitat and contain populations of rainbow and brook trout.

The eight-mile segment of the NFKR from Wishon Reservoir to Black Rock Reservoir contains a variety of habitats. Flows in this reach are provided by releases and spills from Wishon Reservoir. Most spills occur during the snowmelt period of spring and early summer. The first 1.5 miles of this river segment is relatively low gradient and contains a mixture of large pools, cascades, rubble-bottom and sand-bottom glides, and a few riffles (FERC and USFS, 1996). Following this reach, the river flows through Granite Gorge. This high gradient reach consists of large pools and cascades with bedrock channels containing numerous boulders. Below Granite Gorge, the river contains bedrock channels, cascades and low gradient alluvial reaches. The alluvial reaches contain some spawning habitat. The remainder of the river segment, from the Rancheria Creek confluence to Black Rock Reservoir, provides excellent trout habitat. Water temperatures in this river segment during monitoring conducted between 1972 and 1980 never exceeded 70°F (21°C). Access is difficult in most of the segment and thus fishing pressure is low.

Instream Flow Incremental Methodology (IFIM) studies conducted for several locations in the NFKR segment between Wishon and Black Rock reservoirs provided information about the availability of instream habitat for trout at different levels of flow. In general, weighted usable area (WUA), an index of habitat availability, was highest for adult rainbow trout at flows above 30 cfs and was highest for adult brown trout at flows between 15 and 30 cfs. WUA for juvenile trout responded less consistently to flow. For juvenile rainbow trout, WUA peaked, on average, at flows between about 10 and 40 cfs and for juvenile brown trout, WUA was highest at about 10 cfs (PG&E Co., 1985b).

Black Rock Reservoir is a small, deep, steep-sided impoundment with limited fish habitat. It has a surface area of 37 acres and a maximum depth of about 70 feet (PG&E Co., 1986c). The reservoir serves as the afterbay for the Haas Powerhouse and the forebay for the Balch Powerhouses. The volume of Black Rock Reservoir is small relative to the volume of water discharged from Haas and released to Balch. The reservoir therefore has a high flushing rate. Furthermore, during much of the operational season, which is typically between June and October, the water conveyed to and discharged from Haas is drawn from the hypolimnion of Wishon Reservoir and therefore is quite cold. The maximum recorded temperature in the reservoir is about 58°F (14°C) (FERC and USFS, 1996). Because of its high flushing rate and cold water temperatures, Black Rock Reservoir is relatively unproductive. As indicated earlier, angler success in the reservoir tends to be low.

The NFKR between Black Rock Reservoir and Balch Afterbay is a high gradient stretch of river dominated by cascades, waterfalls, and large plunge pools. The average channel slope in the segment is about 500 feet per mile. No major tributaries enter the NFKR in this segment, so flow is determined by releases and spills from Black Rock Reservoir. Most spills occur during the snowmelt period of spring and early summer. The required minimum flows for this segment are 5 cfs from June through November and 2.5 cfs from December through May. During dry water years, the minimum flow is only 2.5 cfs all year. These minimum flows are lower than those for any other segment of the river, but because of the prevalence of pools in this segment, fish habitat is believed to be less affected by low flows in this segment than in the other segments (CDFG, 2000b). Pools continue to provide habitat for fish at flows that are too low to sustain other types of fish habitat (Gordon et al, 1992).

Water temperatures have not been monitored in the NFKR between Black Rock Reservoir and Balch Afterbay. The low flows and lack of riparian shading in the segment likely result in substantial warming. However, deep pools often contain a coldwater layer that provides refuge for coldwater species, so the prevalence of deep pools in this river segment potentially provides sufficient protection for trout even if water temperatures in the river are high. Unfortunately, sedimentation may be reducing the depth of many of these pools and degrading spawning habitat. This may be a result of inadequate flushing flows in the highly regulated flow regime of this river segment (PG&E Co., 1986c).

Balch Afterbay has little productive fish habitat. The 7-acre impoundment receives the discharges from Balch 1 and 2 powerhouses. The water discharged from the powerhouses originates from Black Rock Reservoir and, therefore, is considerably colder than the flow that enters the afterbay from the NFKR. Water temperatures in the afterbay are only slightly warmer than those in Black Rock Reservoir (PG&E Co., 1986c). The flushing rate of the afterbay is very high when the Balch Project is operating. The high flushing rate, the low fertility of the water, the cold water temperatures and the steep shoreline all contribute to the low productivity of the Balch Afterbay.

For purposes of describing habitat, the stretch of the NFKR below the Balch Afterbay is conveniently divided into two segments, one above and the other below the confluence with Dinkey Creek. The upper river segment runs two miles between the afterbay and Dinkey Creek, and consists of moderate gradient riffles, pocket water, and pools, with a few falls or cascades. The average channel slope is 230 feet per mile. This segment of the river lies in a deep canyon with dense riparian vegetation shading the river. Stream substrate consists predominantly of boulders, with cobbles, gravel and silt spread around them (PG&E Co., 1994b).

The lower 3.2-mile river segment, downstream of the Dinkey Creek confluence, is a moderately low gradient stretch running through a canyon in the upper portion and entering a broad, open floodplain in the lower portion. Short riffles, pocket water, and pools characterize most of the stream channel. The average channel slope is 90 feet per mile. Riparian vegetation in the first half mile below Dinkey Creek is scattered. It thins out even more downstream, finally providing no shade at all to the river surface. (PG&E Co., 1994b).

Releases and spills from the afterbay determine the hydrology of the upper segment of the NFKR between the Balch Afterbay and the Kings River. However, Dinkey Creek flows contribute substantially to the hydrology of the lower segment.

Water temperatures in the NFKR between the Balch Afterbay and the Kings River are generally higher than those in the other segments of the river, and this river segment sustains a warmwater fishery. The upper segment of this stretch of river receives cold water releases from Balch Afterbay, but downstream warming of the water often results in marginal conditions for trout (PG&E Co., 1994b). Warming accelerates in the river downstream of the Dinkey Creek confluence because Dinky Creek water temperatures are often high and because water flows relatively slowly through the low-gradient, open channel of this segment. Summer water temperatures can increase more than 18°F (8°C) between the Balch Afterbay Dam and the Kings River confluence, and regularly exceed maximum temperatures suitable for trout (PG&E Co., 1994b).

The Kings River Powerhouse discharges large volumes of relatively cold water into Pine Flat Reservoir or, when the surface level of the reservoir is low, into the Kings River upstream of the reservoir. When water supplies are seasonally limited, the powerhouse operates in a peaking mode. The Kings River Powerhouse discharges can rapidly and significantly alter the flow and water temperature conditions of the river or the upper end of Pine Flat Reservoir. Effects of these fluctuations on fish in the Kings River and Pine Flat River are not known. (PG&E Co., 1986c).

Special-Status Species. Special-status species found within the Kings River Projects include hardhead, and the San Joaquin subspecies (or form) of the California roach. Both of these species can be found on the NFKR between Balch Afterbay and the confluence of the NFKR with the Kings River (Table 4.4-38). Another special-status species, Kern Brook lamprey, likely occur in the mainstream Kings River upstream of Pine Flat Reservoir (Moyle et al, 1995). Hardhead is a State species of special concern and a USFS sensitive species. Within the project hardhead can be found in both the Kerckhoff Reservoir and the San Joaquin River below the reservoir (PG&E Co., 1977). Historically, hardhead was an abundant and widespread species (Reeves, 1964). In general, hardhead is less abundant than it once was, especially in the southern half of its range. Hardhead prefer large to medium-sized, cool to warm-water streams with natural flow. However, these types of streams are increasingly dammed and diverted, thus removing habitat, isolating upstream areas, and creating temperature and flow regimes unfavorable for hardhead. Consequently, populations are decreasing or disappearing throughout its range. The combination of habitat alteration and specialized habitat requirements has led to localized, isolated populations that are exposed to localized extinctions (Moyle et al, 1995).

In the past, hardhead were sufficiently plentiful in reservoirs that they were assumed to compete with trout and other game fish and were regarded as an undesirable. Most of the reservoir populations proved to be temporary, presumably the result of colonization of the reservoir by juvenile hardhead before introduced predators became established (Moyle et al, 1995).

The California roach is divided into eight different populations depending on its region of residence. The San Joaquin roach is found in the tributaries of the San Joaquin River south of the Consumnes River. The San Joaquin roach is assigned to a Class 3 status rating which signifies it as a watch list species (Moyle et al, 1995). Watch list 3 species are those that were historically more abundant or have limited distributions. California roach usually prefer small, warm intermittent streams, and dense populations are frequently found in isolated pools (Moyle et al, 1995). Most populations flourish in mid-elevation streams in the Sierra foothills and in the lower reaches of some coastal streams.

Surveys conducted by Moyle and Nichols (1974), and repeated by Brown and Moyle (1993), indicate an abundance of the California roach in many areas, yet it has declined in many others since 1970 (Moyle et al, 1995). Populations of this subspecies are becoming increasingly isolated due to the construction of dams, diversions, artificial barriers, predation, and habitat destruction (Moyle et al, 1995). Lamprey larvae (ammocoetes) believed to be Kern Brook lamprey have been collected in the mainstream Kings River above Pine Flat Reservoir. According to Fish Species of Special Concern in California (Moyle et al, 1995) by CDFG:

> The Kern Brook lamprey was first discovered in the Friant-Kern Canal, but it has also been found in the lower reaches of the Merced River, Kaweah River, Kings River, and San Joaquin River (Brown & Moyle, 1993). Since the species was first discovered in 1976, attempts to fully document its range have been only partially successful. However, data collected to date suggest that this species is a San Joaquin endemic (Brown & Moyle, 1993). Populations of this species are thinly scattered throughout the San Joaquin drainage and isolated from one another (Moyle et al, 1995). Such a fragmented distribution makes local extirpations likely, without hope of recolonization, followed by eventual extinction of the species. The probability of local extirpation is increased by the fact that all known populations are located below dams, where stream flows are regulated without regard to the needs of the lampreys. Fluctuations or sudden drops in flow may isolate or dry up ammocoetes. Gravel needed for spawning may be eliminated or compacted, so adults cannot use it. Ammocoetes may also be carried to “dead-end” habitats such as the Friant-Kern siphons. Clearly, management of flows in the lower reaches of rivers of the San Joaquin drainage will need to consider the needs of this lamprey in order for the species to persist (Moyle et al, 1995).

Fisheries Management. Several fisheries management issues have been identified for the Kings River Projects. These include water temperatures in NFKR between Wishon Reservoir and Black Rock Reservoir and between Balch Afterbay and the Kings River, discharge from the Kings River Powerhouse during peaking operations, and flushing flows to remove sediments.

Cold water temperatures are needed in the NFKR between Wishon Reservoir and Black Rock Reservoir to support the important trout fishery in this river segment. While temperatures too high for trout have never been recorded in this segment, temperature modeling indicates that temperatures could exceed the maximum for trout in a dry year (FERC and USFS, 1996). The FERC and USFS have recommended increasing the minimum flow release from Wishon Reservoir to mitigate this potential impact.

Water temperatures in the NFKR below Balch Afterbay frequently exceed the upper limit for coldwater species, particularly in the segment below Dinkey Creek. Minimum flow releases from Balch Afterbay and the Dinkey Creek Siphon were developed in part to moderate the high water temperatures. More recently, however, the feasibility of maintaining coldwater habitat in this segment of the river has been called into question (PG&E Co., 1994b). This section of the river is now being evaluated for management as a native warmwater fishery (CDFG, 2000b).

As previously noted, rapid changes in flow and water temperature conditions result from peaking power discharges from the Kings River Powerhouse into the Kings River or Pine Flat Reservoir. These changes likely affect fish. The Kings River Conservation District plans to study the effects of operations on water temperatures in the Kings River and Pine Flat Reservoir (FERC and USFS, 1996).

Fine sediments are accumulating in many reaches of the NFKR affected by the Kings River Projects, which may adversely affect aquatic habitat, particularly spawning gravels for trout. The FERC and USFS have recommended that Pacific Gas and Electric Company study the need for flushing flows and, if the flows are needed, develop a flushing flow plan in consultation with the resource agencies (FERC and USFS, 1996).

There are no fish screens or bypass structures at any of the diversions in the Kings River Projects, so mortality resulting from the entrainment of small fish into conveyance tunnels and powerhouses may be significant. Because of the very large amounts of water moved by the Helms Powerhouse, entrainment mortality may be particularly high in Courtright and Wishon reservoirs. As mitigation for this potential mortality, Pacific Gas and Electric Company has subsidized the CDFG's stocking program for these reservoirs since the construction of the Helms Pumped Storage Project. Pacific Gas and Electric Company also conducts annual creel censuses to assess the effects of the Helms Project on the trout harvest (PG&E Co., 1994a).

Bundle 19: Tule River

Tule River (FERC 1333)

The Tule River Project is located on the North Fork of the Middle Fork Tule River (North Fork). Flow is diverted from the North Fork at the Tule River Diversion Dam, located four miles upstream from the confluence of the North Fork with the Middle Fork Tule River. The diverted water is conveyed in the Tule River Conduit to the Tule River Powerhouse, which sits at the

Middle Fork confluence. The Tule River Powerhouse discharges directly into the Middle Fork Tule River. The Tule River Diversion Dam forms a very small diversion pool with no storage capacity. The project is operated in a run-of-the-river mode. Elevations in the project range from 2,400 feet at the confluence of the North Fork with the Middle Fork to 4,005 feet at the diversion dam (PG&E Co., 1986d).

Instream Flow and Lake Level Requirements. In addition to diverting from the North Fork, the Tule River Project diverts relatively small amounts of water (< 5 cfs) from Hossack Creek and Doyle Springs. Hossack Creek enters the North Fork about a third of a mile downstream of the Tule River Diversion Dam and all flow is diverted into the Tule River Conduit at the Hossack Creek Diversion Dam except during high spring flows. Doyle Springs is about a quarter mile downstream of the Hossack Creek confluence. All Doyle Spring flow is diverted into the North Fork where it is impounded by the Doyle Springs Diversion Dam. This water is then pumped from the impoundment to the Tule River Conduit.

Except during the spring and early summer, when snowmelt and streamflow are especially high, streamflow in the North Fork below the Tule River Diversion Dam is largely determined by releases from the dam. Articles 105 and 401 of the FERC License require minimum releases for normal water years of 7 cfs or natural flow, whichever is less, during May 15 through September 15, and 4 cfs or natural flow, whichever is less, during the remainder of the year. The minimum release for dry water years is 4 cfs or natural flow all year. The articles also require a minimum instream flow of 2 cfs all year below the Doyle Springs Diversion Dam. FERC License Article 405 limits ramping rates below both of the diversion dams; they must be reductions of 50 percent per hour maximum.

The Tule River Project has a capacity of 66 cfs, which allows it to divert most of the streamflow from the North Fork in most months. The project capacity exceeds or nearly exceeds the median streamflow upstream of the dam for every month except May, which has a median flow of 120 cfs. The capacity exceeds 90 percent of all streamflows for the months of August through December (PG&E Co., 1986d). Meadow Creek, which enters the North Fork about a mile downstream of the Tule River Diversion Dam, and Doyle Springs produce significant increases in streamflow, but there appears to be no flow accretion in the river below Meadow Creek (PG&E Co., 1986d).

Pacific Gas and Electric Company recently constructed a passive fish bypass facility to allow fish passage past the Tule River Diversion Dam and minimize entrainment into the Tule River Conduit and Powerhouse (PG&E Co., 1999a). Construction of the fish bypass facility was a requirement of the 1993 FERC license. The requirement was imposed because of concerns identified during relicensing about fish losses at the Tule River and Hossack Creek diversions. The bypass facility was recently improved, as required by FERC Article 105, by installing an overhead covering in front of the bypass intake to provide cover for the fish and encourage their movement to the intake.

Fish Fauna. Four fish species have been reported from the North Fork between the Tule River Diversion Dam and the Middle Fork Tule River confluence (PG&E Co., 1986d). These species are rainbow trout, brown trout, Sacramento pikeminnow, and California roach. These four species and three additional species, Sacramento sucker, green sunfish, and smallmouth bass, have been found in the Middle Fork Tule River downstream of the confluence (Table 4.4-43). The rainbow trout, pikeminnow, roach, and sucker are native species. During an intensive fish sampling survey conducted in 1984, only rainbow trout, brown trout and California Roach were found in the North Fork. Brook trout, which like brown trout is an exotic species, have been reported from Hossack Creek, but the 1984 survey found only rainbow trout in the creek. Meadow Creek has rainbow and brown trout.

Table 4.4-43 Kings Crane-Helms Regional Bundle - Tule River Project (FERC 1333) Fish Occurrence by Location

Location	Minimum Streamflow/Reservoir Level Required[a]	Rainbow trout	Brown trout	San Joaquin roach	Sacramento pikeminnow	Sacramento sucker	Green sunfish	Smallmouth bass
North Fork of Middle Fork Tule River between Diversion Dam and Doyle Springs	Normal year: 5/1-9/30 7 cfs 10/1-4/30: four cfs Dry year: four cfs	X	X	X	X			
Hossack Creek below Diversion Dam	None	X						
North Fork of Middle Fork Tule River between Doyle Springs Diversion and Middle Fork Tule River confluence	Year round: two cfs	X	X	X	X			
Middle Fork Tule River downstream of confluence with North Fork of Middle Fork	None	X	X	X	X	X	X	X

a cfs = cubic feer/second

Rainbow trout are the most abundant species within Tule River Project waters. In the 1984 survey, they were plentiful in all portions of the North Fork as well as in Hossack and Meadow Creeks. Rainbow trout accounted for 83 percent by number and 73 percent by weight of all fish sampled. Brown trout, which accounted for 11 percent by number and 27 percent by weight of the fish collected, were much more abundant in the upper half of the Project reach than in the lower half. In annual surveys conducted from 1986 through 1989, rainbow trout biomass averaged 33.5 pounds per acre and brown trout biomass average 8.6 pounds per acre (FERC, 1991b). Rainbow trout generally spawn successfully in the North Fork, but brown trout redds and early life stages are often subjected to high flows in winter that may eliminate entire year classes (PG&E Co., 1995a). California roach were found only in the lower half of the reach. (PG&E Co., 1986d).

CDFG manages the North Fork as a put-and-take rainbow trout fishery (FERC, 1991b). Stocking of hatchery-raised trout generally occurs between April and September. Allotments of 200 to 400 pounds of catchable-size trout are planted weekly at various locations within a mile upstream and downstream of the Tule River Diversion Dam. A creel census survey conducted in 1987 found that 68 percent of rainbow trout taken by anglers were of hatchery origin. Most of the fishing and most of the fish caught were in the reach of the river that was stocked (FERC, 1991b). Few of the stocked fish appear to survive the winter (PG&E Co., 1995a).

Aquatic Habitat. Aquatic habitat in the North Fork in the Tule River Project is quite variable despite the small amount of area involved. While most of the reach has a relatively high gradient, changes in elevation and riparian vegetation, as well as mineral deposits from springs in the middle of the reach, result in considerable habitat variation. (PG&E Co., 1986d).

The uppermost section of the Tule River Project, between the Tule River Diversion Dam and Doyle Springs, is dominated by pool and riffle habitat. The average channel slope is about 150 feet per mile. The substrate in this section is comprised primarily of small boulders and rubble. Spawning habitat, consisting of small pockets of gravel behind boulders and in pools, is located sporadically throughout the reach. Riparian vegetation provides good shading in this section.

The next section of the project reach extends downstream from the Doyle Springs Diversion Dam to the confluence of Meadow Creek. In most respects, habitat in this section is similar to that in the upstream reach. However, highly mineralized inflow from Doyle Springs produces mineral deposits (travertine) that cover rock and sediments and form friable benches at the lower ends of pools. Dense mats of algae are also common. The travertine degrades aquatic habitat, particularly spawning habitat, because it binds sediments and seals interstitial spaces between rocks. Riparian vegetation provides good shading in this section.

From the Meadow Creek confluence extending about a mile downstream, the gradient of the river increases and habitat consists primarily of boulder or bedrock controlled pools and cascades. The average channel slope of this section is about 500 feet per mile. Cobbles and gravels are abundant in a channel dominated by large boulders that cause flow to pass around them. The cascades generally range between 4 to 10 feet or more in height. There is little riparian vegetation to provide shade in this section, but woody debris is common in the channel. Boulders provide the principal cover. Spawning substrates are scarce because travertine deposits in the streambed have eliminated or restricted gravel availability.

The next section of the project reach extends downstream to about a quarter of a mile above the Tule River Powerhouse from the approximate midpoint of the project reach. This section is characterized by pool and riffle sequences with some cascades. Habitat is similar to that in the reach below the Tule River Diversion Dam except that pools are more numerous and travertine degrades some potential spawning substrates. Boulders are the dominant substrate in the riffles, but cobbles, gravel, and sand occur in the pools. Mats of algae-covered substrates and travertine is evident on the banks and in the channel.

The lowermost section of the North Fork, extending upstream about one and a quarter mile from the Tule River Powerhouse, predominantly contains bedrock-controlled pool and cascade habitat. Most of the channel is lined with bedrock and scattered boulders. Gravel and sand occur in the pools. There is little shading by riparian vegetation in this section.

Spawning habitat appears to be scarce in the project reach and may be a major limiting factor for wild trout (PG&E Co., 1986d). Suitable spawning gravels were found only sporadically and in small patches in the stream channel. Downstream of Doyle Springs, travertine deposits within the channel fill the interstices between rocks, reducing habitat quality. Access to spawning habitat is also reduced by impassable cascades and falls that limit upstream fish movement.

Instream flow studies conducted during 1984 resulted in the following conclusions regarding effects of streamflow on fish habitat and fish populations in the North Fork (PG&E Co., 1986d; FERC, 1991b). Changes in streamflow limit physical habitat in the river section above the Doyle Springs Diversion Dam more than in the stretch of river below Doyle Springs. The river downstream of Doyle Springs is less affected, in part because of the prevalence of pool and cascade habitat elements in this stretch of river. As noted previously, pool-cascade habitat is typically the stream habitat type least affected by changes in streamflow. In addition, fish populations in the river downstream of Doyle Springs may be relatively unaffected by flow-induced habitat changes because suitable spawning substrates may be the limiting factor in this stretch of the river.

Although effects of streamflow on physical habitat appear to be more important in the Tule River Project reach above Doyle Springs than in the lower portion of the reach, effects of streamflow on water temperatures are more important in the lower portion of the river. Most of the project reach provides coldwater habitat suitable for trout under most conditions. The highest water temperatures recorded in the project reach during July through September 1984 were below 68ºF (20ºC) in all but the most downstream portion of the river (FERC, 1991b). The highest temperature, 73.4ºF (23ºC), was recorded in the river just upstream of the Tule River Powerhouse in mid-July and again in early August. Water temperature modeling indicated that water temperatures in the upper two miles of the Project reach would never exceed the threshold for trout, defined as 68ºF (20ºC) for the daily mean temperature and 77ºF (25ºC) for the daily maximum temperature, if the FERC mandated minimum flow releases were maintained (4 cfs below the Tule River Diversion Dam and two cfs below the Doyle Spring Diversion Dam) (PG&E Co., 1986d). However, in the lower half of the reach, and particularly within a mile upstream of the powerhouse, the threshold would often be exceeded in July and August. In years with normal air temperatures and with a streamflow of about 2 cfs, the threshold in the lowest river section would be exceeded all of the time in July and more than 16 percent of the time in August. In very hot years with the same streamflow, the threshold would be exceeded all of the time in July and over half of the time in August. Inflow from Doyle Springs has a moderating effect on stream temperatures, reducing downstream temperatures in the summer and increasing them in the winter (PG&E Co., 1995a).

Special-Status Species. The only special-status species found within the Tule River Project is the San Joaquin subspecies (or form) of the California roach (Table 4.4-38). This fish can be found in the North Fork between the Tule River Diversion Dam and the confluence with the Middle Fork Tule River (Table 4.4-Tule River spp. table). The California roach is divided into eight different populations depending on its region of residence. The San Joaquin roach is found in the tributaries of the San Joaquin River south of the Consumnes River. The San Joaquin roach is assigned to a Class 3 status rating which signifies it as a watch list species (Moyle et al., 1995). Watch list 3 species are those that were historically more abundant or have limited distributions. California roach usually prefer small, warm intermittent streams, and dense populations are frequently found in isolated pools (Moyle et al 1995). Most populations flourish in mid-elevation streams in the Sierra foothills and in the lower reaches of some coastal streams.

Surveys conducted by Moyle, and Nichols (1974), and repeated by Brown and Moyle (1993), indicate an abundance of the California roach in many areas, yet it has declined in many others since 1970 (Moyle et al, 1995). Populations of this subspecies are becoming increasingly isolated due to the construction of dams, diversions, artificial barriers, predation, and habitat destruction (Moyle et al, 1995).

Fisheries Management. The major fisheries management issue for the Tule River Project is tradeoffs of flow releases to maintain cold water habitat.

Implementation of the FERC mandated minimum flows for the Tule River Project has improved water temperature conditions in the North Fork, but it may have resulted in undesirable increases in water temperatures in the Middle Fork Tule River downstream of the North Fork confluence. The Middle Fork is currently managed as a native warmwater fishery, but substantial water temperature increases in the river adversely affect the fishery habitat (CDFG, 2000b). When water is released into the river channel at the Tule River Diversion Dam, the amount of water diverted into the Tule River Conduit is reduced. The water in the river warms considerably more as it flows towards the confluence with the Middle Fork than does the water in the Conduit. The water in the Conduit is shaded and travels quickly and directly to the Powerhouse and then into the Middle Fork. Therefore, the diverted water reduces water temperatures of the Middle Fork more effectively than the bypassed water. Instream flow studies have demonstrated that a summer flow release of 10 cfs at the Tule River Diversion Dam, such as CDFG and USFWS proposed during relicensing (FERC, 1991b), would cause undesirably high temperatures in the Middle Fork downstream of the confluence (CDFG, 2000b). These results illustrate the importance of coordinating fisheries management among hydropower projects.

Bundle 20: Kern Canyon

Kern Canyon (FERC 0178)

Kern Canyon Project is located on the mainstem of the Kern River in the lowermost reach of the Kern Canyon and includes 1.8 miles of river channel. Kern Canyon Reservoir, which serves as the forebay for Kern Canyon Project, sits at an elevation 948 feet. A maximum of 750 cfs can be diverted from this reservoir through a 1.6-mile long conduit to the Kern Canyon Powerhouse. The water discharged from the powerhouse enters the Kern River at an elevation of 684 feet.

Instream Flow and Lake Level Requirements. Kern Canyon Project is operated as a run-of-the-river facility. Kern Canyon Reservoir has a surface area of only 3 acres and a storage capacity of only 26 af. Therefore, project operations are dependent on flows received from a large upstream storage reservoir, Lake Isabella, operated by the USACE. Lake Isabella is operated primarily for water supply and flood control purposes. Southern California Edison Company operates two run-of-the-river projects between Lake Isabella and the Kern Canyon Project.

Streamflow in the Kern River upstream of the Kern Canyon Project normally peaks during April through August. Median monthly streamflows for April through September equal or exceed the 750 cfs capacity of the project (SCE Co., 1993). Therefore, spills into the river channel of the project reach are common during the late spring, summer, and early fall seasons and typically result in a highly variable flow regime. Article 34 of the FERC License requires a minimum release of 25 cfs into the river all year during normal water years and 12.5 cfs all year during dry years.

Fish Fauna. Seven fish species have been reported to occur in the Kern Canyon Project reach of the Kern River (Table 4.4-44) (PG&E Co., 1972). All are warmwater species and three of the species, Sacramento sucker, Sacramento pikeminnow, and hardhead, are native to the Central Valley. However, Sacramento sucker may be the only one of these species native to the Kern River basin (SCE Co., 1993). The four exotic species of the reach are smallmouth bass, bluegill, white crappie, and white catfish. The CDFG manages the Kern River upstream of the Kern Canyon Project as a put-and-take rainbow trout fishery, and some of the stocked trout may occasionally enter the project reach (SCE Co., 1993). There is no evidence that the stocked trout reproduce in the river.

Table 4.4-44 Kings Crane-Helms Regional Bundle – Kern Canyon Project (FERC 0178) Fish Species Occurrence by Location

Location	Minimum Stream Flow/Reservoir Level Required[a]	Hardhead	Sacramento pikeminnow	Sacramento sucker	White catfish	Bluegill	White crappie	Smallmouth bass
Kern River between Diversion Dam and Powerhouse tailrace	Normal year: 25 cfs Dry year: 12.5 cfs	X	X	X	X	X	X	X

a cfs = cubic feet / second

Sacramento suckers are the dominant fish species in the project reach. In sampling conducted by the CDFG in 1971, Sacramento suckers comprised 96 percent of the biomass of fish collected. Sacramento pikeminnow and hardhead comprised about two percent of the biomass, white catfish were about one percent, and smallmouth bass and white crappie made up the rest. The high biomass of suckers is sustained by a high standing crop of algae in the river (PG&E Co., 1972).

The major sport fish in the project reach are smallmouth bass and white catfish. Because of limited access, steep canyon slopes, slippery algae-covered rocks, and frequent high flows, angler access to this reach of the Kern River is difficult and dangerous. Drownings are frequent in the reach (USFS, 2000).

Aquatic Habitat. Because of its relatively low elevation and hot summer air temperatures, the Kern Canyon Project reach of the Kern River provides warmwater fish habitat only. During a temperature study of the lower Kern River conducted during August through October of 1987, mean daily water temperatures immediately upstream of the project reach exceeded 68°F (20°C) on every day until the last half of October (SCE Co., 1993). Maximum water temperatures in the reach sometimes exceed 80°F (26.7°C) (PG&E Co., 1972).

Bedrock and boulders dominate the physical habitat of the project reach. Much of the channel consists of chutes and runs linking short pools. Riffle habitat and gravel or cobble substrates are absent. The average channel slope is 140 feet per mile. As noted earlier, flows vary markedly during the summer months and frequently exceed 1,000 cfs, which probably adversely affects the fish populations (SCE Co., 1993; USFS, 2000).

Special-Status Species. The only special-status species found within the Kern Canyon Project are hardhead. Hardhead is a State species of special concern and a USFS sensitive species. Although presumably not native to this drainage, this species is present in the Kern River between the diversion dam and the tailrace for the powerhouse (Table 4.4-38). Presumably it can be found up and downstream from the project area as well. Historically, hardhead was an abundant and widespread species (Reeves, 1964). In general, hardhead is less abundant than it once was, especially in the southern half of its range. Hardhead prefer large to medium-sized, cool to warm-water streams with natural flow. However, these types of streams are increasingly dammed and diverted, thus removing habitat, isolating upstream areas, and creating temperature and flow regimes unfavorable for hardhead. Consequently, populations are decreasing or disappearing throughout its range. The combination of habitat alteration and specialized habitat requirements has led to localized, isolated populations that are exposed to localized extinctions (Moyle et al, 1995).

In the past, hardhead were sufficiently plentiful in reservoirs and were assumed to compete with trout and other game fish and were regarded as undesirable. Most of the reservoir populations proved to be temporary, presumably the result of colonization of the reservoir by juvenile hardhead before introduced predators became established (Moyle et al, 1995).

Fisheries Management. No major fisheries issues were identified for the Kern Canyon Project.

4.4.5 STANDARDS OF SIGNIFICANCE

Impacts on fish and aquatic resources are considered significant if the implementation of the proposed project could result in one or more of the following conditions:

1. Have a substantial adverse effect, either directly or through habitat modifications, on any aquatic species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service;

2. Interfere substantially with the movement of any native resident or migratory fish species or impede the use of fish spawning sites;

3. Conflict with any local policies or ordinances protecting fishery resources; or

4. Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional or State habitat conservation plan.

4.4.6 ANALYTICAL METHODS

4.4.6.1 Introduction

Hydrologically, Pacific Gas and Electric Company's hydroelectric projects can be divided into three operational categories: (1) run-of-the-river (ROR) projects; (2) ROR projects influenced by upstream projects with storage; and (3) projects with water significant storage capacity (including pumped storage). Run-of-the river projects do not have significant water storage facilities and are, therefore, operated in response to the prevailing hydrological conditions of the river system where they are located; however, run-of-the-river projects located downstream of projects with significant storage capacity can be influenced by upstream operations. Some of Pacific Gas and Electric Company's projects contain both ROR and storage facilities. Run-of-the-river projects that are not affected by storage projects cannot be operated significantly differently by a new owner than they are currently by Pacific Gas and Electric Company. Consequently, it is expected that the transfer to new owners of run-of-the-river projects not influenced by storage facilities will not result in any significant additional environmental impacts to fish and other aquatic resources over baseline conditions. Table 4.4-45 lists each of Pacific Gas and Electric Company's projects by operational classification.

Projects with storage facilities have the potential to release water on-demand and, therefore, could change operations depending on the objectives of the operator. Similarly, run-of-the-river facilities located downstream of projects with storage may also change operations in response to changes in operations upstream. These projects have the potential to impact fish and other aquatic resources and are, therefore, the focus of the aquatic resources impact evaluations.

4.4.6.2 Analysis Approach

The analysis methodology relied upon the results of the OASIS hydrological model (Appendix H) which simulated baseline and future hydrological conditions (i.e., PowerMax Scenario and

Table 4.4-45 Operational Classification of Pacific Gas and Electric Hydroelectric Projects

Project Name	Operational Classification		
	Run-of-River	Run-of-River Influenced by Upstream Storage	Storage
Shasta Regional Bundle			
Hat Creek Project (FERC 2661)	X		
Pit 1 Project (FERC 2687)			X
Pit 3,4 and 5 Project (FERC 0233)			X
McCloud-Pit Project (FERC 2106)			X
Kilarc-Cow Creek Project (FERC 0606)	X		
Battle Creek Project (FERC 1121)	X		
DeSabla Regional Bundle			
Hamilton Branch Project (non-FERC jurisdictional)			X
Upper North Fork Feather River Project (2105)			X
Rock Creek-Cresta Project (FERC 1962)		X	
Poe Project (FERC 2107)		X	
Bucks Creek Project (FERC 0619)			X
Lime Saddle Project (non-FERC jurisdictional)	X		
Coal Canyon (non-FERC jurisdictional)	X		
DeSabla-Centerville Project (FERC 0803)	X		
Drum Regional Bundle			
Potter Valley Project (FERC 0077)			X
Narrows Project (FERC 1403)		X	
Drum-Spaulding Project (FERC 2310)			X
Chili Bar Project (FERC 2155)		X	
Motherlode Regional Bundle			
Mokelumne River Project (FERC 0137)			X
Spring Gap-Stanislaus Project (FERC 2130)			X
Phoenix Project (FERC 1061)			X
Merced Falls Project (FERC 2467)			X
Kings Crane-Helms Regional Bundle			
Crane Valley Project (FERC 1354)			X
Kerckhoff Project (FERC 0096)			X

Table 4.4-45 Operational Classification of Pacific Gas and Electric Hydroelectric Projects

Project Name	Operational Classification		
	Run-of-River	Run-of-River Influenced by Upstream Storage	Storage
Helms Pumped Storage Project (FERC 2735)			X
Haas-Kings River Project (FERC 1988)			X
Balch Project (FERC 0175)		X	
Tule River Project (FERC 1333)	X		
Kern Canyon Project (FERC 0178)	X		

WaterMax Scenario) at key locations in each regional bundle. The model output estimated daily discharges from each powerhouse, end-of-month storage for each reservoir, end-of-month reservoir elevations and mean monthly stream discharges for the primary stream reaches affected by project operations. The model simulations were completed using the hydrological record for the calendar years from 1975 through 1998, a period of 24 years.

4.4.6.3 Analysis Methodology – Storage Reservoirs

The effects of water-level changes on reservoir ecosystems have been of concern to resource managers since the early 1930s when the Tennessee Valley Authority began its first studies of large reservoirs (Ploskey 1983). The storage reservoirs operated by the Pacific Gas and Electric Company support three types of fisheries: (1) predominantly coldwater fishes (trout and related species); (2) predominantly warmwater fishes (basses, sunfish, catfish, minnows); and, (3) "two-story" fisheries consisting of both coldwater and warmwater fishes. Table 4.4-46 summarizes the physical characteristics of all reservoirs with a storage capacity of at least 50 acre-feet or greater that are owned, operated or potentially influenced by Pacific Gas and Electric Company's hydroelectric operations. Table 4.4-46 also identifies the type of fishery present and the sport fishing regulations related to that fishery. Reservoirs and diversions with a storage capacity of less than 50 acre-feet would not be influenced by any future change in operations due to their small capacity.

Reservoirs that support predominantly coldwater fishes like trout (i.e., species in the fish family Salmonidae) are located at the highest elevations in the Pacific Gas and Electric Company hydroelectric system. Salmonids, such as trout, do not reproduce in these reservoirs, but rather migrate from the reservoir to tributary streams to spawn. Having completed spawning, adult fish may return to the reservoir. The progeny of these reservoir fish may also move downstream to the reservoir to rear. For these fish, the reservoir does not provide spawning habitat, but serves rather as an environment in which to rear and grow.

Table 4.4-46 Summary of the Physical Characteristics of Reservoirs Owned or Influenced by the Operation of Pacific Gas and Electric Company's Hydroelectric System and the Type of Fishery Associated with Each Reservoir

Impoundment Name	Watercourse Impacted	Year Completed	Maximum Water Surface Elevation (feet)	Maximum Water Surface Area (acres)	Gross and (Usable) Storage at Maximum Water Surface Elevation (acre-feet)	Information About the Fishery				
						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
Shasta Regional Bundle – Hat Creek Project (FERC 2661)										
Baum Lake	Hat Creek	1943	2,975.7	89	629 (629)		X		No	Rough sculpin: Fully Protected. May not be taken or possessed at any time. Trout: Open season all year with a five fish daily bag limit. Brook trout: Bonus bag limit of ten fish less than eight inches total length may be taken in addition to the other daily bag limit for trout. Bullhead: Open season all year with no bag limit. Lamprey: Open season all year with no bag limit. Non-game species: Open season all year with no bag limit.
Shasta Regional Bundle – Pit 1 Project (FERC 2687)										
Pit 1 Forebay	Fall River	1947	3,304.8	222	3,212 (2,451)		X		No	Rough sculpin: Fully Protected. May not be taken or possessed at any time. Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit. Sunfish: Open all year with no bag limit. Crappie: Open season all year with a 25 fish bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.

Table 4.4-46 Summary of the Physical Characteristics of Reservoirs Owned or Influenced by the Operation of Pacific Gas and Electric Company's Hydroelectric System and the Type of Fishery Associated with Each Reservoir

Impoundment Name	Watercourse Impacted	Year Completed	Maximum Water Surface Elevation (feet)	Maximum Water Surface Area (acres)	Gross and (Usable) Storage at Maximum Water Surface Elevation (acre-feet)	Information About the Fishery				
						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
Shasta Regional Bundle – Pit 3,4 and 5 Project (FERC 0233)										
Lake Britton (Pit 3 Dam)	Pit River	1925	2,738.5	1,293	41,907 (41,877)		X		No	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit. Catfish: Open season all year with no bag limit. Sunfish: Open all year with no bag limit. Crappie: Open season all year with a 25 fish bag limit. Black bass: Open season all year with a five fish bag limit and a 12-inch minimum size limit. Non-game species: Open season all year with no bag limit.
Pit 4 Forebay	Pit River	1927	2,422.5	105	1,970 (1,970)		X		No	Rough sculpin: Fully Protected. May not be taken or possessed at any time. Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit. Sunfish: Open season all year with no bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.
Pit 5 Intake Reservoir	Pit River	1944	2,040.5	32	327 (314)		X		No	Trout: Open season all year with a five fish bag limit. Sunfish: Open all year with no bag limit. Crappie: Open season all year with a 25 fish bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag

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						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
										limit.
Pit 5 Open Conduit Reservoir	off-stream	1944	2,041.5	48	1,044 (1,044)		No Data		No	
Shasta Regional Bundle – McCloud-Pit Project (FERC 2106)										
Lake McCloud	McCloud River	1965	2,680.0	520	35,234 (35,229)	X			No	Trout: Open season all year with a five fish bag limit. Brook trout: Bonus bag limit of 10 fish less than eight inches total length may be taken in addition to the other daily bag limit for trout. Non-game species: Open season all year with no bag limit.
Iron Canyon Reservoir	Iron Creek	1965	2,665.0	500	24,241 (24,197)	X			No	Trout: Open season all year with a five fish bag limit. Brook trout: Bonus bag limit of 10 fish less than eight inches total length may be taken in addition to the other daily bag limit for trout. Non-game species: Open season all year with no bag limit.
Pit 6 Forebay	Pit River	1965	1,426.0	268	15,886 (15,605)	X			No	Trout: Open season all year with a five fish bag limit. Sunfish: Open all year with no bag limit. Non-game species: Open season all year with no bag limit.
Pit 7 Forebay	Pit River	1965	1,271.0	471	34,611 (34,302)	X			No	Trout: Open season all year with a five fish bag limit. Sunfish: Open all year with no bag limit. Non-game species: Open season all year with no bag limit.

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						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
Shasta Regional Bundle – Battle Creek Project (FERC1121)										
North Battle Creek Reservoir	North Fork Battle Creek	1909	5,563.2	80	1,090 (1,090)	X			No	Trout: Open season all year with a five fish bag limit. Brook trout: Bonus bag limit of ten fish less than eight inches total length may be taken in addition to the other daily bag limit for trout.
Macumber Reservoir	North Fork Battle Creek	1909	4,084.5	85	430 (430)	X			No	Trout: Open season all year with a five fish bag limit. Brook trout: Bonus bag limit of ten fish less than eight inches total length may be taken in addition to the other daily bag limit for trout.
Coleman Forebay	off-stream	1911	937.9	10.6	76.4 (76.4)	X			No	Trout: Open season all year with a five fish bag limit.
DeSabla Regional Bundle - Hamilton Branch Project (non-FERC jurisdictional)										
Mountain Meadows Reservoir (Indian Ole Dam)	Hamilton Branch	1965	5,042.6	5,746	23,942 (23,942)		X		Yes	Trout: Open season all year with a five fish bag limit. Catfish: Open season all year with no bag limit. Sunfish: Open all year with no bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.
DeSabla Regional Bundle – Upper North Fork Feather River Project (FERC 2105)										
Lake Almanor (Canyon Dam)	North Fork Feather River	1913/1927/ 1962	4,504.2	27,064	1,142,964 (1,129,016)		X		Yes	Trout and salmon: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit.

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						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
										Catfish: Open season all year with no bag limit. Sunfish: Open season all year with no bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.
Butt Valley Reservoir	Butt Creek	1924	4,142.3	1,600.0	49,897 (49,897)		X		No	Trout and salmon: Open season all year with a two fish bag limit. Bullhead: Open season all year with no bag limit. Sunfish: Open season all year with no bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.
Belden Reservoir (Caribou Afterbay)	North Fork Feather River	1958	2985.7	42.4	2,477 (2,421)		X		Yes	Trout: Open season all year with a five fish bag limit. Sunfish: Open season all year with no bag limit.
DeSabla Regional Bundle – Rock Creek-Cresta Project (FERC 1962)										
Rock Creek Reservoir	North Fork Feather River	1950	2,216.4	114	4,400 (1,500 w/ sediment)		X		Yes	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit. Sunfish: Open all year with no bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.

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						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
Cresta Reservoir	North Fork Feather River	1949	1,681.2	95.0	4,140 (2,156 w/ sediment)		X		Yes	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit. Sunfish: Open all year with no bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.
DeSabla Regional Bundle – Poe Project (FERC 2107)										
Poe Reservoir	North Fork Feather River	1958	1,391.2	53.3	1,204 (1,203)		X		No	Trout: Open season all year with a five fish bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.
DeSabla Regional Bundle – Bucks Creek Project (FERC 0619)										
Three Lakes	Milk Ranch Creek	1928	6,080.0	44	606 (606)	X			Yes	Trout: Open season all year with a five fish bag limit. Non-game species: Open season all year with no bag limit.
Bucks Lake	Bucks Creek	1928	5,160.5	1,852	105,605 (105,327)		X		Yes	Trout: Open season all year with a five fish bag limit. Sunfish: Open all year with no bag limit. Non-game species: Open season all year with no bag limit
Lower Bucks Lake	Bucks Creek	1928	5,025.5	136	5,843 (5,819)	X			No	Trout: Open season all year with a five fish bag limit. Non-game species: Open season all year with no bag limit.
Grizzly Forebay	Grizzly Creek	1928	4,319.5	38	1,112 (1,109)	X			No	Trout: Open season all year with a five fish bag limit.

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						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
DeSabla Regional Bundle – DeSabla-Centerville Project (FERC 0803)										
Round Valley Reservoir (Snag Lake)	West Branch Feather River	1877	5,651.1	98	1,196 (1,196)	X			No	Trout: Open season all year with a five fish bag limit.
Philbrook Reservoir	Philbrook Creek	1926	5,552.5	173	5,009 (5009)	X			Yes	Trout: Open season all year with a five fish bag limit.
DeSabla Forebay	off-stream	1903/1962	2,755	14.9	188 (188)	X			No	Trout: Open season all year with a five fish bag limit.
DeSabla Regional Bundle – Lime Saddle Project (non-FERC jurisdictional)										
Kunkle Reservoir	off-stream	1906	1,440.5	17	154 (154)		X		No	Trout: Open season all year with a five fish bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit.
Drum Regional Bundle – Narrows Project (FERC 1403)										
Englebright Reservoir (Narrows Dam owned by USCOE)	Yuba River	1941	440	815	70,000 (?)		X		Yes	Trout: Open season all year with a five fish bag limit. Catfish: Open season all year with no bag limit. Sunfish: Open all year with no bag limit. Crappie: Open season all year with a 25 fish bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.

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Impoundment Name	Watercourse Impacted	Year Completed	Maximum Water Surface Elevation (feet)	Maximum Water Surface Area (acres)	Gross and (Usable) Storage at Maximum Water Surface Elevation (acre-feet)	Information About the Fishery				
						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
Drum Regional Bundle – Potter Valley Project (FERC 0077)										
Lake Pillsbury (Scott Dam)	Eel River	1921	1,828.3	2,280	80,643 (80,556)		X		Yes	Trout: Open season all year with a five fish bag limit. Lamprey: Open season all year with no bag limit. Sunfish: Open all year with no bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.
Van Arsdale Reservoir (Cape Horn Dam)	Eel River	1908	1,494.3	65	390 (390)		X		No	Closed to fishing year round.
Drum Regional Bundle – Drum-Spaulding Project (FERC 2310)										
Jackson Meadows Reservoir (owned by Nevada Irrigation District)	Middle Fork Yuba River	1965	6,044	938	? (52,000)	X			Yes	Trout: Open season all year with a five fish bag limit. Non-game species: Open season all year with no bag limit.
Bowman Reservoir (owned by Nevada Irrigation District)	Canyon Creek	1927	5,567	825	? (64,000)	X			Yes	Trout: Open season all year with a five fish bag limit. Non-game species: Open season all year with no bag limit.

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						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
Upper Rock Lake	Texas Creek	About 1855	6,714.5	21.1	207[a] (207)	X			Yes	Trout: Open season all year with a five fish bag limit.
Lower Rock Lake	Texas Creek	1855	6,625.8	8.7	48[a] (48)	X			Yes	Trout: Open season all year with a five fish bag limit.
Culbertson Lake	Unnamed tributary to Texas Creek	1852/1872/ 1922	6,436.4	70	3,150 (953)		X		Yes	Trout: Open season all year with a five fish bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.
Upper Lindsey Lake	Lindsey Creek	About 1870	6,482.6	6	180[a] (6)		X		Yes	Trout: Open season all year with a five fish bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.
Middle Lindsey Lake	Lindsey Creek	1870	6,435.7	23.9	1,100[a] (110)		X		Yes	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.
Lower Lindsey Lake	Lindsey Creek	1870	6,235.6	29	293[a] (293)		X		Yes	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.
Upper Feeley Lake	Lake Creek	1870-1875	6,723.6	56.3	739[a] (739)		X		Yes	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit.

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						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
Lower Feeley Lake (*aka* Carr Lake)	Lake Creek	1870-1875/ 1975	6,663.7	16.9	150[a] (150)		X		Yes	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit. Non-game species: Open season all year with no bag limit.
Blue Lake	Rucker Creek	Before 1870	5,931.6	63	1,163[a] (1,163)		X		Yes	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit.
Rucker Lake	Rucker Creek	1870	5,464.2	69	648[a] (648)		X		No	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit.
Fuller Lake	Unnamed tributary to Jordan Creek	1870/1922	5,341.8	68.9	1,127 (1,127)		X		Yes	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit.
Kidd Lake	Unnamed tributary to South Yuba River	1850-1855	6,627.6	86	1,505[a] (1,505)		X		Yes	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit.
Upper Peak Lake (*aka* Upper Cascade Lake)	Unnamed tributary to South Yuba River	1850	6,607.4	85.4	1,736[a] (1,736)		X		No	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit.
Lower Peak Lake (*aka* Lower Cascade Lake)	Unnamed tributary to South Yuba River	1860	6,581.9	33.3	484[a] (484)		X		No	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit.

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						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
White Rock Lake	White Rock Creek	1850	7,820.0	90	570[a] (570)	X			Yes	Trout: Open season all year with a five fish bag limit. Non-game species: Open season all year with no bag limit.
Meadow Lake	Unnamed tributary to Fordyce Creek	1864	7,281.8	250	4,935[a] (4,841)	X			Yes	Trout: Open season all year with a five fish bag limit.
Lake Sterling	Unnamed tributary to Fordyce Creek	1877	6,987.9	111.6	1,764[a] (1,764)	X			Yes	Trout: Open season all year with a five fish bag limit. Non-game species: Open season all year with no bag limit.
Lake Fordyce	Fordyce Creek	1873/1881/ 1926/1980	6,405.1	772	49,903 (49,903)	X			Yes	Trout: Open season all year with a five fish bag limit.
Lake Spaulding	South Yuba River	1912/1917/ 1919	5,014.6	698	74,773 (74,773)		X		Yes	Trout and salmon: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit. Sunfish: Open all year with no bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.
Lake Valley Reservoir	North Fork of the North Fork American River	1887-1911/ 1980	5,784.9	298	7,964 (7,964)		X		Yes	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit. Non-game species: Open season all year with no bag limit.
Kelly Lake	North Fork of the North Fork American River	Rebuilt 1928	5,907.3	26	336[a] (336)		X		Yes	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit.

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						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
Drum Forebay	off-stream	1913/1965	4,762.5	23	621 (621)		No Data			
Drum Afterbay	Bear River	1968	3,383.2	10	341 (341)		No Data			
Halsey Forebay	off-stream	1913-1916	1,817.2	18	244 (240)		No Data			
Halsey Afterbay (*aka* Christian Valley Reservoir)	Dry Creek	1913-1916	1,496.0	10	106 (96)		No Data			
Rock Creek Reservoir	Rock Creek	1913-1916	1,442.1	55	548 (548)		No Data			
Drum Regional Bundle – Chili Bar Project (FERC 2155)										
Chili Bar Reservoir	South Fork American River	1964	997.5	110	3,139 (3,139)	X			No	Trout: Open season all year with a five fish bag limit. Non-game species: Open season all year with no bag limit.
Motherlode Regional Bundle – Mokelumne River Project (FERC 0137)										
Upper Blue Lake	Blue Creek	1881	8,137.5	343	7,300[a] (7,300)	X			Yes	Trout: Open season all year with a five fish bag limit.
Lower Blue Lake	Blue Creek	1885	8,053.4	198	5,091[a] (5,091)	X			Yes	Trout: Open season all year with a five fish bag limit.
Twin Lakes	Meadow Creek	1898	8,144.7	106	1,207 (1,207)	X			Yes	Trout: Open season all year with a five fish bag limit. Non-game species: Open season all year with no bag limit.

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Impoundment Name	Watercourse Impacted	Year Completed	Maximum Water Surface Elevation (feet)	Maximum Water Surface Area (acres)	Gross and (Usable) Storage at Maximum Water Surface Elevation (acre-feet)	Information About the Fishery				
						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
Meadow Lake	Meadow Creek	1903	7,774.4	140	5,656[a] (5,656)	X			Yes	Trout: Open season all year with a five fish bag limit.
Salt Springs Reservoir	North Fork Mokelumne River	1931/1946	3,960.2	963	141,857 (136,864)		X		No	Trout: Open season all year with a five fish bag limit. Catfish: Open season all year with no bag limit. Sunfish: Open all year with no bag limit. Non-game species: Open season all year with no bag limit.
Upper Bear River Reservoir	Bear River	1900	5,878.0	173	7,306 (6,806)	X			Yes	Trout: Open season all year with a five fish bag limit.
Lower Bear River Reservoir	Bear River	1952	5,822.2	746	52,025 (48,725)	X			Yes	Trout: Open season all year with a five fish bag limit. Non-game species: Open season all year with no bag limit.
Tiger Creek Regulator	Tiger Creek	1931	3,587.4	13	533 (522)	X			No	Trout: Open season all year with a five fish bag limit.
Tiger Creek Afterbay	North Fork Mokelumne River	1931	2,334.2	70	2,607 (2,607)	X			No	Trout: Open season all year with a five fish bag limit.

Table 4.4-46 Summary of the Physical Characteristics of Reservoirs Owned or Influenced by the Operation of Pacific Gas and Electric Company's Hydroelectric System and the Type of Fishery Associated with Each Reservoir

Impoundment Name	Watercourse Impacted	Year Completed	Maximum Water Surface Elevation (feet)	Maximum Water Surface Area (acres)	Gross and (Usable) Storage at Maximum Water Surface Elevation (acre-feet)	Information About the Fishery				
						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
Tabeaud Forebay	off-stream	1901	1,966.6	44	1,259 (1,246)		X		Yes	Trout: Open season all year with a five fish bag limit. Crappie: Open season all year with a 25 fish bag limit. Non-game species: Open season all year with no bag limit.
Motherlode Regional Bundle – Spring Gap-Stanislaus Project (2130)										
Relief Reservoir	Middle Fork Stanislaus River	1901	7,338	223	15,554 (15,122)	X			Yes	Trout: Open season all year with a five fish bag limit.
Donnells Reservoir (owned by Tri-Dams)	Middle Fork Stanislaus River	1957	4,835	401	64,300 (56,893)	X			Yes	Trout: Open season all year with a five fish bag limit.
Beardsley Reservoir (owned by Tri-Dams)	Middle Fork Stanislaus River	1957	3,398	650	97,800 (77,600)	X			Yes	Trout: Open season all year with a five fish bag limit.
Pinecrest Lake (Strawberry Reservoir)	South Fork Stanislaus River	1916	5,620.1	299	18,312 (18,266)		X		Yes	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit. Sunfish: Open all year with no bag limit. Non-game species: Open season all year with no bag limit.
Stanislaus Forebay	off-stream	1908	2,602.3	16.3	320 (320)		No Data			

Table 4.4-46 Summary of the Physical Characteristics of Reservoirs Owned or Influenced by the Operation of Pacific Gas and Electric Company's Hydroelectric System and the Type of Fishery Associated with Each Reservoir

Impoundment Name	Watercourse Impacted	Year Completed	Maximum Water Surface Elevation (feet)	Maximum Water Surface Area (acres)	Gross and (Usable) Storage at Maximum Water Surface Elevation (acre-feet)	Information About the Fishery				
						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
Motherlode Regional Bundle – Phoenix Project (FERC 1061)										
Lyons Reservoir	South Fork Stanislaus River	1930	4,226.6	184	6,228 (6,224)		X		Yes	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit. Catfish: Open season all year with no bag limit. Sunfish: Open season all year with no bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.
Motherlode Regional Bundle – Merced Falls Project (FERC 2467)										
Merced Falls Reservoir	Merced River	1901/Rebuilt 1930	344.0	65	678 (603)		X		Yes	Trout: Open season all year with a five fish bag limit. Lamprey: Open all year with no bag limit. Catfish: Open season all year with no bag limit. Sunfish: Open all year with no bag limit. Crappie: Open season all year with a 25 fish bag limit.
Kings Crane-Helms Regional Bundle – Crane Valley Project (FERC 1354)										
Chilkoot Lake	Chilkoot Creek	1890	7,497.2	57	310 (308)	X			Yes	Trout: Open season all year with a five fish bag limit.
Bass Lake (Crane Valley Reservoir)	North Fork Willow Creek	Rebuilt 1910	3,376.8	1,165	45,410 (45,410)		X		Yes	Trout: Open season all year with a five fish bag limit. Bullhead: Open season all year with no bag limit. Catfish: Open season all year with no bag limit. Sunfish: Open all year with no bag limit. Crappie: Open season all year with a 25 fish bag limit.

Table 4.4-46 Summary of the Physical Characteristics of Reservoirs Owned or Influenced by the Operation of Pacific Gas and Electric Company's Hydroelectric System and the Type of Fishery Associated with Each Reservoir

Impoundment Name	Watercourse Impacted	Year Completed	Maximum Water Surface Elevation (feet)	Maximum Water Surface Area (acres)	Gross and (Usable) Storage at Maximum Water Surface Elevation (acre-feet)	Information About the Fishery				
						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
										Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.
Manzanita Lake (San Joaquin No. 2 Reservoir)	North Fork Willow Creek	1917	2,817.7	26	168 (164)		X		Yes	Trout: Open season all year with a five fish bag limit. Sunfish: Open all year with no bag limit. Crappie: Open season all year with a 25 fish bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit. Non-game species: Open season all year with no bag limit.
Corrine Lake (Wishon Forebay)	off-stream	1896	2,401.0	7	69 (69)		X		Yes	Trout: Open season all year with a five fish bag limit. Sunfish: Open all year with no bag limit. Black bass: Open season all year with a five fish bag limit and no minimum size limit.
Kings Crane-Helms Regional Bundle – Kerckhoff Project (FERC 0096)										
Kerckhoff Reservoir	San Joaquin River	1920	985.7	160	4,252 (4,252)			X	Yes	Striped bass: Open season all year with a two fish bag limit. Fish must be at least 18 inches in total length. Non-game species: Open season all year with no bag limit.
Kings Crane-Helms Regional Bundle – Helms Pumped Storage Project (FERC 2735)										
Courtright Lake	Helms Creek	1958	8,184.0	1,632	123,286 (119,200)	X			Yes	Trout: Open season all year with a five fish bag limit.

Table 4.4-46 Summary of the Physical Characteristics of Reservoirs Owned or Influenced by the Operation of Pacific Gas and Electric Company's Hydroelectric System and the Type of Fishery Associated with Each Reservoir

Impoundment Name	Watercourse Impacted	Year Completed	Maximum Water Surface Elevation (feet)	Maximum Water Surface Area (acres)	Gross and (Usable) Storage at Maximum Water Surface Elevation (acre-feet)	Information About the Fishery				
						Coldwater Fishery	Warmwater and Coldwater Fishery	Warmwater Fishery	Is the Impoundment Stocked as Part of Current Management Practices?	Sport Fishing Regulations that Apply to the Impoundment Based on the Fish Species Known to be Present (see fish species occurrence tables for each project in the Environmental Setting)[a]
Wishon Reservoir	North Fork Kings River	1958	6,550.5	1,025	129,118 (129,078) Helms: (89,100)	X			Yes	Trout: Open season all year with a five fish bag limit. Non-game species: Open season all year with no bag limit.
Kings Crane-Helms Regional Bundle – Balch Project (FERC 0175)										
Black Rock Reservoir (Balch Diversion)	North Fork Kings River	1927/1958	4,098.0	35	1,260 (1,260)	X			No	Trout: Open season all year with a five fish bag limit.
Balch Afterbay	North Fork Kings River	1928/1962	1,704.0	7	318 (317)	X			No	Trout: Open season all year with a five fish bag limit.

a Black bass = Includes largemouth, smallmouth, redeye and spotted basses.
Bullhead = Includes brown and black bullheads.
Catfish = Includes channel and white catfishes.
Salmon = Includes chinook and coho salmon.
Sunfish = Includes bluegill, green sunfish, redear sunfish, pumpkinseed, warmouth and Sacramento perch.
Trout = Includes all trouts, chars, steelhead and kokanee.
Crappie = Includes black and whilte crappies.
Lamprey = Includes all species of lamprey.

Most, but not all, of the Pacific Gas and Electric Company's coldwater reservoirs receive sufficient angling pressure to require supplemental stocking with hatchery fish by the California Department of Fish and Game. It is the policy of the California Fish and Game Commission that catchable-sized trout be stocked only in reservoirs where the natural reproduction and growth are inadequate to maintain populations capable of supporting fishing. Further, stocking is only undertaken when it is reasonable to expect at least a 50 percent return of fish to anglers measured by either numbers or weight of fish harvested (California Fish and Game Commission Trout Policy, amended January 4, 1994.

Reservoirs that are stocked do not produce sufficient numbers of sportfish to sustain angling pressure. The intent of the Trout Policy is to ensure that most of the stocked fish are harvested. For those reservoirs that are stocked, reservoir operation is less of a factor influencing the dynamics of the fish community than the stocking practices of the California Department of Fish and Game and the angling regulations set by the California Fish and Game Commission.

Only one of Pacific Gas and Electric Company's reservoirs is exclusively a warmwater fishery, Bass Lake (Crane Valley Reservoir) located on the North Fork Willow Creek in the Kings Crane-Helms Regional Bundle. Most of the reservoirs operated by Pacific Gas and Electric Company support both cold and warmwater fisheries. Such fisheries are often referred to as "two-story" fisheries, because those fish typical of coldwater environments (such as trout) are found in the deeper, colder waters of reservoirs and fish typical of warm water environments are associated with the shallower, warmer waters of the reservoir. The coldwater fishery consists of various salmonids (trout and salmon). The warmwater fisheries are comprised of a wide variety of species, all of which are non-native to California, except for the Sacramento perch. Many species of native and introduced non-game fish are associated with both the coldwater and warmwater sportfish communities.

As a general observation, it may be stated that no two reservoirs are alike in their physical, chemical and biological environments. The dynamics of reservoir fish communities are influenced by numerous environmental factors and management practices that make the assessment of reservoir fishery dynamics difficult as best. Water level fluctuations are the most obvious and readily measured physical factor associated with reservoir operations. The impact of water level fluctuations on reservoir fish communities has been researched extensively over the past 70 years, resulting in a vast scientific literature on the subject (for example, see Ploskey 1982). While it is not the purpose of this EIR to review that literature, some summary findings are relevant to the analysis of operational impacts on aquatic communities. Changes in water levels that significantly affect fish communities have three characteristics:

1. They are of large magnitude;
2. They are of long duration; and
3. They occur during at least part of the growing season.

Small, short-term fluctuations in water levels generally have little effect on nutrients, plants or invertebrates. Winter fluctuations generally do not increase productivity because low temperatures retard or stop the growth of plants and "cold-blooded" animals such as fish. Further, for reservoirs where the fluctuation zone is barren of vegetation, as is the case for virtually all of Pacific Gas and Electric Company's reservoirs, even large changes in water levels usually have little effect on productivity. The effects of frequent (daily or monthly) fluctuations in water levels on feeding and growth of fish are subtler than effects related to long-term (1-3 year) cycles of water levels.

The evaluation of project operational changes on reservoir fish communities focused on analyzing the magnitude and duration of water level changes during the fish growing season. In addition, for those reservoirs supporting warmwater fish species, the analysis included an assessment of the impact of fluctuating water levels during the springtime spawning and nesting season for sunfishes, basses and catfishes. The specific analysis methods are described in the following narrative.

Thresholds for evaluating significance of operational changes on reservoirs fisheries depend on the species present and management goals of the reservoir. Reservoirs within the Pacific Gas and Electric Company system are managed either as coldwater fisheries or as two-story fisheries. To evaluate the potential effects of the different Scenarios on coldwater fisheries, the May-October cumulative baseline reservoir storage was first calculated. The modeling results for the PowerMax and WaterMax Scenarios were compared to a significance threshold of 20 percent. A reduction in cumulative storage in any year under any of the Scenarios greater than 20 percent was considered to have a significant impact on the reservoir fishery resources. For two-story fishery reservoirs, a second phase of analysis was conducted. This involved the evaluation of changes in reservoir elevation during the spawning season, April to June, for sunfishes, basses and catfishes. The end-of-month storage values for April were compared to those from May, and May values were also compared to June. A change in reservoir elevations of 15 feet, up or down, during this period was considered to result in a "substantial reduction" in available habitat for warmwater fishery resources. A fluctuation of elevation over the evaluation threshold in at least 10 percent of the months for the period of record was deemed to be significant.

4.4.6.4 Analysis Methodology - Streams

When weighted usable area (WUA) estimates from instream flow studies were available, these estimates were used to evaluate changes in habitat availability for the PowerMax and WaterMax Scenarios. WUA results provide an index of instream habitat availability for any given level of flow. Therefore, the modeled streamflow data were used to estimate the mean monthly WUAs for each Scenario, and the total WUAs over all selected months and all years modeled were used to compare the Scenarios with the baseline condition. If a Scenario provided less than 80 percent of the WUA provided by the baseline conditions, the Scenario was considered to have a significant impact. Detailed discussions of the WUA analysis and the associated flow studies are presented in the appropriate sections of this document. Unfortunately, WUA estimates have not been developed for most stream reaches, so a second approach to impact assessment was also required.

To evaluate the potential effects under the PowerMax and WaterMax Scenarios, a 20 percent decrease in the mean monthly flow of a Scenario from the modeled mean monthly baseline was considered a "substantial reduction" in physical habitat (i.e., living space). The number of such “substantial reduction” events that occurred during a period of interest was then calculated. For example, if rainbow trout spawning was of concern on a specific stream reach, the period of April and May, when spawning activity of rainbow trout typically peaks, was evaluated. The maximum possible number of monthly flow events that could occur is 24 data years multiplied by 2 months, or 48. A reduction of instream flow during at least 10 percent of the months in this period was deemed to be significant. In the preceding example, to be significant, a Scenario would have to reduce streamflows by 20 percent at least five times (10 percent of 48) before it would be considered to have a significant impact on fisheries and aquatic resources.

In those stream reaches containing special-status fish species, any reduction in mean monthly flows from April through November would be considered significant. This time period corresponds to important fish life stages (spawning and rearing) and includes the primary summer rearing period when habitat and water temperature concerns are most likely to affect fisheries. This period of analysis also reduces the influence of higher flows associated with winter storms and short duration spill events that generally exceed the operational capacity of Pacific Gas and Electric Company’s facilities.

4.4.6.5 Analysis Methodology for Water Temperature – Reservoirs and Streams

Water temperature is the principal water quality parameter affecting fish that may be affected by changes in operation of Pacific Gas and Electric Company’s hydroelectric projects. It strongly influences the type of fish species that can inhabit a water body. Coldwater habitats support trout and salmon and other coldwater species, whereas warmwater habitats support important gamefish such as largemouth bass and a number of nongame native species. Changes in project operations can result in increases or decreases in water temperature, although increases are more common.

Coldwater and warmwater habitats are important beneficial uses of the California Regional Water Quality Control boards, but they have not been explicitly defined. In general, the boards use a water temperature of 20°C (68°F) as the upper limit for coldwater habitat (for example, California Regional Water Quality Control Board – Central Valley Region, 1985). This informal standard is consistent with the following conclusion derived from numerous scientific studies: “…20-21°C should…be accepted as the upper permissible temperature for salmon and trout waters during the warmest season of the year, although natural temperatures may rise above these levels.” (Alabaster and Lloyd, 1980.) Given the review of the scientific literature conducted as part of this effort, as a general practice for the protection of the coldwater fishery the trend would be to manage for mean daily temperatures of less than 20°C (68°F). Mean daily temperatures above 20°C (68°F) could be considered as not fully protecting the beneficial use in the instance where controllable factors (project operations) exist. Any deviation from these general guidelines would have to be made on a case-by-case basis.

In the impact analyses for this project, changes in water temperatures are evaluated with regard to the management goals of the water body in which they occur. For stream reaches or reservoirs managed for coldwater fisheries, changes in operations that would result in a reduction in the amount of habitat with water temperatures not exceeding 20°C (68°F) are considered significant impacts. In contrast, for stream reaches or reservoirs managed for warmwater fisheries, changes that would result in an increase in water temperatures are not considered significant impacts. Few of the FERC licenses have included studies providing sufficient water temperature data or analysis to allow quantitative determination of the effects of project operations on water temperatures. Therefore, the analyses in this report for most licenses are based on qualitative assessments of effects of changes in operations on the availability of habitat with water temperatures not exceeding 20°C (68°F).

Under the existing FERC license conditions, many Pacific Gas and Electric Company projects operate in the upper portion of the acceptable temperature range or have documented temperature problems (for example: Potter Valley, Bucks Creek, Willow Creek). This is often, but not always, the result of the FERC license not requiring minimum flow release into natural stream channels. Cases exist where there is no FERC minimum flow, and actual, on-the-ground conditions could be considered potentially detrimental to coldwater fisheries. Existing conditions defined for this Project are the hydrologic data that resulted from the OASIS model and includes stream reaches with no minimum flow requirement. Because of this definition, it was possible that the following impact analysis resulted in a no, or less-than-significant impact evaluation, because the variation from the modeled baseline did not surpass the threshold criteria already described. On-the-ground conditions are generally not addressed in the analysis. Additionally, when comparing scenarios, detailed temperature analysis was not possible. A qualitative statement regarding potential increases in temperature is made is some cases. Most evaluations of potential impacts to fisheries resources are made based on modeled changes in streamflows and not potential changes in water temperature.

4.4.7 INTRODUCTION TO IMPACTS AND MITIGATION MEASURES

For Fisheries and Aquatic Biology, the following impacts have been identified:

- Impact 4-1 Instream flow reductions within natural channels as a result of a new owner operation of Pacific Gas and Electric Company's hydroelectric facility assets could adversely affect fishery and aquatic resources, especially special status species, through habitat or water quality degradation (Significant).

- Impact 4.2: Changes in the timing, magnitude, duration and frequency of reservoir levels as a result of new owner operation of Pacific Gas and Electric Company's hydroelectric facility assets could adversely affect fishery and aquatic resources, especially special-status species, through habitat or water quality degradation (Significant).

Where impacts are significant, mitigation measures are recommended at the conclusion of the analysis of each impact.

4.4.8 Impact 4-1: Impact, Analysis, and Mitigation Measures

Impact 4-1 Instream flow reductions within natural channels as a result of a new owner operation of Pacific Gas and Electric Company's hydroelectric facility assets could adversely affect fishery and aquatic resources, especially special status species, through habitat or water quality degradation (Significant).

4.4.8.1. Impact 4-1: Shasta Regional Bundle

The following section analyzes potential impacts on fisheries resources from facilities operations under either of the two Scenarios, PowerMax and WaterMax, in the Shasta Regional Bundle. This analysis is based primarily on the results of the hydrologic modeling (Appendix C) and on additional reference material, as appropriate (Section 4.4.6, Analytical Methods).

Bundle 1: Hat Creek

Hat Creek 1 and 2 (FERC 2661)

The Hat Creek Project is managed as a run-of-river power generation facility. With the exception of minimum bypass flows all diversion flows pass directly from the forebay through canals to each powerhouse. A lack of adequate storage within each diversion forebay limits the ability to operate the project in a power-peaking mode.

Because the Hat Creek Project is characterized as a run-of-river operation and has limited storage capacity, OASIS hydrologic modeling assumed that FERC required minimum flows were maintained for each bypass reach. Potential new owners would be required to maintain bypass releases at least as high as the current bypass releases as required under the current FERC License. OASIS hydraulic modeling of the Hat Creek facilities shows no difference in flow release patterns for all of the Scenarios when compared to the baseline. Therefore, the project is expected to have *no impact* on the aquatic resources of Hat Creek.

Bundle 2: Pit River

Assessments of impacts on fish within each of the individual FERC projects that make up the Pit River Bundle are based on a comparison between the results of OASIS modeling for the baseline condition and the PowerMax Scenario. OASIS Hydrologic Modeling was not conducted for the WaterMax Scenario because the lack of seasonal storage capacity within the Pit River system would result in the operation of the facilities similar to the baseline and PowerMax Scenario. Therefore, it is assumed that impacts that may occur under the WaterMax Scenario would be essentially the same as impacts that may occur under the PowerMax Scenario. Because of the presence of special-status species in the Pit River, any decrease in flow below mean monthly modeled baseline flows within natural stream channels associated with the project was considered a substantial reduction in physical habitat (living space), and thus a significant impact.

Pit 1 (FERC 2687)

Because Pit 1 has limited storage capacity and is operated as a run-of-river facility, OASIS hydrologic modeling was not conducted for this facility. In the absence of hydrologic modeling, assessments to determine potential impacts to fishery resources must rely on the assumption that current operating conditions are consistent with established FERC license minimum flow requirements. Given the limited storage capacity and operational flexibility it is assumed that operation of Pit 1 by a new owner under each Scenario would be essentially the same as current operations exercised by Pacific Gas and Electric Company (baseline). A new owner would also be required to operate Pit 1 in compliance with current FERC license requirements and would therefore operate the facilities in essentially the same way as the current license holder. Therefore, the project would have *no impact* on fishery resources in this system.

Pit 3, 4, and 5 (FERC 0233)

Pit 3, 4, and 5 influences flows in the Pit 3, Pit 4 and Pit 5 bypass reaches of the Pit River. Its greatest influence to stream flows occurs seasonally in summer and fall and during dry and critical water years. The limited storage capacity of the system reservoirs limits its ability to have any substantial influence on stream flows during major storm events or periods of snowmelt runoff related to above normal and wetter water years. Seasonal fluctuations in flow vary between the high spring runoff period when water may be spilled and the low-flow period during summer and fall when the river is completely regulated. Modeling conducted for this assessment reinforces the extent of control that has been imposed on the Pit River during the lower flow period and the relative lack of control during high spring flows (Appendix H: Shasta Figures 2, 4, 6).

A comparison of OASIS modeled mean monthly flow data between the baseline and the PowerMax Scenarios was made to determine if flow reduction events could potentially occur within each of the three bypass reaches. Modeled mean monthly flows for the baseline and PowerMax Scenarios were the same in all three bypass reaches for the period from May through October (Appendix H: Shasta Tables 1, 3, 5). Modeled flows during this period are equivalent to the FERC license required minimum flows of 150 cfs for Pit 3 and 4 bypass reaches, and 120 cfs for the Pit 5 bypass reaches. Flow reductions below the baseline condition occur under the PowerMax Scenario within each bypass reach occur on only one occasion during April and November; each of these reductions is related to project spills that occur during above normal or wet water year types.

Modeled mean monthly stream flows associated with these flow reductions during April of 1978 were 703 cfs (baseline) and 622 cfs (PowerMax) in the Pit 3 bypass reach, 207 cfs (baseline) and 150 cfs (PowerMax) in the Pit 4 bypass reach, and 369 cfs (baseline) and 289 cfs (PowerMax) in the Pit 5 bypass reach. Modeled mean monthly streamflows associated with the flow reductions during November of 1981 were 1,285 cfs (baseline) and 1,186 cfs (PowerMax) in the Pit 3 bypass reach, 763 cfs (baseline) and 664 cfs (PowerMax) in the Pit 4 bypass reach, and 937 cfs (baseline) and 838 cfs (PowerMax) in the Pit 5 bypass reach. The flow reductions observed occurred during periods of the year when water temperature and other water quality parameters are less likely to impact fisheries and other aquatic resources. In addition, flow reductions observed never violated FERC minimum flow releases established to ensure protection of fishery resources. This factor, combined with project operational constraints (limited storage) during periods of high flow result in little operational flexibility and result in similar flow releases and therefore would not cause a substantial change in the riverine environment when compared to the baseline.

Operation of Pit 3, 4, and 5 by a new owner would be substantially the same as the baseline condition, and there would be no substantial change in stream habitat for special-status species or rainbow trout during the period of analysis from April through November. Minor flow reductions that occur during facility spills are unlikely to cause a substantial decrease in habitat availability for fishery resources. Based on this information it is concluded that a future owner's operation of the project would be substantially the same as Pacific Gas and Electric Company's past operation. This project would therefore have a *less-than-significant impact* on fisheries and aquatic resources in this stream system.

McCloud-Pit (FERC 2106)

The thresholds selected for determining significance of impacts on fish species present in natural stream channels of the lower McCloud River, Iron Canyon Creek, and the Pit River depend on the species present and management goals of each stream. Hardhead is the only special-status fish species known to inhabit these stream reaches. Aside from hardhead, the most important fishery resources of these reaches are rainbow trout and brown trout. Management of the McCloud River (Wild Trout Area) seeks to reduce access to these waters by non-game fish species (suckers and pike minnow) that could compete with native trout populations.

For this analysis, a reduction of 20 percent or more in instream flow during at least 10 percent of months in the April through November period over the period of record is considered a significant impact.

A comparison of modeled mean monthly flow data between the baseline condition and the PowerMax Scenario was made to determine the magnitude and number of flow reduction events that would occur (Appendix H: Shasta Table-11 and 13). Flow reductions occur over 20 times at both locations, which is more than 10 percent of the months analyzed under the PowerMax Scenario. Under the significance criteria applied, this project, therefore, would result in a *significant impact* to fishery resources in the McCloud River.

Under all Scenarios OASIS hydrologic modeling correctly assumes that operation of the McCloud-Pit facilities would release the FERC required minimum flow of 3.0 cfs to Iron Canyon Creek downstream of Iron Canyon Dam. Therefore, because operation of the McCloud-Pit facilities by a new owner would be the same as the baseline condition, this project would result in *no impact* to fishery resources in Iron Canyon Creek.

Pit 7 Dam is the last facility operated by Pacific Gas and Electric Company on the Pit River. The purpose of the Pit 7 Dam is to regulate fluctuating flow releases caused by hydroelectric power peaking operations upstream. The entire flow of the Pit River and diverted flows from the McCloud River pass this point prior to release to the lower Pit River and Lake Shasta. Examination of OASIS modeled mean monthly flow data indicate that minor deviations in flow occur between the baseline and PowerMax Scenario (Appendix H: Shasta Table-9, and Appendix H: Shasta Figure-9 and 10). Modeled mean monthly flows under the PowerMax Scenario result in both increases and decreases in flow when compared to the baseline condition. Although reductions in flow occur these reductions do not result in significant impacts to special-status fish species because the magnitude of flows present exceed historic flows, and provide more than adequate living space for fishery resources. Therefore, impacts to fishery resources in the Pit River downstream of Pit 7 Dam as a result of this project would be considered *less-than-significant*.

Bundle 3: Kilarc-Cow Creek

Kilarc-Cow Creek (FERC 0606)

The Kilarc-Cow Creek system has little storage capacity and, therefore, operates much like a run-of-the-river project. Because its operational flexibility is limited, no hydrologic modeling was conducted. In the absence of hydrologic modeling data for Kilarc-Cow, assessments to determine potential impacts to fishery resources in Old Cow Creek that may occur under differing project alternatives must rely on the assumption that operational conditions provided under the existing FERC license conditions are adequate to protect fishery resources. The new owner will be required to operate the facility in compliance with the conditions of the current FERC license. This factor combined with the limited operational flexibility of the project indicates that this project would have *no impact* on fishery resources in this stream section.

South Cow Creek Facility. Similar to the Kilarc facilities, the Cow Creek Facility has little storage capacity and, therefore, operates much like a run-of-the-river facility project. As such, its operational flexibility is limited; therefore, no hydrologic modeling was conducted. In the absence of hydrologic modeling data for the Kilarc-Cow Creek system, assessments to determine potential impacts to fishery resources in South Cow Creek that may occur under differing project alternatives must rely on the assumption that existing agreements and operational conditions described in the existing FERC license conditions are adequate for the protection of fishery resources and are consistent with the baseline condition. The new owner will be required to operate the facility in compliance with the conditions of the current FERC license and agreements. This factor combined with the limited operational flexibility of the project indicates that this project would have *no impact* on fishery resources in this stream section.

Bundle 4: Battle Creek

Battle Creek (FERC 1121)

Implementation of the measures contained in the Battle Creek MOU will improve stream flow and habitat conditions for listed anadromous salmonids in Battle Creek over those conditions that currently exist. While the MOU is presently undergoing NEPA/CEQA review and has not yet been formally adopted, due to the broad based support for the plan and its likely adoption, the measures in the MOU are used as the baseline for this analysis. Pacific Gas and Electric Company has agreed that any new owner will be contractually bound to the conditions of the MOU. Pacific Gas and Electric Company is also obliged to request an amendment to its FERC license to include the instream flows and facility changes set forth in the MOU. For these reasons, operation of the Battle Creek system by a new owner under all proposed Scenarios would be the same when compared to the baseline conditions. Therefore, this project would have *no impact* on fishery resources within this stream.

Summary of Impact 4-1 to Entire Shasta Regional Bundle

Hat Creek 1 and 2 (FERC 2661), Pit 1 (FERC 2687), and Kilarc-Cow Creek (FERC 0606) operate as run-of-river system with limited storage. For this reason, a new owner would have limited operational flexibility that could impact fisheries resources. Consequently, no impact is expected. However, the facilities associated with Pit 3, 4, and 5 (FERC 0233) would allow a new owner sufficient operational flexibility that changes in operations could result in a *less-than-significant impact* on the fisheries resources, especially special status species. In a similar manner, the operations of facilities associated with McCloud-Pit (FERC 2106) could alter streamflows and result in a *significant impact* to the fisheries resources and their habitats, especially special status species. Because of the potential effects associated with a new owner's potential operations of the McCloud-Pit system, fisheries resources within the Shasta Regional Bundle could be subject to a *significant impact*.

4.4.8.2 DeSabla Regional Bundle

The following section analyzes potential impacts on fisheries resources from facilities operations under either of the two Scenarios, PowerMax and WaterMax Scenarios, in the DeSabla Regional Bundle. This analysis is based primarily on the results of the hydrologic modeling (Appendix C) and on additional reference material, as appropriate (Section 4.4.6, Analytical Methods).

Bundle 5: Hamilton Branch

Hamilton Branch (non-FERC)

The hydrologic results for the WaterMax and PowerMax Scenarios in the Hamilton Branch between Indian Ole Dam and the Hamilton Diversion Dam (Node 1-2) indicate that flows are reduced by 20 percent or more for both Scenarios from baseline conditions over 10 percent of the months during rainbow trout spawning (April-May) and brown trout spawning (October – November) period of record (Appendix H: DeSabla Table-24). Under the representative normal water year, both the WaterMax and PowerMax Scenarios show a 74 percent reduction from the baseline flow of 120 cfs in the month of May. In the representative wet year, flows for all Scenarios are similar throughout the year. In the representative critically dry year, there are flow reductions in several months, with a significant 66 percent reduction from baseline under both the PowerMax and WaterMax Scenarios in the month of October. The WaterMax and PowerMax Scenarios are nearly identical to baseline in the representative dry year analysis. Regardless of a new owner's incentives and operation of the Hamilton Branch facility, any new owner would be responsible for maintaining the minimum 2 cfs flow in this stream section that is stipulated in the 1989 Fish and Wildlife Agreement. However, based on the modeling information it is concluded that a future owner's operation could be substantially different than the baseline operation for this stream section, and therefore the project could have a *significant impact* on fisheries and aquatic resources in this stream section.

The hydrologic results for the WaterMax and PowerMax Scenarios in Hamilton Branch between the Hamilton Diversion Dam and the Hamilton Branch Powerhouse (Node 2-4) indicate that flows are essentially the same as baseline. All of the representative water years (Appendix H: DeSabla Figure-23 and 24) delineate a clear adherence to the four cfs minimum flow under all of the project Scenarios except for high spring flows during wet years. Based on the modeling information it is concluded that a future owner's operations would be essentially the same as baseline operation for this stream section, and therefore this project would have a *less-than-significant impact* on fisheries and aquatic resources in this stream section.

Bundle 6: Upper North Fork Feather River

Upper North Fork Feather River (FERC 2105)

Two stream sections in the Upper North Fork Feather River system were assessed for the impact of reductions in instream flow (see Table 4.4-47). These sections are the NFFR between Canyon Dam and Belden Reservoir (Node 4-9) and the NFFR between Belden Dam and the NFFR confluence with the East Branch of the NFFR (Node 16-17).

The hydrologic modeling results for the WaterMax and PowerMax Scenarios in the NFFR section between Canyon Dam and Belden Reservoir (Node 4 - 9) indicate that flows are not reduced by 20 percent or more from baseline conditions for normal, wet, dry, and critically dry years (Appendix H: DeSabla Table-1 and 2). In fact, the representative water year types (Appendix H: DeSabla Figure-1 and 2) clearly show that under every Scenario, the new owner would keep flows at the FERC required minimum of 35 cfs. This is probably due to the vast storage available in Lake Almanor and the more profitable use of this water being run through the Prattville Intake for creating hydroelectricity at the Butt Valley Powerhouse, as well as the Caribou 1 & 2 powerhouses. Based on the modeling information it is concluded that a future owner's operation would be substantially the same as baseline, and therefore the project would have a *less-than-significant impact* on fisheries and aquatic resources in this stream section.

Table 4.4-47 Stream Reaches with Reduced Flows in the North Fork Feather River

NFFR Stream Rash	Miles
Lake Almanor (Canyon Dam) to Caribou Powerhouse	10
Belden Dam to Belden Powerhouse	8
Rock Creek Dam to Bucks Creek Powerhouse	7
Cresta Dam to Cresta Powerhouse	5
Poe Dam to Poe Powerhouse	8
Total for North Fork Feather River Between Lake Almanor (Canyon Dam) and Poe Powerhouse	**38**

The hydrologic results for the WaterMax and PowerMax Scenarios in NFFR between the Belden Dam and the confluence of the NFFR with the East Branch of the NFFR (Node 16 - 17) indicate that flows are generally the same as baseline for the period of record during the April through November timeframe (Appendix H: DeSabla Table-7). However, the WaterMax Scenario would experience a 20 percent reduction in flows over 18 percent of the months for the period of record during the brown trout spawning season (October-November) mostly during wet years (Appendix H: DeSabla Table-8). Because these reductions in flow would occur during the fall (when air temperatures are generally low) of wet years, they would probably not result in adverse water temperature conditions, but likely would affect availability of physical spawning habitat. The representative water year analysis (Appendix H: DeSabla Table-7 and 8) details a close adherence to the FERC mandated minimum flow under both Scenarios for the critically dry, dry, and normal years. In the representative wet year, FERC mandated flows are met, but each Scenario exhibits different flow patterns during uncontrolled spring spills. Based on the modeling information it is concluded that a future owner's operation could differ substantially from baseline during the brown trout spawning season (October-November) for the period of record, and therefore the project could have a *significant impact* on fisheries and aquatic resources.

Rock Creek-Cresta (FERC 1962)

Two stream sections in the North Fork Feather River (NFFR) were assessed for the impact of reductions in stream flow for the Rock Creek-Cresta project. These sections are the NFFR between the Rock Creek Dam and the Bucks Creek Powerhouse tailrace (Node 18-22) and the NFFR between Cresta Dam and the Poe Reservoir.

The hydrologic modeling results for the NFFR between the Rock Creek Dam and Bucks Powerhouse (Node 18-22) indicate that flows do not exceed the 20 percent threshold from baseline conditions over 10 percent of the months in the April through November period over the period of record (Appendix H: Drum Table-10). During the key rainbow trout spawning season of April through May, however, the PowerMax Scenario would exceed the 20 percent criteria for instream flows over 10 percent of the months for the period of record. These situations, however, occur in above normal and wet years (Appendix H: DeSabla Table-9 and 10) during the uncontrolled spring run-off months. The analysis results in a spurious classification of potential operational changes as potentially significant because reductions from baseline occur during periods of uncontrolled, extreme spill at the facilities. Seasonal fluctuations in NFFR flow can be substantial during peak spring runoff periods of wet years. In fact, the representative wet water year (Appendix H: DeSabla Figure-12) shows uncontrolled flows above 6,000 cfs in this NFFR stream section during the month of May exceed project capacity and flows over the top of project dams towards Lake Oroville. Twenty percent reductions, and for that matter higher reductions, from baseline flow during these periods would not have a detrimental effect on the fishery resource. In fact, any flow reduction during this substantial movement of floodwater might provide additional refugia habitat and therefore could have a beneficial effect on the fishery resource. Water temperatures are not an issue during this time of the year. The representative normal, dry, and critically dry years (Appendix H: DeSabla Figure-11 and 12) show all Scenarios strictly adhering to the FERC mandated minimum flow requirements.

For the NFFR between the Cresta Dam and Poe Powerhouse (Node 24-26), the hydrologic results also indicate that flows do not exceed the 20 percent threshold from baseline conditions over 10 percent of the months in the April through November period for the period of record (Appendix H: DeSabla Table-14). During the key rainbow trout spawning season of April through May, the PowerMax Scenario would exceed the 20 percent criteria for reduction of instream flows approximately 18 percent of the months for the period of record. However, these situations, like the stream section described above, occur in above normal and wet years (Appendix H: DeSabla Table-13 and 14) during the uncontrolled spring run-off months. As discussed above, the analysis results in a spurious classification of potential operational changes as significant because reductions from baseline occur during periods of uncontrolled, extreme spill at all project facilities. The representative normal, dry, and critically dry years (Appendix H: DeSabla Figure-13 and 14) show all Scenarios strictly adhering to the FERC mandated minimum flow requirements.

A new owner's operation would be essentially the same as those under baseline, except during uncontrolled spring runoff periods. Therefore there would be no substantial change in the availability of physical habitat or water quality for fisheries populations. Based on the modeling information, it is concluded that a future owner operation would be essentially the same as baseline, and therefore the project would have a *less-than-significant impact* on fisheries and aquatic resources in this stream section in this stream section.

Poe (FERC 2107)

One stream section in the North Fork Feather River (NFFR) was assessed for the impact of reductions in instream flow for the Poe System. This section is the NFFR between Poe Dam and the Poe Powerhouse.

Like the hydrologic modeling results for the Rock Creek-Cresta stream section previously described, the hydrologic results for the WaterMax and PowerMax Scenarios for the NFFR stream section between Poe Dam and Poe Powerhouse (Node 27-29) indicate that flows do not exceed the 20 percent threshold from baseline except for multiple instances in above normal and wet years (Appendix H: DeSabla Table-15 and 16) during the highly uncontrolled spring run-off months of March through May. As discussed above, the analysis results in a spurious classification of potential operational changes as significant because reductions from baseline occur during periods of uncontrolled, extreme spill at all project facilities. The representative normal, dry, and critically dry years (Appendix H: DeSabla Figure-15 and H-16) show all future owner Scenarios strictly adhering to the FERC mandated minimum flow requirements.

A new owner's operation would be substantially the same as modeled baseline conditions, and there would be no substantial change in the availability of physical habitat or level of water quality for fisheries populations. Based on the modeling information, it is concluded that a future owner operation would be substantially the same as baseline operation, and therefore the project would have a *less-than-significant impact* on fisheries and aquatic resources in this section.

Bundle 7: Bucks Creek

Bucks Creek (FERC 0619)

Streamflows in the North Fork Feather River and Pacific Gas and Electric Company's operation of the Bucks Creek system influence Bucks, Grizzly, and Milk Ranch creeks flows. Four stream sections were assessed for the impact of reductions in instream flow. Flow in these stream sections are regulated during non-runoff periods. Milk Ranch Creek below Three Lakes Reservoir to its confluence with the NFFR is a 3.5 mile reach in which there is currently no required FERC minimum flow. It is not anticipated that a future owner would change operation in this stream section; therefore, it was not analyzed for impacts.

While the hydrologic results for the WaterMax and PowerMax Scenarios in the Bucks Creek stream section between Bucks Lake and Lower Bucks Lake (Node 11-12) indicate that flows are reduced by 20 percent or more from baseline conditions under a myriad of circumstances for all water year types (Appendix H: DeSabla Table-3), the data does not reflect the considerable variability in flow that this stream section exhibits under all Scenarios, including baseline, for all water years over the period of record. This variability exists for all Scenarios due to different operating incentives (Appendix C), and because the stream section acts as a short water conveyance rapidly reacting to power demands. When flows reach Lower Bucks Lake, they are diverted for power production at the Grizzly Powerhouse or released into Bucks Creek below Lower Bucks Lake.

For this same stream section (Node 11-12), viewing the representative water year types (Appendix H: DeSabla Figure-3 and 4) demonstrates the flow variability discussed above. There are multiple situations under the representative wet, normal, and dry year analysis, where the 20 percent significance criteria is exceeded. In reality these reduced flows might have a more beneficial effect on the stream section's fishery and aquatic resources than the baseline. As described in the Bucks Creek Bundle setting (Section 4.4), holding habitat for trout is limited during high flow conditions due to high velocities. In all of the representative water year types, the baseline, PowerMax, and WaterMax Scenario flows criss-cross each other in response to differing economic incentives and downstream obligations. The WaterMax and PowerMax Scenarios flows exceed baseline conditions on as many occasions as they drop below baseline. In these Scenarios, the variable fluctuations would have different detrimental and beneficial effects on the fishery resource. Although the hydrologic modeling for this stream section determined that a new owner with different operating incentives could operate the system differently, ultimately reducing flows 20 percent below baseline, it is concluded that the high degree of variability exhibited under all of the Scenarios would have equally unpredictable effects on an already stressed fishery resource. Based on the modeling, it is concluded that the project would result in a *less-than-significant impact* on fisheries and aquatic resources in this stream section.

The hydrologic results for the WaterMax and PowerMax Scenarios for the Bucks Creek stream section between Lower Bucks Lake and the NFFR (Node 12-22) indicate that flows do not exceed the 20 percent threshold from baseline conditions over 10 percent of the months in the April through November period for the period of record (Appendix H: DeSabla Table-27 and 22). The representative wet, normal, dry, and critically dry years (Appendix H: DeSabla Figure-27 and 28) show all future owner Scenarios releasing the FERC mandated minimum flow, with the exception of some significant downstream spilling in the representative wet year. Based on the modeling, it is concluded that a future owner operation would be essentially the same as baseline. The project would therefore result in a *less-than-significant impact* on fisheries and aquatic resources in this stream section.

For the PowerMax and WaterMax Scenarios, the hydrologic results for the Grizzly Creek stream section (Node 13-26) are exactly the same as they are for baseline for all months for the period of record (Appendix H: DeSabla Table-5 and 6). The representative wet, normal, dry, and critically dry water years (Appendix H: DeSabla Figure-5 and 6) show all Scenarios releasing the FERC mandated minimum flow level. Based on the modeling, it is concluded that this project, therefore would therefore have *no impact* on fisheries and aquatic resources in this stream section.

The stream section on the NFFR between Bucks Powerhouse and Cresta Reservoir (Node 23-24) is approximately 1 mile, and has always exhibited significant flow fluctuation because the Bucks Creek system acts as a regulating unit separate from North Fork Feather River facilities and is designed to react rapidly to changes in energy load. In fact, fluctuations in instream flow at the Bucks Powerhouse tailrace can vary from 0 to 340 cfs within a period of 80 seconds (CDWR, 1986). While the hydrologic results for the WaterMax and PowerMax Scenarios in this stream section indicate that flows are reduced by 20 percent or more from baseline conditions under a myriad of circumstances for all water year types (Appendix H: DeSabla Table-11 and 12), it does not also reflect the considerable variability in flow that this stream section exhibits under baseline for all water years over the period of record. The variability exists between the Scenarios, as each owner has different operating incentives (Appendix C). The representative water year data captures some of the spiking fluctuation levels in this stream section for the all the water year types (Appendix H: DeSabla Figure-11 and 12). Since the development of the Bucks Creek Project, the fishery resource in this stream section has always existed under extreme variations in flow. Therefore, it is not clear that the WaterMax and PowerMax Scenarios, which are sometimes 20 percent above and other times 20 percent below baseline, would have a detrimental effect on the fishery. Under all Scenarios and in all water years, any new owner would be responsible for maintaining the FERC mandated minimum flows for this stream section. Based on the modeling, it is concluded there would be a *less-than-significant impact* on fisheries and aquatic resources in this stream section as a result of this project.

Summary of Effects. Although there is the potential for extreme variability of instream flows, as discussed above, a new owner's operation would not significantly impact the availability of physical habitat or the level of water quality for fisheries populations in stream sections influenced by the Bucks Creek Project. Based on the modeling information, it is concluded that this project would have a *less-than-significant impact* on fisheries and aquatic resources.

Bundle 8: Butte Creek

No hydrological modeling was prepared for the Butte Creek Bundle, because system flexibility is constrained by a general lack of storage, regulatory requirements, and water delivery constraints.

DeSabla-Centerville (FERC 0803)

Fluctuations in streamflows and corollary changes in water quantity and quality could result in a number of in-stream changes harmful to anadromous and resident fish species and other aquatic biota. The DeSabla-Centerville System has little storage capacity and, therefore, operates much like a run-of-the-river project. This limits operational flexibility. Therefore, no hydrologic modeling of the system was conducted. Nonetheless, habitat needs within the Butte Creek system are complex and vary by area and time of year. Butte Creek streamflows and water temperature issues, in particular, are major concerns of State and Federal resource agencies due to the presence of Federal and State listed threatened spring-run chinook salmon and steelhead.

While no hydrologic modeling was conducted for the WBFR and Philbrook Creek stream sections, the ability to alter flows significantly in these sections are limited due to the system's lack of flexibility and because of physical and regulatory constraints. Therefore, a new owner with different operating incentives would not be able to significantly alter flows in this stream section. Instream flows for the PowerMax and WaterMax Scenarios are expected to be essentially the same as those for baseline conditions. Because there would be no substantial change in the availability of physical habitat or the level of water quality for fisheries populations in these stream sections, there would be a *less-than-significant impact* on fisheries and aquatic resources as a result of this project.

There are two bypass reaches on Butte Creek associated with Pacific Gas and Electric Company's DeSabla-Centerville Project. The first bypass reach is between the Butte Creek Diversion Dam and the DeSabla Powerhouse (DeSabla reach) and the other is between the Lower Centerville Diversion Dam and the Centerville Powerhouse (Centerville reach).

While no hydrologic modeling was conducted for the DeSabla bypass reach, the ability to alter flows significantly in this section is limited due to the system's lack of flexibility and because of physical and regulatory constraints. Therefore, a new owner with different operating incentives would not be able to significantly alter flows in this stream section. Instream flows for the PowerMax and WaterMax Scenarios are expected to be essentially the same as those for baseline conditions. Because there would be no substantial change in the availability of physical habitat or the level of water quality for fisheries populations in this stream section, there would be a *less-than-significant impact* on fisheries and aquatic resources as a result of this project.

While hydrologic modeling was not conducted for the DeSabla-Centerville system as part of this project, thresholds developed for determining significance of impacts on fish based on the modeling can be utilized for Butte Creek. baseline would be considered the current informal year-round 40 cfs flow currently released by Pacific Gas and Electric Company. One of the basic assumptions of a new owner interested in maximizing power generation is disregarding informal agreements. Therefore a new owner, disregarding the informal year-round release of 40 cfs below the Lower Centerville Diversion Dam and adhering to minimum FERC flow requirements would reduce flows in this stream section in normal years to 30 cfs (a 25 percent reduction) from November 1 to December 14, and reduce flows in dry years to 10 cfs (a 75 percent reduction) from September 15 to May 31. For the purposes of this analysis, any reduction in mean monthly flow is considered significant for stream reaches with listed species. Therefore, a new owner reducing instream flow on Butte Creek below the Lower Centerville Diversion Dam associated with this hydrodivestiture could have a *significant impact* on the listed species or its habitat in this reach.

Summary of Effects. A new owner operation of the DeSabla-Centerville project in most cases would be essentially the same as current operation because the system lacks flexibility resulting from a lack of storage and institutional constraints. Therefore, in most cases, there would be no substantial change in the availability of physical habitat or of water quality for fisheries resources. However, a new owner disregarding the informal year-round release of 40 cfs below the Lower Centerville Diversion Dam and adhering to minimum FERC flow requirements would reduce flows in the Centerville bypass reach to levels that could significantly impact State and Federally listed threatened spring-run chinook salmon and steelhead. Based on the foregoing information it is concluded that a future owner's operations could be substantially different than baseline operations, and therefore there would be a *significant impact* on the listed species or their habitat in this reach.

Lime Saddle (non-FERC) and Coal Canyon (non-FERC)

Fluctuations in stream flows, and corollary changes in water quantity and quality, could result in a number of instream changes harmful to resident fish species and other aquatic biota. The Lime Saddle and Coal Canyon powerhouses are essentially run-of-the-river projects in the lower section of the West Branch Feather River (WBFR) with little storage capacity or operational flexibility due to binding water delivery constraints. Therefore, no hydrologic model was conducted.

While hydrologic modeling was not conducted for the Lime Saddle and Coal Canyon powerhouses as part of this project, thresholds developed for determining significance of impacts on fish based on the modeling can be utilized for the WBFR. Baseline would be considered the current informal release made by Pacific Gas and Electric Company below the Upper Miocene Diversion Dam. One of the basic assumptions of a new owner interested in maximizing power generation is disregarding voluntary practices. Therefore a new owner, disregarding the voluntary release below the Upper Miocene Diversion Dam, and diverting all of the WBFR flow into the Upper Miocene Diversion Dam, would reduce flows in this stream section to zero during the dry summer months. For the purposes of this analysis, a reduction of 20 percent or more in the instream flow during at least 10 percent of months in the April through November period over the period of record is considered a significant impact. Therefore, a new owner reducing instream flow to zero in the WBFR below the Upper Miocene Diversion Dam could significantly impact trout populations, already limited by reduced flows, through reduction of habitat and degradation of water quality. Based on the foregoing information it is concluded that a future owner operation could be substantially different than Pacific Gas and Electric Company's past operation, and therefore is considered a *significant impact* on fisheries and aquatic resources.

Summary of Impact 4-1 to Entire DeSabla Regional Bundle

A future owner's operation is likely to have a *less-than-significant impact* on Bundle 7. However, a future owner's operation could have a *significant impact* on Bundle 5 and portions of Bundle 6. The DeSabla-Centerville Project (Bundle 8) could be operated in a manner that would result in a 50 percent reduction of instream flows in Butte Creek, a stream supporting State and Federally listed Central Valley steelhead and spring-run chinook. This is considered a *significant impact*. Because of the potential project effects in Bundle 5, 6 and 8, a new owner operating at Pacific Gas and Electric Company's facilities in the DeSabla Regional Bundle could result in a *significant impact* on fisheries resources.

4.4.8.3 Drum Regional Bundle

The following section analyzes potential impacts on fisheries resources from facilities operations under either of the two Scenarios, PowerMax and WaterMax Scenarios, in the Drum Regional

Bundle. This analysis is based primarily on the results of the hydrologic modeling (Appendix C) and on additional reference material, as appropriate (Section 4.4.6, Analytical Methods).

Bundle 9: North Yuba River

Narrows (FERC 1403)

The Yuba River complex below Englebright Reservoir and Deer Creek below Scotts Flat Reservoir supports anadromous runs of chinook (fall and spring) and steelhead. Spring chinook and steelhead are Federally listed and fall chinook are proposed for listing. For this reason, any reduction in streamflows during any time of the year is considered a significant impact on these species.

The Yuba River below Englebright Reservoir (Node 197) is primarily subject to releases from Englebright Reservoir and operations of Narrows Powerhouse 1 (operated by Pacific Gas and Electric Company) and 2 (operated by Yuba County Water Agency) (Node 210). Modeling results indicate that there is often no flow in this reach under baseline conditions. There are only 44 months out of the entire 24-year (288 month) period of record in which the baseline Scenario provided flow into this channel. Analysis of potential effects that could result from a change in facility operations were compared to those months in which there was flow in the Yuba River under baseline conditions. Between Nodes 197 and 210 the PowerMax and WaterMax Scenarios result in reductions in flows within this stream channel. The WaterMax Scenario reduces flows in 6 months over the 44-month period of record, approximately 14 percent of the time (Appendix H: Drum Table-25). The WaterMax Scenario results in reductions to modeled streamflows in 5 months, or in approximately 11 percent of the months (Appendix H: Drum Table-25). The streamflow resulting from operations under the different Scenarios, as portrayed within the representative water years, do not display a clear pattern of variation (Appendix H: Drum Figure-25 and 26). Because of the presence of special-status species in this reach, these reductions in flow that may result from this project could have a *significant impact* on the aquatic resources in this stream reach.

As mentioned above, the Yuba River below Englebright Reservoir is primarily subject to releases from operations of Narrows Powerhouse 1 (operated by Pacific Gas and Electric Company) and 2 (operated by Yuba County Water Agency). The powerhouse discharges and release flows from Englebright combine just below Englebright Reservoir (Node 210). Water released from these facilities flows to the confluence with Deer Creek (Node 211). OASIS modeling results indicate that the PowerMax and WaterMax Scenarios result in reductions in flows within this stream channel. The PowerMax and WaterMax Scenarios reduce flows in 64 and 65 months over the 288-month period of record approximately 22 percent of the time (Appendix H: Drum Table-27). The months most frequently affected by operational changes are November, December, February, and April. The variations in streamflow as a result of operations under the different Scenarios as portrayed within the representative water years indicate this variation from baseline, but the graphical scale of the figures does not clearly display this variation (Appendix H: Drum Figure-27 and 28). These reductions in flow discussed above that may result from this project could have a *significant impact* on the aquatic resources in this stream reach.

Streamflows from the confluence of the Yuba River with Deer Creek (Node 211) downstream to a point at which the Yuba County Water Agency diverts water from the stream (Node 213) are subject to project operations. The PowerMax and WaterMax Scenarios result in reduction in flows within this stream channel. The PowerMax and WaterMax Scenarios both reduce flows in 80 and 83 months over the 288-month period of record approximately 28 percent of the time (Appendix H: Drum Table-29). The months most frequently affected by operational changes are November, December, February, and May. The variations in streamflow as a result of operations under the different Scenarios as portrayed within the representative water years indicate this variation from baseline, but the graphical scale of the figures does not clearly display this variation (Appendix H: Drum Figure 29 and 30). These reductions in flow discussed above that may result from this project could have a *significant impact* on the aquatic resources in this stream reach.

Streamflows from the point at which the Yuba County Water Agency diverts water from the stream (Node 213) to the downstream end of the project area (Node 999) are subject to project operations. The PowerMax and WaterMax Scenarios also reduce streamflows within this channel. The PowerMax Scenario reduces flows in 71 months over the 288-month period of record, approximately 25 percent of the time (Appendix H: Drum Table-31). The WaterMax Scenario results in reductions to modeled streamflows in 72 months, or in approximately 25 percent of the months. The months most frequently affected by operational changes are November, December, February, and May (Appendix H: Drum Table-31). The variations in streamflow as a result of operations under the different Scenarios, as portrayed within the representative water years, indicate this variation from baseline, but the graphical scale of the figures do not clearly display this variation (Appendix H: Drum Figure-31 and 32). These reductions in flow discussed above that may result from this project could have a *significant impact* on the aquatic resources in this stream reach.

Summary of Effect. As a result of this project, the listed fisheries resources in the Yuba River from the confluence with Deer Creek to the downstream end of the project area could be subject to reduced streamflows from either the PowerMax or WaterMax Scenarios and corresponding impacts to listed species and their habitat. This is a *significant impact*.

Scotts Flat Reservoir receives water from the South Yuba Canal and Deer Creek Powerhouse. Because these facilities are subject to Pacific Gas and Electric Company operations, they are potentially subject to a change in operations from a new owner of the facilities. Hydrological modeling conducted for the Yuba-Bear system indicated that operational changes could result in streamflow fluctuations in Deer Creek from Scotts Flat Reservoir (Node 173) to the Yuba River (Node 211).

Deer Creek streamflows from Scotts Flat Reservoir (Node 173) to the D-S Canal (Node 175) vary depending on operations of Scotts Flat Reservoir. The PowerMax and WaterMax Scenarios result in reductions in flows within this stream channel. The PowerMax Scenario reduces flows in 10 months over the 24-year (288-month) period of record (approximately three percent). The

WaterMax Scenario results in reductions to modeled streamflows in 15 months, or in approximately five percent of the months (Appendix H: Drum Table-17). Variations in streamflow as a result of operations under the different Scenarios tend to be greater in dry and critically dry water years (Appendix H: Drum Figure-17 and 18). The reductions in flow as a result of this project could have a *significant impact* on the aquatic resources in this stream reach.

Flow in Deer Creek from the D-S Canal (Node 175) to China Ditch (Node 178) vary depending on upstream operations. The PowerMax and WaterMax Scenarios result in reductions in flows within this stream channel. In 25 months during the 24-year period of record, flows within this reach were 0 cfs under baseline conditions. The PowerMax Scenario reduces flows in 10 months over the 263-month period of record. The WaterMax Scenario results in reductions to modeled streamflows in 13 months (Appendix H: Drum Table-19). The WaterMax Scenario reduces flows to 0 cfs on five separate occasions when there would have been flow under baseline conditions during this period.

Most reductions occur during the months of July through October (Appendix H: Drum Table-19). Variations in streamflow as a result of operations under the different Scenarios tend to be greater in dry water years (Appendix H: Drum Figure-19 and 20). These reductions in flow could have a *significant impact* on the aquatic resources in this stream reach.

Deer Creek streamflows from the China Ditch (Node 178) to the model Node 180 vary depending on upstream operations. Hydrologic modeling results indicate that flows in this channel under baseline conditions are often 0 cfs. There are only 69 months out of the 288 in the period of record in which the baseline Scenario provided flow into this channel. Potential effects from a change in facility operations were analyzed and compared to those months in which the channel was provided streamflow under baseline conditions. The PowerMax and WaterMax Scenarios result in reductions in flows within this stream channel. The PowerMax Scenario reduces flows in four months over the 69-month period of record (approximately six percent). In one instance flows are reduced to 0 cfs under this Scenario when baseline provides flow. (Appendix H: Drum Table-21). The WaterMax Scenario results in reductions to modeled streamflows in two months, or in approximately three percent of the months (Appendix H: Drum Table-21). The variations in streamflow as a result of operations under the different Scenarios within this reach do not fall into an obvious pattern (Appendix H: Drum Figure-21 and 22). These reductions in flow as a result this project could have a *significant impact* on the aquatic resources in this stream reach.

Deer Creek streamflows from Node 180 to the confluence with the Yuba River (Node 211) vary depending on upstream operations. Hydrologic modeling results indicate that instream flows between June and September under baseline conditions are often 0 cfs. There are only 13 months out of this period (June-September) in which the baseline Scenario provided flow into this channel. Potential effects from a change in facility operations were analyzed and compared to those months in which there was flow in Deer Creek under baseline conditions (197 months). The PowerMax and WaterMax Scenarios result in reductions in flows within this stream channel. The PowerMax and WaterMax Scenarios reduce flows in 12 months over the 197-month period of record, approximately six percent (Appendix H: Drum Table-23). Each of these Scenarios reduced instream flows to 0 cfs on two occasions when baseline provided water in the channel. The variations in streamflow resulting from operations under the different Scenarios as portrayed within the representative water years indicate that the PowerMax and WaterMax Scenarios are more variable than baseline in critical water years (Appendix H: Drum Figure-23 and 24). These reductions in flow discussed above that may result from this project could have a *significant impact* on the aquatic resources in this stream reach.

Summary of Effect. As a result of this project, the listed fisheries resources in Deer Creek from Scotts Flat Reservoir downstream to the confluence of Deer Creek and the Yuba River could be subject to reduced flows from either the PowerMax or WaterMax Scenarios streamflows and corresponding impacts to listed species and their habitat. This is a *significant impact*.

Bundle 10: Potter Valley

Potter Valley (FERC 77)

Hydrologic modeling data conducted for the Potter Valley Project (PVP) includes data for baseline conditions and the PowerMax Scenario. The WaterMax Scenario was not modeled for the PVP because baseline conditions have been established to maximize water deliveries. For this reason it is assumed there are no potential impacts to the fishery resources of the Eel River from the operation of the PVP in a manner that would maximize water deliveries. Because there are two listed species of salmonids to be found within the PVP, chinook and steelhead (Table 4.4-25), any reduction in modeled streamflows in comparison to baseline flows are considered to have a significant impact on these species. For the PVP the baseline Scenario represents the operations of the project under current conditions with all informal agreements remaining in place. Because the baseline is already maximized for delivery of water, there was no WaterMax Scenario modeled for the PVP.

The PowerMax Scenario represents the operation of the project in a manner to maximize power generation and the associated revenue. In this situation all voluntary agreements have been dropped and only those required by law (FERC minimum flows and deliveries to PVID) have been maintained. Targeted storage values for Lake Pillsbury have been established to allow for suitable storage and corresponding power generation. For example, the end of December storage target has been set to 30,000 af in normal water years and 25,000 af in dry or critical water years. The end of May storage target is 60,000 af. Water year types are based on those used in Article 38 (FERC 1983).

Lake Pillsbury to Cape Horn Dam. The PowerMax Scenario could result in significant impacts to the fishery resources in the stream reach between Lake Pillsbury (Node 800) and Cape Horn Dam (Node 810) because this Scenario results in significantly reduced streamflows (Appendix H: Drum Figure-43 through 46). This could have a direct impact on chinook and steelhead as follows:

- Reduction of fall flows (October through December) could impede upstream migration of chinook and steelhead adults, as well as reduce available spawning habitat. Modeled streamflow data indicates that this could occur under the PowerMax Scenario approximately 45 percent of the time. S*ignificant impacts***.**

- Reduction in winter and early spring flow (January through March) occurs 4 percent of the time within this period. These reductions could have a significant impact on the spawning success of listed chinook and steelhead. S*ignificant impact***.**

- Reduction in spring flows (March through June) occurs approximately 22 percent of the time under the PowerMax Scenario. In theory, this could have a potential beneficial effect on chinook outmigration by providing more "natural" hydrology (declining flows and a corresponding increase in temperature) and initiating earlier outmigration from the reach above Cape Horn Dam. However, potential impact to steelhead could occur if flows between Cape Horn and Scott dams are reduced in a manner that initiates the premature outmigration of these fish. It has been demonstrated that larger juvenile steelhead have a higher survival rate (SEC, 1998). The reach between the dams is excellent habitat for steelhead and they reach large sizes in a single growing season (SEC, 1998). Because the PowerMax Scenario could result in reduced flows, juvenile steelhead may prematurely leave the project area. S*ignificant impact***.**

- Reduction in spring flows (March through June) occurs approximately 22 percent of the time under the PowerMax Scenario. In addition to the items previously discussed, this could slow downstream migration of juvenile chinook and steelhead. Impeding migration could lead to increases in predation or exposure to unfavorable water temperatures in the lower river. *Significant impact***.**

- Reduction of streamflow in the summer months (June through October) occurs approximately 13 percent of the time under the PowerMax Scenario. This could limit available steelhead rearing habitat and increase water temperatures. S*ignificant impact*.

Eel River below Cape Horn Dam (Node 810-999). Fall (October through December): Reduction of streamflows below Cape Horn Dam during the fall chinook and steelhead migration and spawning season could have significant impacts on these species. To augment mean monthly data provided by the hydrologic modeling, the weighted usable area (WUA) values calculated as part of a study that was conducted as part of the long-term monitoring study for Pacific Gas and Electric Company (SEC, 1998) were used. The chinook spawning habitat-suitability relationship developed by SEC was used to generate percent of total WUA available on a monthly basis for the months of October, November, and December. Because the SEC relationship is only valid for flows between 12 and 400 cfs, discharges above these values were not evaluated in this analysis. Values for modeled minimum flows of 5 cfs were assigned the WUA percentage for 12 cfs to account for accretion. To calculate WUA values at intermediate discharges, a two-stage polynomial relationship was created (Table 4.4-48). Analysis of the resultant WUA values under the PowerMax Scenario indicates that there would be a reduction in available habitat below Cape Horn Dam. This reduction varies depending on the year and month. For example, October reductions are 23 percent in 1979 (Water Year 1980) under the PowerMax Scenario (Table 4.4-48). In November there are more frequent reductions in WUA, six occurrences under the PowerMax Scenario. In December the PowerMax Scenario results in two years with lower WUA values and

Table 4.4-48 Difference in Percent of Peak Weighted Usable Area Available Under Baseline and PowerMax Conditions[a]

Site: Drum: Eel River below Cape Horn Dam					Location: Node 810-999			Watershed: Sacramento		
Water Year	Water Year Type	October			November			December		
		Percent Peak WUA			Percent Peak WUA			Percent Peak WUA		
		BL2000	PowerMax	Difference	BL2000	PowerMax	Difference	BL2000	PowerMax	Difference
1975	Wet	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
1976	Critical	12	12	0	53	53	0	66	66	0
1977	Critical	12	12	0	12	12	0	12	12	0
1978	Above Normal	12	12	0	12	12	0	80	95	15
1979	Below Normal	12	12	0	12	12	0	12	12	0
1980	Above Normal	35	12	-23	82	78	-5	87	97	10
1981	Dry	12	12	0	12	12	0	46	38	-8
1982	Wet	12	12	0	N/A	N/A	N/A	N/A	N/A	N/A
1983	Wet	12	12	0	74	53	-21	N/A	N/A	N/A
1984	Wet	12	12	0	N/A	N/A	N/A	N/A	N/A	N/A
1985	Dry	12	12	0	N/A	83	N/A	79	79	0
1986	Wet	12	12	0	54	12	-42	79	79	0
1987	Dry	12	12	0	12	12	0	12	12	0
1988	Critical	12	12	0	12	12	0	N/A	74	N/A
1989	Dry	12	12	0	34	12	-23	79	79	0
1990	Critical	12	12	0	66	66	0	79	79	0
1991	Critical	12	12	0	12	12	0	12	12	0
1992	Critical	12	12	0	12	12	0	12	12	0

Table 4.4-48 Difference in Percent of Peak Weighted Usable Area Available Under Baseline and PowerMax Conditions[a]

Site: Drum: Eel River below Cape Horn Dam					Location: Node 810-999			Watershed: Sacramento		
Water Year	Water Year Type	October			November			December		
		Percent Peak WUA			Percent Peak WUA			Percent Peak WUA		
		BL2000	PowerMax	Difference	BL2000	PowerMax	Difference	BL2000	PowerMax	Difference
1993	Above Normal	12	12	0	12	12	0	N/A	101	N/A
1994	Critical	12	12	0	12	12	0	38	38	0
1995	Wet	12	12	0	12	12	0	53	53	0
1996	Wet	12	12	0	12	12	0	N/A	101	N/A
1997	Wet	12	12	0	35	12	-24	N/A	N/A	N/A
1998	Wet	12	12	0	12	12	0	12	12	0
1999	Wet	12	12	0	70	12	-58	71	40	30

a Based on SEC (1998) and polynimial curve FIT to predict intermediate values. Values below the minimum flow calculated (12 cfs) were assigned the WUA value for 12 cfs because the minimum flows in the modeling do not account for tributary accretion below Cape Horn Dam where the original study accounted for accretion. WUA for flows $< =200$ cfs calculated as $WUA = -0.0025Q^2 + .9725Q + 6.7857$ ($R^2 = .9998$). N/A = Flows > 400 cfs two with higher WUA values. Based on the modeling, a new owner's operation of the PVP could reduce available habitat; this project, therefore could have a *significant impact* on the migration and spawning of Federally listed chinook and steelhead.

Spring (February through June): This period of time is important to incubation and outmigration of juvenile chinook and steelhead. Reductions in streamflow could lead to dewatering of redds and reduction in transit rates. In February and March, the PowerMax Scenario often provides slightly higher streamflows than the modeled baseline (Appendix H: Drum Table-47). However, the PowerMax Scenario results in reductions in streamflows in three years during February and two instances in March (Appendix H: Drum Table-47). In April, the PowerMax Scenario reduces discharges into the Eel River below Cape Horn Dam in 10 of the 24 years. This could have a significant impact on outmigration of juvenile chinook and steelhead and on upstream migrating and spawning steelhead. During May, the PowerMax Scenario provides more water into the Eel River below Cape Horn Dam than baseline. In June, the PowerMax Scenario reduces releases into the Eel River in five of the 24 years within the analysis period. Decreased flows warm more rapidly and may result in hostile rearing conditions for salmonids. Additionally, reduced flows result in a reduction in available instream habitat and potentially subject chinook and steelhead to greater predation pressures. Reductions in flow and available habitat that could result from this project could have a *significant impact* on the fisheries resources in the upper Eel River.

Summer (July through September): In the summer months (July-September) there is no difference between the modeled baseline and the PowerMax Scenario. Because there is no difference, the project would result in *no impact* to the resources during this time period.

East Branch Russian River (Node 820-999). The East Branch Russian River is managed primarily as a put-and-take rainbow trout fishery. It is expected that because the management of a portion of this reach results in the regular addition of fish through planting and rapid removal through sport fishing, changes in operations will have no impact on CDFG's management of this reach. Reductions in streamflows within this reach could effect resident fish, both trout and other non-game species. Analysis of the modeled data indicate that discharges from the PVP would be reduced below the 20 percent threshold value in 33 instances (Appendix H: Drum Table-49 and 50). Most of these events (21) occur during the months of November and April. The reduction of streamflows that may result from a this project could have a *significant impact* on the resident fish within this stream reach.

Summary of Effects:

- Reductions in flow between Cape Horn and Scott dams could impede adult migration, reduce spawning success, delay outmigration, and reduce rearing habitat. *Significant impact*.

- Mean monthly discharges for the Eel River below Cape Horn Dam indicate that less area would be available for chinook spawning in October, November, and December. *Significant impact*.

- Upstream migration of adult chinook and steelhead may be impaired during October, November, and December because of reduced flows under the PowerMax Scenario. *Significant impact*.

- Reduction in discharges to the Eel River below Cape Horn Dam in spring, April-June, could affect juvenile chinook and steelhead outmigration and may result in water temperatures that are not conducive to salmonid survival. *Significant impact*.

- Reduction in diversions to the East Branch Russian River could substantially reduce the habitat available for resident fisheries. *Significant impact*.

Bundle 11: South Yuba River

The Drum-Spaulding Project supports a viable rainbow and brown trout fishery. For this reason, reductions in flows from April through November were evaluated for potential project impact on these resources.

Drum-Spaulding (FERC 2310)

Fordyce Creek between Fordyce Reservoir (Node 152) and Lake Spaulding (Node 154) is the upper portion of the South Yuba River system. Variations in streamflow as a result of operations under the different Scenarios tend to be greater in dry and critically dry water years especially during the summer months (Appendix H: Drum Figure-1 and 2). The PowerMax and WaterMax Scenarios result in reductions in flows below the 20 percent threshold level during April through November in 29 and 26 instances respectively, for all years (Appendix H: Drum Table-2). These represent more than 10 percent of the possible number of events within the evaluation period 192-month. Therefore, this project could have a *significant impact* on the fisheries resources in Fordyce Creek between Fordyce Reservoir and Lake Spaulding.

The South Yuba River between Lake Spaulding (Node 154) and Englebright Reservoir is subject to discharge from Spaulding 2 powerhouse (Node 160) and the Snow Mountain Ditch (Node 162). These two reaches were combined for analysis because they exhibit similar conditions under the different Scenarios. Examination of the representative water years selected for this analysis indicate that there is a large amount of variation in streamflow as a result of operations under the different Scenarios, especially during the summer months (Appendix H: Drum Table-3 and 4 and Figure-3 through 6).

Operations of Pacific Gas and Electric Company’s facilities under the PowerMax Scenario result in minor variations in streamflow in relation to baseline, for the representative water years (Appendix H: Drum Figure-4, 6, and 8). The number of reductions in streamflows below the 20 percent threshold level during April through November that result from modeled PowerMax Scenario operations ranges from one event between Lake Spaulding and Spaulding 2 discharge (Nodes 154-160) and 12 events between the South Yuba at Snow Mountain Ditch and Englebright (Node 160-162) for all years (Appendix H: Drum Table-4 and 6). Because these represent less than 10 percent of the possible number of events within the evaluation period, this project is considered to have a *less-than-significant impact* on the fisheries resources in this reach.

In a similar pattern to the PowerMax Scenario discussed above, project operations under the WaterMax Scenario also result in minor variations of streamflow in relation to baseline, for the representative water years (Appendix H: Drum Figure-4, 6, and 8). The number of reductions in streamflows below the 20 percent threshold level during April through November that result from modeled WaterMax Scenario operations ranges from two events between Lake Spaulding and Spaulding 2 discharge (Nodes 154-160) and eight events for the South Yuba Snow Mountain Ditch to Englebright (Nodes 160-162) (Appendix H: Drum Table-4 and 6). Because these represent less than 10 percent of the possible number of events within the evaluation period, this project's considered to have a *less-than-significant impact* on the fisheries resources in this reach.

Summary of Effect. As a result of this project, the trout fisheries in Fordyce Creek and the South Yuba River from Fordyce to Lake Spaulding and on downstream to Englebright Reservoir could be subject to reduced streamflows from either the PowerMax or WaterMax Scenarios and corresponding impacts to aquatic resources within this reach. These reductions could have a *significant impact* between Fordyce and Lake Spaulding. Alterations of flow from either of the two Scenarios in the remainder of this reach are considered a *less-than-significant impact***.**

Texas and Lindsey creeks are subject to diversion of water to the Bowman-Spaulding Canal (Node 150) and, therefore, are subject to potential changes in operations as a result of this project. Water not diverted into the Bowman-Spaulding Canal eventually flows into Englebright Lake (Node 190). Examination of the representative water years selected for this analysis indicates that there is a no variation in streamflow as a result of operations under the different Scenarios (Appendix H: Drum Table-34). Within this reach, the PowerMax and WaterMax Scenarios do not result in reductions in streamflows below the 20 percent threshold level between April and November (Appendix H: Drum Figure-33 and 34). For this reason, this project is expected to have *no impact* on the aquatic resources in this stream reach.

Summary of Effect: The trout fisheries in Texas and Lindsey creeks from the point of diversion at the Bowman Canal downstream to Englebright Reservoir do not appear to be subject to reduced streamflows under either the PowerMax of WaterMax Scenarios. *No impact***.**

Because Pacific Gas and Electric Company has contractual water agreements with the owners of Bowman Reservoir and the Bowman-Spaulding Canal on Canyon Creek (NID), the transfer of Pacific Gas and Electric Company's facilities to a new owner could result in a change in operations of these facilities.

Canyon Creek below Bowman Reservoir is subject to facility operations when water is diverted from Bowman Reservoir into the Bowman-Spaulding Canal. Water entering the creek from Bowman Reservoir (Node 147) flows to Englebright Lake (Node 190). Examination of the representative water years selected for this analysis indicate that there is very little variation in streamflow as a result of operations under the different Scenarios (Appendix H: Drum Figure-35 and 36).

Under the PowerMax Scenario, streamflows are reduced below the 20 percent threshold level during April through November that result from modeled PowerMax Scenario operations only three times over the 24-year period of record (Appendix H: Drum Table-36). This represents less than ten percent of the possible number of events within the evaluation period. The effects of this project, therefore, are considered to have a *less-than-significant impact* on the fisheries resources in this reach.

In a similar pattern to the PowerMax Scenario discussed above, project operations under the WaterMax Scenario also result in variation of streamflow in relation to baseline, for the representative water years (Appendix H: Drum Figure-35 and 36). Streamflows are not reduced below the 20 percent threshold level during April through November period (Appendix H: Drum Table-36). For this reason, this project is considered to have *no impact* on the fisheries resources in this reach.

Summary of Effect. The trout fisheries in Canyon Creek from Bowman Lake downstream to Englebright Reservoir would be subject to streamflow changes under the operational Scenarios. Under the PowerMax Scenario, this project would result in *less-than-significant impacts*. Under the WaterMax Scenario, this project would have *no impact* on fisheries and aquatic resources within this reach.

The Middle Fork Yuba River is impounded in Jackson Meadows Reservoir (Node 98). Below Jackson Meadows, flows are diverted into a canal system at the Milton Diversion Dam (Node 100). Diverted water eventually enters Canyon Creek, Bowman Lake and the Spaulding powerhouse system. Water that is not diverted at Milton continues downstream until the Lohman Ridge Tunnel intake (Node 105) at the Hour House Diversion Dam where water is transferred to Oregon Creek (Node 110) then to New Bullards Bar Reservoir via the Camptonville Tunnel. Because Pacific Gas and Electric Company has contractual water agreements with the owners of these facilities (NID), the transfer of Pacific Gas and Electric Company's facilities could result in changes in facility operations at the upper end of the system (Jackson Meadows Reservoir and Milton Diversion Dam) have the potential to affect instream flows and fisheries resources in the Middle Fork Yuba River.

Examination of the representative water years selected for this analysis indicate that there is a large amount of variation in streamflow within this reach (Node 98-100) as a result of operations under the different Scenarios (Appendix H: Drum Figure 37 and 38). Streamflows are reduced below the 20 percent threshold levels as a result of PowerMax and WaterMax Scenario operations during April through November for all years 37 and 26 times respectively (Appendix H: Drum Table-38). This represents more than 10 percent of the possible number of events within the evaluation period. This project, therefore, could have a *significant impact* on the fisheries resources in this reach.

Examination of the representative water years selected for this analysis indicate that there is only minor variation in streamflow within this reach (Node 100-105) as a result of operations under the different Scenarios (Appendix H: Drum Figure-39 and 40). Operations of Pacific Gas and Electric

Company's facilities under the PowerMax and WaterMax Scenarios result in no variation of streamflow in relation to baseline below the 20 percent threshold levels as a result of Scenario operations during April through November for all years (Appendix H: Drum Table-40). For this reason, facility operations under either Scenario is considered to have *no impact* on the fisheries resources in this reach.

Hour House Diversion Dam to Englebright Reservoir. Examination of the representative water years selected for this analysis indicate that there is only minor variation in streamflow within this reach (Node 105-190) as a result of operations under the different Scenarios (Appendix H: Drum Figure-41 and 42). Within this reach, the PowerMax and WaterMax Scenarios show reductions in streamflows below the 20 percent threshold level between April and November only once over the period of record (Appendix H: Drum Table-42). This occurs in May for the PowerMax Scenario and April for the WaterMax Scenario. This is within the rainbow trout spawning season and could have a *less-than-significant impact* on the reproductive success of this species.

Summary of Effect: The trout fisheries in the Middle Fork Yuba River from Jackson Meadows Reservoir downstream to Englebright Reservoir would be subject to streamflow changes under the operational Scenarios. Under the PowerMax Scenario, the project could result in *significant impacts* to the aquatic resources between Jackson Meadows and Milton Diversion Dam. The PowerMax and WaterMax Scenarios show the project could result in *less-than-significant impacts* to the aquatic resources between Hour House Diversion Dam and Englebright Reservoir. Similarly, both Scenarios show the project could have *no impact* to resources between Milton and Hour House diversion dams.

The Bear River above Rollins Reservoir (Node 247) is subject to operations of Drum 1 and 2 powerhouses, Dutch Flat Powerhouses 1 (operated by Pacific Gas and Electric Company) and 2 (operated by NID), and operations at Spaulding 1 and 2. The natural stream reaches in this area are from the Drum Afterbay (Node 270) to Rollins Reservoir. This reach is further split where it receives discharges from Dutch Flat 1 and 2 Powerhouses (Node 240). FERC minimum flows and potential spill from powerhouse operations are the main source of flow in this reach. The hydrologic modeling results indicate that baseline flows vary from 5 to 10 cfs depending on the reach and month (Appendix H: Drum Figure-9 through 12). Under the PowerMax and WaterMax Scenarios there is no deviation from the baseline modeled flows in any month within the time period (Appendix H: Drum Table-9 through 12). In these reaches the operations of Pacific Gas and Electric Company's facilities by a new owner is expected to have *no impact* on the aquatic resources above Rollins Reservoir.

Below Rollins Reservoir is a diversion structure where water is diverted into the Bear River Canal. Streamflows in the Bear River from Rollins Reservoir (Node 247) to Lake Combie (Node 253) are subject to facility operations. Between Rollins Reservoir and the Bear River Canal (Nodes 247-250), the PowerMax Scenario results in reductions in flows below the 20 percent threshold level during April through November in 6 instances, for all years within the April through November period (Appendix H: Drum Table-13 and 14). Variations in streamflow as a result of operations under the different Scenarios tend to be greater in dry and critically dry water years (Appendix H: Drum Figure-13 and 14). These are all less than 10 percent of the months and therefore are considered to have a *less-than-significant impact* to the aquatic resources in this stream reach. Under operational conditions resulting from the WaterMax Scenario, there are 12 reduction events within the April through November period. This is less than 10 percent of the months and would be considered a *less-than-significant impact*. However, eight of these events occur between October and November during brown trout spawning season. Because the number of events is above the 10 percent criterion during this period, operations under the WaterMax Scenario could have a *significant impact* on this species.

Between the Bear River Canal (Node 250) intake and Lake Combie (Node 253) variations in streamflow as a result of operations under the different Scenarios tend to be greater in dry and critically dry water years (Appendix H: Drum Figure-15 and 16). The PowerMax Scenario results in reductions in flows below the 20 percent threshold level during April through November in 16 instances, for all years within the April through November period (Appendix H: Drum Table-15 and 16). This is less than 10 percent of the months and therefore could be considered a *less-than-significant impact*. However, seven of these events occur during the October to November brown trout spawning season. Because the number of events is above the 10 percent criterion for this sub-period, operations under the PowerMax Scenario could have a *significant impact* on this species. Under operational conditions resulting from the WaterMax Scenario, there are 20 reduction events within the April through November period. This is greater than 10 percent of the months and would be considered a *significant impact*.

Summary of Effect. As a result of this project, facilities operations in the Bear River from the Drum Afterbay downstream to Rollins Reservoir could have *no impact* on the fisheries resources in this reach. However, streamflows from Rollins Reservoir to the Bear River Canal intake would be subject to streamflow changes under the operational Scenarios. The PowerMax Scenario shows the project could result in *less-than-significant impacts* to the aquatic resources in this reach. The WaterMax Scenario shows the project could result in *significant impacts* to brown trout spawning within this reach. Both Scenarios show the project could result in *significant impacts* to fisheries and aquatic resources from the Bear River Canal to Lake Combie.

Bundle 12: Chili Bar

Chili Bar (FERC 2155)

The Chili Bar System is operated as a run-of-the-river project. Because of this, there is limited flexibility in how a new owner could operate the facilities and therefore, no hydrologic modeling was conducted for this project. Instream flows for the two Scenarios, PowerMax and WaterMax, are expected to be essentially the same as those for baseline conditions. Because there would be no substantial change in the availability of physical habitat or the level of water quality for fisheries populations in these stream sections, the project is likely to have *no impact* on fisheries and aquatic resources.

Summary of Effect: Under the project, facilities operations on the South Fork American River in the Chili Bar System are likely to have *no impact* on the fisheries resources in this reach.

Summary of Impact 4-1 to Entire Drum Regional Bundle

This project could have a *significant impact* on the resident and anadromous fisheries resources found in the streams and rivers of the Drum Regional Bundle. The PowerMax and WaterMax Scenarios show that the project could result in reduction of streamflows and corresponding *significant impacts* to listed species and their habitat in the Deer Creek (below Scotts Flat Reservoir), Yuba River (below Englebright Reservoir), and Eel River (below Lake Pillsbury) watersheds. The PowerMax and WaterMax Scenarios also show that the project could result in reduced streamflows and corresponding *significant impacts* to resident fisheries resources, primarily trout, in the Bear River system above Lake Combie and the Yuba River system above Englebright Reservoir. The PowerMax Scenario shows the project could result in reduction of instream habitat for resident fish in the East Branch Russian River and a corresponding *significant impact*.

4.4.8.4 Motherlode Regional Bundle

Bundle 13: Mokelumne River

The following section analyzes potential project impacts on fisheries resources from facilities operations under either of the two Scenarios, PowerMax and WaterMax Scenarios, in the Motherlode Regional Bundle. This analysis is based primarily on the results of the hydrologic modeling (Appendix C) and on additional reference material, as appropriate (Section 4.4.6, Analytical Methods).

Mokelumne River (FERC 137)

Bear River. The hydrologic results for the PowerMax Scenario in Bear River from Upper Bear Reservoir downstream to Lower Bear Reservoir (Node 309-310) illustrate that flows are reduced by 20 percent or more from baseline conditions over 10 percent of the months in the April through November period over (192-month) the period of record (Appendix H: Motherlode Table-2). Under the PowerMax and WaterMax Scenarios 12.8 percent and 20.5 percent of the months, respectively, could result in flows that potentially reduce trout habit during the brown trout spawning season (October-November) (Appendix H: Motherlode Table-2).

In a representative critically dry year (Appendix H: Motherlode Figure-1), the PowerMax and WaterMax Scenarios flows are almost identical to baseline for the period between April through November, with the exception of the WaterMax Scenario in which flows are below baseline during the month of May (Appendix H: Motherlode Figure-1). In a representative dry year (Appendix H: Motherlode Figure-1), the PowerMax Scenario shows flows are below baseline from October through November and the WaterMax Scenario shows results in flows below baseline in November. Flows in a representative normal year under the PowerMax Scenario are below baseline from September through November and the WaterMax Scenario flows drop below baseline during October (Appendix H: Motherlode Figure-2). Flows in a representative wet year tended to be similar to baseline with the exception of the WaterMax Scenario when flows drop below baseline during September (Appendix H: Motherlode Figure-2). Based on the modeling results and the preceding analysis, the project could have a *significant impact* on fisheries and aquatic resources.

The Bear River downstream from Lower Bear Reservoir (Node 310-316) was analyzed for adult rainbow and brown trout habitat during the trout-angling season (April through November). WUA was maximized at approximately 45 cfs for rainbow and 50 cfs for brown trout. Flows that result in a decrease in WUA by 20 percent or more when compared to baseline conditions, were considered to be a significant effect on the resource. In some cases, baseline conditions may not be providing maximum potential habitat. This analysis compares changes in relation to baseline, not the potential habitat available.

The PowerMax and WaterMax Scenarios show that modeled mean monthly flows under the project could result in reductions to adult rainbow or brown trout habitat below the 20 percent threshold during the month of November. When compared to baseline conditions, the PowerMax Scenario shows streamflows that supply 54 and 67 percent, for rainbow and brown trout respectively, of the WUA available under baseline. Similarly the WaterMax Scenario shows streamflows that supply 50 and 64 percent, for rainbow and brown trout respectively, of the WUA available under baseline. Habitat conditions under baseline conditions are not optimum, 70 and 77 percent for rainbow and brown trout respectively, but this analysis compares the two Scenarios to baseline conditions. The most severe reductions in streamflows occur in November and February (Appendix H: Motherlode Table-3 and 4). Examination of representative water year graphics indicates that this reach is subject to relatively low, yet stable flows in most years (Appendix H: Motherlode Figure-3 and 4). Both the PowerMax and WaterMax Scenarios show the project could exceed the 20 percent reduction threshold within the evaluation period. Because of this, the project could result *significant impact* to fisheries and aquatic resources in this stream reach.

Hydrologic results for the Bear River from the Tiger Creek Conduit to the North Fork Mokelumne River (Node 316-325), indicates that the PowerMax and WaterMax operations are similar to the baseline conditions (Appendix H: Motherlode Table-3 and 4). All the representative water years illustrate the PowerMax and WaterMax Scenarios to be identical to baseline (Appendix H: Motherlode Figure-5 and 6). The PowerMax and the WaterMax Scenarios illustrate that flows were never reduced by 20 percent or more from baseline conditions over 10 percent of the months over the period of record (Appendix H: Motherlode Table-6). For this reason, the operations of the facilities by a new owner is likely to have a *less-than-significant impact* aquatic resources in this reach.

Summary of Effect. The trout fisheries in the Bear River between Upper Bear Reservoir and the North Fork Mokelumne River could be subject to substantially altered streamflows from either the PowerMax or WaterMax operations and corresponding impacts to aquatic resources within this reach. These reductions could have a *significant impact* only on the stream reach between Upper Bear Reservoir the Tiger Creek Conduit. Changes in flow patterns in the Bear River from Lower Bear Reservoir to the North Fork Mokelumne River could have a *less-than-significant impact***.**

Analysis of the model output for Cole Creek between the Cole Creek Diversion (Node 312) and the Tiger Creek Conduit (Node 314) indicates that flows within this reach will not be reduced below baseline under either the PowerMax or WaterMax Scenarios (Appendix H: Motherlode Table-7 and 8). Analysis of the representative water years indicates that this reach is subject to low yet relatively stable streamflows (Appendix H: Motherlode Figure-7 and 8). The WUA relationship is bi-modal and was maximized in this reach at approximately 40 cfs and 150 cfs for providing over 99 percent of the available rainbow trout habitat. While operations under baseline may not be optimized for rainbow trout habitat, operations under the PowerMax and WaterMax Scenarios are not likely to result in a reduction in this habitat. For this reason the project is expected to have *no impact* on the aquatic resources in this stream reach.

From the Tiger Creek Conduit (Node 314) downstream to the confluence of Cole Creek and the North Fork Mokelumne River (Node 323), is actually the tailrace of Salt Springs 1 Powerhouse. As such it is subject to extreme fluctuations in flow under any operational Scenario. For this reason the project is expected to have *no impact* on fisheries resources in this reach.

i Under the project, facilities operations in Cole Creek above the Tiger Creek Conduit are likely to have no impact on the fisheries resources in this reach. Cole Creek from the Tiger Creek Conduit to the confluence with the North Fork Mokelumne River could be subject to substantially altered streamflows from either the PowerMax or WaterMax Scenarios and corresponding impacts to aquatic resources within this reach. These reductions resulting from the project could have a *significant impact* on the aquatic resources in this reach.

For the confluence of East and West Branch Panther Creeks (Node 318), downstream to the confluence of Panther Creek and the NF Mokelumne River (Node 326), hydrological results indicate that all three Scenarios are identical (Appendix H: Motherlode Table-29) for the entire period of record, and thus any operation would have *no impact* to the fisheries and biological resources in this stream segment (Appendix H: Motherlode Table-28). Flows for critical and dry years are identical for the three Scenarios (Appendix H: Motherlode Figure-29). During normal and wet years, flows for all three Scenarios are identical (Appendix H: Motherlode Figure-30).

Summary of Effect. Under the project, facilities operations in Panther Creek from the Tiger Creek Conduit to the confluence with the NFMR are likely to have a *less-than-significant impact* on the fisheries resources in this reach.

From Twin and Meadow lakes (Node 304-306) downstream to the confluence with the North Fork Mokelumne River, the WaterMax Scenario is generally identical to baseline operations, with the exception of May and September (Appendix H: Motherlode Table-11 and 12, Appendix H: Motherlode Figure-11 and 12). The flows were reduced by 20 percent or more from baseline conditions under the WaterMax Scenario in 1.5 percent of the months over the 192-month period of record from April through November. The flows were reduced by 20 percent or more from baseline conditions by the PowerMax Scenario in 5.7 percent of the months over the 192-month period of record from April through November. These both represent less than 10 percent of the possible number of events within the evaluation period. Based on the analysis, the project is expected to have a *less-than-significant impact* on fisheries resources in this reach.

Flow releases from Upper and Lower Blue lakes (Node 303) travel down Blue Creek where it converges with the NF Mokelumne River and continue to Salt Springs Reservoir (Node 306). There are several tributaries outside of Pacific Gas and Electric Company's control which feed this portion of the watershed. This segment of the NF Mokelumne River system experiences similar baseline flow trends to those released from Twin and Meadow lakes. The modeling shows flows were reduced by 20 percent or more from baseline conditions under the WaterMax Scenario on 3.1 percent of the months over the 192-month period of record from April through November. The flows were reduced by 20 percent or more from baseline conditions under the PowerMax Scenario on 8.8 percent of the months over the period of record from April through November (Appendix H: Motherlode Table-13 and 14). The representative years illustrate a close correlation between baseline and the two Scenarios (Appendix H: Motherlode Figure-13 and 14). These both represent less than 10 percent of the possible number of events within the evaluation period. The project, therefore, is considered to have a *less-than significant impact* on fisheries resources in this reach.

From Salt Springs Reservoir downstream to the confluence of the NR Mokelumne River and Cole Creek (Node 306-323), the NF Mokelumne River had no streamflow for a majority of the period of record (Appendix H: Motherlode Table-15). A stream with zero flow is not necessarily dry, since the pools continue to hold water even after the stream has ceased flowing. Hydrologic modeling results indicate that the PowerMax and WaterMax Scenarios are similar to baseline conditions (Appendix H: Motherlode Table-15). The flows were not reduced by 20 percent or more from baseline conditions, under either Scenario, over 10 percent of the months in the April through November period over the period of record (Appendix H: Motherlode Table-16). In the representative critical and dry years, as expected, flows are zero for all Scenarios for all 12 months (Appendix H: Motherlode Figure-15). The representative normal and wet years show zero flows for a majority of the months, with significant increases in flow under all Scenarios in May through July (Appendix H: Motherlode Figure-16). Therefore, based on the modeling results it is expected that the project would have a *less-than-significant impact* on fisheries and aquatic resources.

The hydrologic modeling results for the PowerMax and WaterMax Scenarios in the segment of river from the confluence of the NF Mokelumne River with Cole Creek (Node 323) downstream to the confluence of the NF Mokelumne River with the Bear River (Node 325), illustrate that flows would not be reduced by 20 percent or more from baseline conditions between April and November for over 10 percent of the months the period of record (Appendix H: Motherlode Table-18). Under the PowerMax and WaterMax Scenarios 12.5 percent and 14.6 percent of the months, respectively, would have flows that are reduced by 20 percent from baseline (Appendix H: Motherlode Table-18). For the representative critical dry year, flows for all Scenarios are identical (Appendix H: Motherlode Figure-17). For the representative dry year, PowerMax and WaterMax flows were similar to baseline during the April through November trout growing period (Appendix H: Motherlode Figure-17). The representative normal year illustrates that PowerMax and WaterMax flows were below baseline during November (Appendix H: Motherlode Figure-18). For the representative wet year the PowerMax Scenario dropped below baseline for the months of May and July. The WaterMax Scenario dropped below baseline during the month of September in the representative wet year (Appendix H: Motherlode Figure-18). Both the PowerMax and WaterMax Scenarios exceed the 20 percent reduction threshold on more than 10 percent of the months within the evaluation period. Because of this, the project could result in *significant impacts* to fisheries and aquatic resources in this stream reach.

The NF Mokelumne River flows from the Bear River confluence down to the confluence of Panther Creek and the NF Mokelumne River (Node 325-326). Under the WaterMax Scenario stream flows in 14.1 percent of the months exceeded the 20 percent reduction threshold and result in flows that could adversely affect trout habitat from April through November (Appendix H: Motherlode Table-20). Additionally, under the PowerMax and WaterMax Scenarios 16.7 percent and 37.5 percent of the months over the period of record, respectively, would result in flows that could reduce brown trout spawning habitat from October through November (Appendix H: Motherlode Table-20). For the representative critical year, flows under all operational Scenarios are identical (Appendix H: Motherlode Table-19). In the representative dry year, flows under all Scenarios are identical, except lower flows, when compared to baseline operations, during November for the WaterMax Scenario (Appendix H: Motherlode Table-19). During the representative normal year, flows under the PowerMax Scenario are lower in comparison to the baseline flow for November (Appendix H: Motherlode Figure-20). The WaterMax Scenario results in flows that are lower in comparison to baseline from October through November during the representative normal year (Appendix H: Motherlode Figure-20). In the representative wet year, the PowerMax drops below baseline in May and the WaterMax Scenario drops below baseline October through November (Appendix H: Motherlode Figure-20). Neither the PowerMax or WaterMax Scenarios exceed the 20 percent reduction threshold on more than 10 percent of the months within the evaluation period, but because there are reduction events, the project could result in a *significant impact* on fisheries resources.

From Panther Creek confluence, the NF Mokelumne River flows to Tiger Creek Afterbay (Node 326-328). As expected, results for this segment of the river are nearly identical to the segment immediately upstream. Under the WaterMax Scenario 14.1 percent of the months exceeded the 20 percent reduction threshold and result in flows that could adversely affect trout habitat from April through November (Appendix H: Motherlode Table-22). Additionally, under the PowerMax and WaterMax Scenarios 16.7 percent and 37.5 percent of the months of record, respectively, would have flows that could reduce brown trout spawning habitat from October through November (Appendix H: Motherlode Table-22). For the representative critical year, flows under all operational Scenarios are identical (Appendix H: Motherlode Figure-21). In the representative dry year, flows under all Scenarios are identical, except lower flows, when compared to baseline operations, during November for the WaterMax Scenario (Appendix H: Motherlode Figure-21). During the representative normal year, flows under the PowerMax Scenario are lower in comparison to the baseline flow for November (Appendix H: Motherlode Figure-22). The WaterMax Scenario results in flows that are lower in comparison to baseline from October through November during the representative normal year (Appendix H: Motherlode Figure-22). In the representative wet year, PowerMax drops below baseline in May and the WaterMax Scenario drops below baseline October through November (Appendix H: Motherlode Figure-22). Neither the PowerMax nor WaterMax Scenarios exceed the 20 percent reduction threshold on more than 10 percent of the months within the evaluation period, but because there are reduction events, the project could result in a *significant impact* on fisheries resources.

The hydrologic results for the PowerMax and WaterMax Scenarios in the segment of river from Tiger Creek Afterbay down to the Electra Tunnel (Node 328-331), illustrate that flows are not reduced by 20 percent or more from baseline conditions over 10 percent of the months in the April through November period over the period of record (Appendix H: Motherlode Table-24). However, operations under the PowerMax and WaterMax Scenarios 10.4 percent and 18.7 percent of the months, respectively, result in flows that could reduce habitat during the brown trout spawning season (Oct-Nov) (Appendix H: Motherlode Table-24). Graphic display of a representative critical and dry year shows that flows under the Scenarios are almost identical (Appendix H: Motherlode Figure-23). During the representative normal year, flows under the PowerMax and WaterMax Scenarios are either identical or above in comparison to baseline from April through November (Appendix H: Motherlode Figure-24). During the representative wet year the PowerMax Scenario is not below baseline during the April through November; however, the WaterMax Scenario is below baseline from October through November. Operations under both the PowerMax and WaterMax Scenarios exceed the 20 percent reduction threshold on more than 10 percent of the months within the evaluation period. Because of this, the project could result in *significant impact* to fisheries and aquatic resources in this stream reach.

From the Electra Tunnel (Node 331) downstream to where water returns to the NF Mokelumne River from the Electra Power House (Node 333), the hydrologic results for the PowerMax and WaterMax Scenario illustrate that flows are not reduced by 20 percent or more from baseline conditions over 10 percent of the months in the April through November period over the period of record (Appendix H: Motherlode Table-25). Under the PowerMax and WaterMax Scenarios only 2.6 percent and 3.1 percent of the months during the periods of record were reduced by 20 percent

(Appendix H: Motherlode Table-26). The respective critically dry and dry years are identical to baseline (Appendix H: Motherlode Figure-25). The respective normal and wet years illustrate a close correlation between the two Scenarios and baseline. Neither the PowerMax or WaterMax Scenarios exceed the 20 percent reduction threshold on more than 10 percent of the months within the evaluation period. Therefore, the project is expected to have a *less-than-significant impact* on fisheries resources.

For the segment of the NF Mokelumne River that flows from Electra Power House (Node 333) to Pardee Reservoir (Node 336), the hydrologic results for the PowerMax and WaterMax Scenario illustrate that flows are not reduced by 20 percent or more from baseline conditions over 10 percent of the months between April through November over the 192-month period of record (Appendix H: Motherlode Table-27). Under the PowerMax and WaterMax Scenarios, only 3.6 percent and 7.3 percent of the months were reduced by over 20 percent when compared to baseline (Appendix H: Motherlode Table-28). However, the WaterMax Scenario shows flow reductions in 18.75 percent of the months during the brown trout spawning season (October-November) (Appendix H: Motherlode Table-28). The representative critical and dry years illustrate the PowerMax and WaterMax Scenarios oscillating around baseline throughout the year (Appendix H: Motherlode Figure-27). The representative normal year only shows the WaterMax Scenario dropping below baseline in November. The representative wet year graph illustrates the PowerMax and WaterMax Scenarios are near baseline. Based on the preceding information it is concluded the project could result in a *significant impact* to brown trout spawning in this stream reach.

Summary of Effect. Under the project, the trout fisheries in the North Fork Mokelumne River from Twin and Meadow lakes to Pardee Reservoir could be subject to substantially altered streamflows from either the PowerMax or WaterMax Scenarios and corresponding impacts to aquatic resources within this reach. In the North Fork Mokelumne system there could be *significant impacts* to fisheries resources in the NFMR between Cole and Bear creeks, Panther Creek and the Tiger Creek Afterbay, and the Electra Diversion to the Electra Powerhouse Discharge. In the remainder of the modeled reaches there could be *less-than-significant impacts* to fisheries resources.

Bundle 14: Stanislaus River

Spring Gap-Stanislaus (FERC 2130)

Middle Fork Stanislaus River. The hydrologic results for the PowerMax and WaterMax Scenarios in the segment of river from Relief Reservoir downstream to Donnells Reservoir (Node 430-435), illustrate that flows are not reduced by 20 percent or more from baseline conditions over 10 percent of the months in the April through November period over the period of record (Appendix H: Motherlode Table-42). However, both Scenarios show reductions beyond the 20 percent threshold in 16.6 percent and 12.5 percent of the months, respectively. This could adversely affect trout habit during the brown trout spawning season (Oct-Nov) (Appendix H: Motherlode Table-42). The representative critical dry year flows under all three Scenarios are identical (Appendix H: Motherlode Figure-41). For the representative dry year PowerMax and WaterMax flows were similar to baseline during the April through November trout growing period, with the exception of August when both Scenarios were below baseline (Appendix H: Motherlode Table-41 and Motherlode Figure-41). The representative normal and wet years illustrate PowerMax and WaterMax flows were similar to baseline (Appendix H: Motherlode Figure-42).

Under both the PowerMax and WaterMax Scenarios the project exceeds the 20 percent reduction threshold on more than 10 percent of the months within the evaluation period. Because of this, the project could result in *significant impacts* to fisheries and aquatic resources in this stream reach.

From Donnells Reservoir downstream to Beardsley Reservoir (Node 435-440), the hydrologic modeling results for the PowerMax and WaterMax Scenarios in this reach indicate that all Scenarios are nearly identical throughout a year (Appendix H: Motherlode Table-43). In the representative critical, dry (Appendix H: Motherlode Figure-43), normal and wet years (Appendix H: Motherlode Figure-44), all monthly flows under all Scenarios are nearly identical (Appendix H: Motherlode Figure-43). Neither the PowerMax or WaterMax Scenarios exceed the 20 percent reduction threshold on more than 10 percent of the months within the evaluation period. Therefore, the project is expected to have a *less-than-significant impact* on fisheries resources in this stream reach.

From Beardsley Reservoir downstream to Beardsley Afterbay (Node 440-445), the hydrologic modeling results indicate that baseline flow is often zero for this segment of the river (Appendix H: Motherlode Table-31). Analysis of hydrologic results indicates that although flows are not reduced by 20 percent or more from baseline conditions over 10 percent of the months in the April through November period there are reductions over the period of record (Appendix H: Motherlode Table-32). The representative critical dry year graph shows, as expected, flows of 0 cfs for baseline and Scenarios for all 12 months (Appendix H: Motherlode Figure-31). The representative dry, normal, and wet years show a close correlation between the two Scenarios and baseline (Appendix H: Motherlode Figure-31 and 32). Neither the PowerMax nor WaterMax Scenarios exceed the 20 percent reduction threshold on more than 10 percent of the months within the evaluation period. Therefore, the project is expected to have a *less-than-significant impact* on fisheries resources in this stream reach.

From Beardsley Afterbay downstream to the confluence of Spring Gap and Sand Bar powerhouses (Node 445-450), the hydrologic results show that flows are not reduced by 20 percent or more from baseline conditions over 10 percent of the months between April through November over the period of record (Appendix H: Motherlode Table-33 and 34). The graphs of the representative years illustrate a close correlation between baseline and the two Scenarios (Appendix H: Motherlode Figure-33 and 34). Therefore, the project is expected to have a *less-than-significant impact* on fisheries and aquatic resources in the stream reach.

For the Middle Fork Stanislaus River from of the confluence of Sand Bar and Spring Gap powerhouses (Node 450), to the Sand Bar Diversion (Node 451) are subject to project operations. Analysis indicates that the flows were reduced by 20 percent or more from baseline conditions under the PowerMax Scenario on 10.9 percent of the months and the under WaterMax Scenario in 13 percent of the months over the period of record (Appendix H: Motherlode Table-35 and 36). There are over 10 percent of the months and therefore, the PowerMax and WaterMax Scenarios could potentially reduce habitat for trout during the April through November growing season. May, October, and November accounted for a majority of the reduction events (Appendix H: Motherlode Table-36). In the representative critical year during the months of June, October, and November the PowerMax and WaterMax Scenarios drop below baseline (Appendix H: Motherlode Figure-35). During the representative dry and normal years both Scenarios are similar to baseline (Appendix H: Motherlode Figure-35 and 36). Both the PowerMax and WaterMax Scenarios exceed the 20 percent reduction threshold on more than 10 percent of the months within the evaluation period. Because of this, the project could have *significant impacts* on fisheries and aquatic resources in this stream reach.

The 12.4 miles of the Middle Fork Stanislaus River below Sand Bar Power House (Node 451-480) and the 1.9 miles of the North Fork Stanislaus River downstream from its confluence with the Middle Fork Stanislaus River (Node 480-999) are subject to project operations.

Hydrologic analysis shows that under baseline, average April and May flows are 391 and 1,144 cfs, respectively. High mean monthly flows adversely affect adult trout habitat during May through July and low mean monthly flow adversely affects adult trout habitat during February, March, and April (Appendix H: Motherlode Table-37 through 40). The current mean monthly flow during October, 152 cfs, poses an adverse affect on brown trout spawning habitat.

The aggregation of the 24-year record into a monthly mean value in this case results in no impacts to the resource when Scenario flows are compared to baseline. However, if the years are evaluated on an individual basis, each of the PowerMax and WaterMax Scenarios showed similar monthly adverse affects from operations. Analysis of the alternatives for the 24-year modeled period of record indicates that operations under the PowerMax Scenario would have a *less-than-significant impact* on rainbow trout spawning, and rearing. Operations under the WaterMax Scenario however, could result in *significant impacts* to brown trout spawning through the reduction of flows between October and November (Appendix H: Motherlode Figure-37 through 40).

Summary of Effect. As a result of the project, the trout fisheries in the Middle Fork Stanislaus River from Relief Reservoir to the confluence with the South Fork Stanislaus could be subject to substantially altered streamflows from either the PowerMax or WaterMax Scenarios and corresponding impacts to aquatic resources within this reach. In the Middle Fork Stanislaus River system the project could have *significant impacts* on fisheries resources in the river between Relief and Donnells Reservoir on the upper drainage and between the Sand Bar Spring Gap powerhouses discharge point to the confluence with the South Fork Stanislaus River. In the remainder of the modeled reaches the project is expected to have a *less-than-significant impact* on fisheries resources.

Phoenix (FERC 1061)

The South Fork Stanislaus River from Strawberry (Pinecrest) Reservoir downstream to the Philadelphia Diversion (Node 400-405), is subject to project operations. Flows were reduced by 20 percent or more from baseline conditions under the PowerMax and WaterMax Scenarios more than 10 percent of the months over the 192-month period of record between April and November (Appendix H: Motherlode Table-46). Operations under the PowerMax and WaterMax Scenarios 25 percent and 30 percent of the time, respectively, could result in reductions to trout habitat below the 20 percent threshold. During the representative critical flow year the PowerMax Scenario was below baseline for the months of April, August, October, and November (Appendix H: Motherlode Figure-45). The WaterMax Scenario was below baseline for the months of August, October, and November (Appendix H: Motherlode Figure-45). During the representative dry year (Appendix H: Motherlode Figure-45) the PowerMax was below baseline in May and October, and the WaterMax Scenario was below baseline in September and October. During the representative normal and wet years (Appendix H: Motherlode Figure-46), mean monthly flows generally track baseline operations in curve shape, but both Scenarios oscillate above and below the baseline. Both the PowerMax and WaterMax Scenarios exceed the 20 percent reduction threshold on more than 10 percent of the months within the evaluation period. Because of this, the project could result in *significant impact* to fisheries and aquatic resources in this stream reach.

The South Fork Stanisluas River continues from Philadelphia Diversion downstream to Lyons Reservoir (Node 405-410). The PowerMax and WaterMax Scenarios show reductions to streamflows, 20 and 13 percent of the time respectively, and a corresponding reduction in trout habitat over the 192-month period of record (Appendix H: Motherlode Table-47).

During critical flow years, the PowerMax Scenario results in lower monthly flows in April and August and generally higher flows than baseline operations for the other months between April and November (Appendix H: Motherlode Figure-47). The WaterMax Scenario, during the representative critical1y dry year, results in lower monthly flows for the month of August and flows higher than baseline operations between April and November. During dry (Appendix H: Motherlode Figure-47), normal and wet year types (Appendix H: Motherlode Figure-48), modeled mean monthly flows generally track baseline operations, but all three alternatives oscillate around baseline. Operations under both the PowerMax and WaterMax Scenarios exceed the 20 percent reduction threshold on more than 10 percent of the months within the evaluation period. Because of this, the project could result in *significant impact* to fisheries and aquatic resources in this stream reach.

The South Fork Stanislaus River downstream from Lyons Reservoir (Node 410) is subject to hydroelectric operations. This reach of the South Fork Stanislaus River was analyzed for adult rainbow and brown trout habitat during the trout-angling season (April through November) because this period includes important life history phases. Flows that result in a decrease WUA by 20 percent or more when compared to baseline conditions, were considered significant. In some cases, baseline conditions may not be providing maximum potential habitat. This analysis compares changes in relation to baseline, not the potential habitat available.

Under the current operation, aggregate mean monthly flows adversely affect adult trout habitat during April and August through November. The PowerMax Scenario would not result in reductions to WUA below the threshold when all the years are combined. The aggregation of the 24-year record into a monthly mean value in the PowerMax Scenario results in no impacts to the resource when Scenario flows are compared to baseline. However, if the years are evaluated on an individual basis (according to 20 percent reductions in flow, not WUA), the PowerMax Scenario indicates that there could be potentially adverse affects from operations. Analysis of the alternatives for the 24-year modeled period of record indicates that operations under the PowerMax Scenario could have a *less-than-significant impact* on rainbow trout spawning, and rearing (Appendix H: Motherlode Table-50). Additionally, operations under the PowerMax Scenario could result in *significant impact* to brown trout spawning habitat in October to November (Appendix H: Motherlode Table-50).

Operations under the WaterMax Scenario result in a 50 percent reduction to available habitat in August and could result in *significant impact* to the adult trout.

Summary of Effect. As a result of this project, the trout fisheries in the South Fork Stanislaus River from Strawberry (Pinecrest) Reservoir to the confluence with the Middle Fork Stanislaus River could be subject to substantially altered streamflows under either the PowerMax or WaterMax Scenarios and corresponding impacts to aquatic resources within this reach. The PowerMax and WaterMax Scenarios also show the project could result in *significant impacts* to fisheries resources between Strawberry (Pinecrest) Reservoir and the Middle Fork Stanislaus River.

Bundle 15: Merced River

Merced Falls (FERC 2467)

The Merced Falls Project is located on the lower reaches of the Merced River. Pacific Gas and Electric Company has no storage rights in this Project, meaning that all water entering the Merced Falls Reservoir passes directly from the river, through the powerhouse and back into the river. The Merced Falls Project is operated as a run-of-the-river project; therefore, no hydrologic modeling of the project was conducted.

While no hydrologic modeling was conducted for the Merced River, the ability to alter flows significantly in this section are limited due to the system's lack of flexibility and because of physical and regulatory constraints. Therefore, a new owner with different operating incentives would not be able to significantly alter flows in this stream section. Instream flows under the two project

Scenarios, PowerMax and WaterMax, are expected to be essentially the same as those for baseline conditions. Because there would be no substantial change in the availability of physical habitat or the level of water quality for fisheries populations in these stream sections, the project is expected to have *no impact* on fisheries and aquatic resources.

Summary of Effect. Under the project, facilities operations on the Merced River at the Merced Falls Project are expected to have *no impact* on the fisheries resources in this reach.

Summary of Impact 4-1 to Entire Motherlode Regional Bundle

The project could have *significant impacts* on the resident fisheries resources found in the streams and rivers of the Motherlode Regional Bundle. In general the PowerMax and WaterMax Scenarios show potentially significant reductions in streamflows in the Mokelumne River Project (Bundle 13) and the Stanislaus River Project (Bundle 14). Because of limited operational flexibility, the operation of the Merced Falls Project (Bundle 15) by a new owner is expected to have *no impact* on the aquatic resources in the Merced River.

4.4.8.5 Kings Crane-Helms Regional Bundle

Bundle 16: Crane Valley

Crane Valley (FERC 1354)

Three stream sections in the Crane Valley Project were assessed for the impact of reductions in instream flow. These sections are the North Fork Willow Creek below Bass Lake, South Fork Willow Creek below Browns Creek Diversion Dam, and the Willow Creek mainstem. These are the stream sections most affected by changes in facility operations. Assessments of potential impacts on fish in these stream sections are based both on results of the OASIS modeling and on independent information about changes in operations for the PowerMax and WaterMax Scenarios.

Bass Lake Dam only occasionally spills and seepage from the dam plus accretions contribute no more than about 0.4 cfs to the North Fork Willow Creek (NFWC) (PG&E Co., 1986a). Therefore, flows in this stream section are largely determined by releases from Bass Lake. Under the baseline, a voluntary minimum release of 1 cfs is made from Bass Lake into the NFWC (PG&E Co., 1999a). This minimum flow is not maintained under the PowerMax or WaterMax Scenarios.

According to the OASIS modeling, instream flow in the NFWC under the WaterMax or PowerMax Scenarios would usually be 0 cfs. However, because of seepage from the dam, these flows would actually be between 0 and 0.4 cfs. Therefore, the impacts of these Scenarios were evaluated under two baseflow assumptions: 1) the lowest flows would be 0 cfs and 2) the lowest flows would be 0.3 cfs. Evaluations based on either baseflow assumption indicate that both Scenarios would reduce flows 20 percent or more in the NFWC in approximately 87 percent of the months over June through October period of record and in about 84 percent of the months over the April through November period (Appendix H: Kings Crane-Helms Appendix Table 5 and 6).

The reductions in flow would result in reductions in the WUA of rainbow trout. WUA results for rainbow trout in the MFWC were obtained from Pacific Gas and Electric and Company. Using the 0 cfs baseflow assumption, the mean WUA of adult rainbow trout would be reduced about 75 percent for the June through October period of record and about 55 percent for the April through November period for both the WaterMax and PowerMax Scenarios. Using the 0.3 cfs baseflow assumptions, the mean WUAs would be reduced 27 percent and 23 percent for the June through October and April through November periods, respectively.

Reductions in instream flow not only affect WUA of fish, but also affect water temperature conditions. Water temperatures greater than 68°F (20°C) are generally considered unsuitable for trout (Alabaster and Lloyd, 1980; Biosystems, 1985a; PG&E Co., 1986d). Results of water temperature modeling by Pacific Gas and Electric Company are useful for evaluating effects of the Project Scenarios on the water temperature conditions in the stream (FERC, 1992). Table 4.4-49 shows the percentages of different stream segments with water temperatures below 68°F (20°C) at eight different flow levels, assuming average July meteorological conditions. These results were used with the modeled instream flow data for the baseline and Project Scenarios to estimate the average July percentages of each stream segment with coldwater habitat (i.e., < 68°F) for each of the Scenarios (Table 4.4-49).

Table 4.4-49 Percentages of Stream Segments with Water Temperatures Less Than 68°F (20°C) During July at Several Flow Levels and Under Baseline Conditions and the Two Scenarios

Flow (cfs) or Scenario	Stream Segment (Length of Segment)					
	NFWC Below Bass Lake (3.3 miles) % <68°F	NFWC below Manzanita Lake (3.1 miles) % <68°F	SFWC Below Browns Creek Diversion (4.6 miles) % <68°F	SFWC Below Peckinpah Creek (1.8 miles) % <68°F	Willow Creek from NFWC-SFWC Confluence to Whisky Creek (4.4 miles) % <68°F	Willow Creek Below Whiskey Creek (2.0 miles) % <68°F
0	43	100	100	58	17	0
1	70	100	100	66	5	0
3	98	100	100	85	41	0
5	100	100	100	100	56	0
7	100	100	100	100	72	0
10	100	100	100	100	89	0
25	100	100	100	100	100	70
50	100	100	100	100	100	100
Baseline	72.5	100	100	86.7	20.5	2.9
PowerMax	47.8	100	100	61.5	20.5	2.9

Table 4.4-49 Percentages of Stream Segments with Water Temperatures Less Than 68ºF (20°C) During July at Several Flow Levels and Under Baseline Conditions and the Two Scenarios

Flow (cfs) or Scenario	Stream Segment (Length of Segment)					
	NFWC Below Bass Lake (3.3 miles) % <68ºF	NFWC below Manzanita Lake (3.1 miles) % <68ºF	SFWC Below Browns Creek Diversion (4.6 miles) % <68ºF	SFWC Below Peckinpah Creek (1.8 miles) % <68ºF	Willow Creek from NFWC-SFWC Confluence to Whisky Creek (4.4 miles) % <68ºF	Willow Creek Below Whiskey Creek (2.0 miles) % <68ºF
WaterMax	47.8	100	100	61.5	20.5	2.9

Adapted from Table 5 in FERC, 1992.

For the NFWC, these results indicate that the PowerMax and WaterMax Scenarios would cause a substantial reduction in the amount of coldwater habitat available in the segment between Bass Lake and Manzanita Lake. The lower segment of NFWC is generally cooler than the upper segment because it is much more shaded.

Summary of Effects. Based on the foregoing analysis, the project is expected to have a *significant impact* on fish in NFWC.

In the South Fork Willow Creek (SFWC), under the baseline operations, a voluntary minimum release is made from the Browns Creek Diversion Dam. This minimum flow is four cfs or the natural flow upstream of the dam, whichever is less (PG&E Co., 1999a). This minimum flow is not maintained under the PowerMax or WaterMax Scenarios.

The hydrologic modeling results for this stream segment (Nodes 523 and 524) indicate that flows under the WaterMax and PowerMax Scenarios are generally lower than those under the baseline condition (Appendix H: Kings Crane-Helms Table-1). For both the June through October and the April through November periods, the flows were reduced 20 percent or more from baseline conditions in about 75 percent of the months under both the WaterMax and PowerMax Scenarios (Appendix H: Kings Crane-Helms Table-2). In critical and dry years all monthly flows under the PowerMax and WaterMax Scenarios were zero, as illustrated in Appendix H: Kings Crane-Helms Figure-1 for 1977, a critical year, and 1981, a dry year. It should be noted that a stream with zero flow is not necessarily dry, since the pools continue to hold water even after the stream has ceased flowing. In normal and wet years, flows under the PowerMax and WaterMax Scenarios were generally zero except during the winter and spring (Appendix H: Kings Crane-Helms Figure-2). Even in 1983, the wettest year on record, flow was zero in several months (Appendix H: Kings Crane-Helms Figure-2).

Mean WUAs for rainbow and brown trout in the SFWC were computed using WUA curves developed for the section of the SFWC above Peckinpah Creek (PG&E Co., 1995a). This stream section represents more than two-thirds of the stream. For the June through October period, adult rainbow trout WUA was about 58 percent lower under the WaterMax and PowerMax Scenarios than under the baseline Scenario. Adult brown trout WUA was about 67 percent lower under the WaterMax and PowerMax Scenarios. For the April through November period, adult rainbow trout WUA was about 58 percent lower under the WaterMax and PowerMax Scenarios and adult brown trout WUA was about 54 percent lower.

In addition to WUA, estimates of water temperatures under different Scenarios were used to evaluate conditions for fish. The results in Table 4.4-49 indicate that the WaterMax and PowerMax Scenarios would cause a substantial reduction in the amount of coldwater habitat available in the lower segment of SFWC, below the confluence with Peckinpah Creek.

Summary of Effects. The analysis indicates the project could have a *significant impact* on fish in SFWC.

The hydrologic modeling results for Willow Creek (Nodes 512 through 515) indicate that flows are identical under baseline conditions and the PowerMax and WaterMax Scenarios for the June through October growth period and are almost identical for the April through November sportfishing season (Appendix H: Kings Crane-Helms Table-3). Instream flows are 0 cfs in all months during critical and dry years under all the modeled Scenarios, as illustrated in Appendix H: Kings Crane-Helms Figure-3. Actual flows would often be slightly higher than 0 cfs because of seepage from the diversions and accretions and, as noted previously, a stream with zero flow is not necessarily dry. Even during normal and wet years, other than 1983, flows are 0 cfs during more than half of the year under both Scenarios (Appendix H: Kings Crane-Helms Figure-4). There were few differences in flow between baseline conditions and either of the Project Scenarios during any of the seasons (Appendix H: Kings Crane-Helms Table-3 and 4).

Summary of Effects. There were few differences in flow between the baseline conditions and either the PowerMax or WaterMax Scenarios during the June through October or April through November period. Therefore, the project is expected to have *less-than-significant impact* on fish in Willow Creek.

Bundle 17: Kerckhoff

Kerckhoff (FERC 0096)

The principal stream reach of the Kerckhoff Project is the San Joaquin River from Kerckhoff Dam to Millerton Reservoir. The Kerckhoff Project has little storage capacity and, therefore, operates much like a run-of-the-river project. As such, the operational flexibility of the Project is limited. Assessments of impacts on fish in the San Joaquin River are based on results of the OASIS modeling.

Instream flows in the San Joaquin River below Kerckhoff Dam are identical under the Scenarios (Appendix H: Kings Crane-Helms Table-7 and 8). Since there is no change in flow between the baseline and either of the Project Scenarios, the project is considered to have *no impact* on aquatic biological resources in this reach.

Bundle 18: Kings River

Helms Pumped Storage (FERC 2735)

Haas-Kings River (FERC 1988)

Balch (FERC 0175)

The North Fork of the Kings River downstream of the confluence with Helms Creek is the major river section affected by the Helms Pumped Storage Project, the Haas-Kings River Project and the Balch Project. The objective of operating the Helms Pumped Storage system is to retain as much water as possible under any Scenario (Appendix C). Therefore, no hydrologic modeling was conducted for these locations as instream flows are expected to be essentially the same as those under baseline conditions. The project is considered to have *no impact* on aquatic biological resources in these stream reaches.

Bundle 19: Tule River

Tule River (FERC 1333)

The Tule River Project is a run-of-the-river project on the North Fork Middle Fork Tule River (NFMFTR) with very little storage capacity or operational flexibility. Therefore, no hydrologic modeling of the Project was conducted for these facilities. Instream flows for the two Project Scenarios, PowerMax and WaterMax, are expected to be essentially the same as those for baseline conditions. Therefore, the project is expected to have *no impact* on aquatic biological resources in this reach.

Bundle 20: Kern Canyon

Kern Canyon (FERC 178)

The Kern Canyon Project is a run-of-the-river project on the lower Kern River with little storage capacity and little operational flexibility. Therefore, no hydrologic modeling was conducted for these facilities. Instream flows for the two Project Scenarios, PowerMax and WaterMax, are expected to be essentially the same as those for baseline conditions. The project is considered to have *no impact* on aquatic biological resources in the Kern River.

Summary of Impact 4-1 to Entire Kings Crane-Helms Regional Bundle

The project could have *significant impacts* on the resident fisheries resources found in the streams and rivers of the Crane Valley Project (Bundle 16, FERC 1354). The Kerckhoff, Kings River, Tule River, and Kern Canyon bundles have *no impact* on the aquatic resources in their respective streams.

4.4.8.6 Evaluation of Impact 4-1 Entire System

The project could have *significant impacts* to the anadromous and resident fisheries resources found within the streams affected by Pacific Gas and Electric Company's hydroelectric system (Table 4.4-50, Summary of Streams Impacts).

4.4.8.7 Impact 4-1: Mitigation Measures

Mitigation Measures Proposed as Part of the Project

Within the PEA (Pacific Gas and Electric Company, 1999a), Pacific Gas and Electric Company does not provide specific mitigation measures for each FERC and non-FERC licensed facility as part of the sale of hydroelectric assets to a new owner. Instead, Pacific Gas and Electric Company states that because a new owner will be required to operate according to existing agreements, and will be subject to environmental and resource regulations and directives in the same way that Pacific Gas and Electric Company is and has been, that aquatic resources will be protected. Pacific Gas and Electric Company offers to assist a new owner in understanding aquatic resource issues at each project, by providing the new owner with all non-privileged informational materials in its

4.4-50 Summary of Potential Impacts to Streams Before Mitigation and Status After Mitigation

Before Mitigation				After Mitigation			
Regional Bundle	No Impact	Less Than Significant	Significant	No Mitigation Required	Less Than Significant	Significant	Significant and Unavoidable
Shasta							
Bundle 1: Hat Creek Hat Creek 1 and 2 (FERC 2661)	X			X			
Bundle 2: Pit River Pit 1 (FERC 2687)	X			X			
Pit 3, 4, and 5 (FERC 0233)		X		X			
McCloud-Pit (FERC 2106)			X		X		
Bundle 3: Kilarc-Cow Creek Kilarc-Cow Creek (FERC 0606)	X			X			
Bundle 4: Battle Creek Battle Creek (FERC 1121)	X			X			
DeSabla							
Bundle 5: Hamilton Branch Hamilton Branch (non-FERC)			X		X		

4.4-50 Summary of Potential Impacts to Streams Before Mitigation and Status After Mitigation

Before Mitigation				After Mitigation			
Regional Bundle	**No Impact**	**Less Than Significant**	**Significant**	**No Mitigation Required**	**Less Than Significant**	**Significant**	**Significant and Unavoidable**
Bundle 6: Feather River Upper North Fork Feather River (FERC 2105)			X		X		
Rock-Creek-Cresta (FERC 1962)		X		X			
Poe (FERC 2107)		X		X			
Bundle 7: Bucks Creek Bucks Creek (FERC 0619)		X		X			
Bundle 8: Butte Creek DeSabla-Centerville (FERC 0803)			X(informal)		X		
Lime Saddle (non-FERC)			X		X		
Coal Canyon (non-FERC)			X		X		
Drum							
Bundle 9: North Yuba River Narrows (FERC 1403)			X				X
Bundle 10: Potter Valley Potter Valley (FERC 0077)			X				X
Bundle 11: South Yuba–Bear Drum-Spaulding (FERC 2310)			X		X		
Bundle 12: Chili Bar Chili Bar (FERC 2155)	X			X			
Motherlode							
Bundle 13: Mokelumne River Mokelumne River (FERC 0137)			X		X		
Bundle 14: Stanislaus River Spring Gap-Stanislaus River (FERC 2130)			X		X		
Phoenix (FERC 1061)			X		X		
Bundle 15: Merced River Merced Falls (FERC 2467)	X			X			
Kings Crane-Helms							

4.4-50 Summary of Potential Impacts to Streams Before Mitigation and Status After Mitigation

Before Mitigation				After Mitigation			
Regional Bundle	No Impact	Less Than Significant	Significant	No Mitigation Required	Less Than Significant	Significant	Significant and Unavoidable
Bundle16: Crane Valley Crane Valley (FERC 1354)			X		X		
Bundle 17: Kerckhoff Kerckhoff (FERC 96)	X			X			
Bundle 18: Kings River Helms Pumped Storage (FERC 2735)	X			X			
Haas-Kings River (FERC 1988)	X			X			
Balch (FERC 0175)	X			X			
Bundle 19: Tule River Tule River (FERC 1333)	X			X			
Bundle 20: Kern Canyon Kern Canyon (FERC 0178)	X			X			

possession related to sensitive biological resources. Additionally, Pacific Gas and Electric Company proposes to transfer its BMPs to a new owner to provide guidance on procedures for complying with license conditions and applicable laws.

Mitigation Measures Identified in This Report

Prior to or concurrent with the transfer of title for any facility within the Shasta, DeSabla, Drum, Motherlode, or Kings Crane-Helms Regional Bundles, formalization of the informal agreements/operating practices or additional conditions detailed in the Bundle mitigation measures discussions below that pertain to the release of water into natural stream channels and/or to the maintenance of instream flows shall by written instrument be made binding upon the new owner.

Development of Mitigation Measures

The preceding analysis (Section 4.4.7) has indicated that a new owner’s operations of Pacific Gas and Electric Company's facilities could result in significant impacts to the fisheries resources found within project streams. Analysis of the PowerMax and WaterMax Scenarios involved evaluation of the mean monthly modeled flow data in certain discreet time periods as related to important life history phases of fisheries resources. In non-anadromous waters, April-May is rainbow trout spawning period, June-September represents the resident fish rearing season, and October-November covers the brown trout spawning season. A Scenario was determined to result in a substantial reduction in habitat when it resulted in a 20 percent or greater reduction in flows. This evaluation was conducted on a monthly basis for the entire 24-year period of record for stream reaches as indicated in the model. A Scenario was determined to result in a potential impact to instream resources when it resulted in substantial reductions (greater than 20 percent) in ten percent or more of the months within an evaluation period when compared to baseline (Section 4.4.6, Analytical Methodology).

The ideal mitigation measure would institute a minimum flow to be released at the upstream end of a hydrologic stream reach that would reduce potential impacts to fisheries resources while allowing a new owner to operate the facilities in a manner that allows for the economically feasible generation of electricity. Mitigation measures should also be enforceable. The Project assumes that there is no impact under baseline conditions. Additionally, less-than-significant impacts to aquatic resources do not require mitigation under CEQA. The mitigation procedure discussed below is only to be implemented for those stream reaches in which analysis indicated that there was a *significant impact* resulting from a change in baseline.

Water year types as developed by DWR (2000a) (Sacramento River Index or SRI) were utilized to separate the years within the modeled period of record into two categories. DWR calculates five water year types: wet, above normal, below normal, dry, and critical (DWR 2000a). These were combined into two categories: (1) Hydrologic conditions for above normal and wet water years were combined into an Above Normal category; and (2) conditions for below normal, dry, and critical years were combined into a Below Normal category. This results in an even division of the modeled period of record into two subsets of data, each with 12 years resulting from conditions above or below normal water conditions

The impact analysis allowed for overlap of evaluation periods. Resident trout rearing was considered for June through October, which overlaps with brown trout spawning in October and November, or the sport fishing season of April through November which covers rainbow and brown trout spawning and the resident rearing period. Because it is not possible to have minimum flow values that overlap (and could be different), the calculation of mitigating interim flows split the life history periods into three periods: April through May, June through September, and October through November. The average flow provided under baseline was calculated for each of these periods for Above Normal and Below Normal water year types. The resulting value was considered for implementation as the required interim minimum flow to which the new owner must operate Pacific Gas and Electric Company's facilities to avoid significant impacts to aquatic resources in a specific stream reach.

For some locations, the resulting minimum release values (Above Normal versus Below Normal) were extremely close. When the difference between the Above and Below Normal values was less than 20 percent, the lower of the two flows was applied for all water year types. Additionally, if stream reaches between a series of common hydrologic control points (through a series of diversions on the same river for example) resulted in minimum flows within 20 percent of one another, the higher value was selected and implemented at the upstream most control point in the reach. Mitigation is only identified for those stream reaches and months in which the analysis indicated that there was a significant impact from a modeled change in operations.

When this standard is applied to individual years, a reduction of over 20 percent occurs, sometimes for several months in a row. However, when this methodology is applied to the long-term modeled record and compared to baseline, the resulting impact would be considered less-than-significant. The following mitigation measures establish minimum mean monthly flows for the stream reaches where the modeled operations of Pacific Gas and Electric Company's facilities resulted in a significant impact on aquatic resources (Table 4.4-50 Impact Stream summary).

Shasta Regional Bundle

Bundle2: Pit River

McCloud-Pit (FERC 2106)

Mitigation Measure 4-1a: Prior to or concurrent with the transfer of title for the Pit River Bundle and in order to provide rearing habitat for coldwater fisheries and hardhead, the new owner shall by binding written instrument agree to maintain an interim minimum flow schedule for the McCloud River below Lake McCloud as follows: (1) 430 cfs in an Above Normal water year and 129 cfs in a Below Normal water year during the months of April and May; (2) 184 cfs from June through September in all water year types as measured in the McCloud River below Lake McCloud. These flows shall remain in place until consultation and agreement with appropriate resource agencies results in a new binding minimum instream flow.

The new owner, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, shall perform an instream flow analysis and develop appropriate minimum flows that balance the protection of the stream section’s fisheries resources with hydroelectric operations. The interim flow(s) identified above shall remain in effect until the new owner and resource agencies develop a binding agreement implementing the new instream flows.

Implementation of the interim flows combined with consultation with the appropriate agencies and adoption of minimum instream flows will reduce this significant impact to a *less-than-significant* level.

DeSabla Regional Bundle

Bundle 5: Hamilton Branch

Hamilton Branch (non-FERC licensed)

Mitigation Measure 4-1b: Prior to or concurrent with the transfer of title for Bundle 5, and in order to provide suitable April-May and October-November habitat for spawning resident rainbow and brown trout, the new owner shall by binding written instrument agree to maintain an interim minimum flow in Below Normal water years of 21 cfs in the months of April and May and 53 cfs during the months of October through November in Hamilton Branch. These flows shall be in effect until consultation and agreement with appropriate resource agencies results in a new binding minimum instream flow.

The new owner, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, shall perform an instream flow analysis and develop appropriate minimum flows that balance the protection of the stream section's fisheries resources with hydroelectric operations. The interim flow(s) identified above shall remain in effect until the new owner and resource agencies develop a binding agreement implementing the new instream flows.

Implementation of the interim flows combined with consultation with the appropriate agencies and adoption of minimum instream flows will reduce this significant impact to a *less-than-significant* level.

Bundle 6: Upper North Fork Feather River

Upper North Fork Feather River (FERC 2105)

Mitigation Measure 4-1c: Prior to or concurrent with the transfer of title for Bundle 6, and in order to provide October-November spawning habitat for brown trout, the new owner shall by binding written instrument agree to maintain an interim minimum instream flow of 82 and 64 cfs in Above and Below Normal water years respectively as measured below Oak Flat Powerhouse during the months of October and November until consultation and agreement with appropriate resource agencies results in a new binding minimum instream flow.

The new owner, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, shall perform an instream flow analysis and develop appropriate minimum flows that balance the protection of the stream section's fisheries resources with hydroelectric operations. The interim flow(s) identified above shall remain in effect until the new owner and resource agencies develop a binding agreement implementing the new instream flows.

Implementation of the interim flows combined with consultation with the appropriate agencies and adoption of minimum instream flows will reduce this significant impact to a *less-than-significant* level.

Bundle 8: Butte Creek

DeSabla-Centerville (FERC 0803)

Mitigation Measure 4-1d: Prior to or concurrent with the transfer of title for the Butte Creek Bundle, and in order to ensure adequate holding, spawning, and rearing habitat for State and Federally listed threatened spring-run chinook salmon and steelhead, the new owner, in a manner consistent with Pacific Gas and Electric Company's current informal operation, shall by binding written instrument agree to maintain a minimum 40 cfs flow below the Lower Centerville Diversion Dam year-round.

Implementation of this mitigation measure will reduce this significant impact to a *less-than-significant* level.

Lime Saddle (non-FERC) and Coal Canyon (non-FERC)

Mitigation Measure 4-1e: Prior to or concurrent with the transfer of title for the Butte Creek Bundle, and in order to ensure adequate year-round habitat for resident rainbow trout and brown trout, the new owner shall, in a manner consistent with Pacific Gas and Electric Company's current informal operation, by binding written instrument agree to release water into the West Branch Feather River below the Upper Miocene Diversion Dam at the level currently provided informally by Pacific Gas and Electric Company, which level shall be established by Pacific Gas and Electric Company in a manner satisfactory to the CPUC.

Implementation of this mitigation measure will reduce this significant impact to a *less-than-significant* level.

Drum Regional Bundle

Bundle 9: North Yuba River

Narrows (FERC 1403)

Reduction of instream flows below baseline could result in significant impacts to aquatic resources. According to the modeling, a significant reduction of instream flows by a new owner could occur in Deer Creek from Scotts Flat Reservoir to the confluence with the Yuba River. These stream reaches are subject to the operational variations of the different Scenarios. For example, by maximizing storage for water delivery, the WaterMax Scenario results in different streamflows when compared to baseline operations. This same relationship holds true for the PowerMax Scenario. The facilities in question are not part of Pacific Gas and Electric Company's facilities and therefore would not be transferred as part of the divestiture. Many of the stream reaches in this segment receive little on no flow for large portions of the year, however the analysis regarding resident fisheries requirements indicates that less-than-significant impacts could result from a change in operations. The potential presence of Federally listed chinook and steelhead triggers the criteria whereby any deviations from baseline are considered significant. No mitigation measures have been identified that would avoid any deviation from the baseline. Thus, this impact is considered to be *significant and unavoidable*.

Mitigation Measure 4-1f: Prior to or concurrent with the transfer of title for the North Yuba River, and in order to provide adequate habitat for chinook and steelhead, the new owner shall by binding written instrument agree to maintain the following interim flows:

- From the Narrows 1 and 2 Powerhouses tailrace to the confluence with Deer Creek for the months of October through December, the minimum flows shall be 1,868 cfs in Above Normal water years and 957 cfs in Below Normal water years;
- In the Yuba River below the confluence with Deer Creek for the months of October through December, the minimum flows shall be 2,644 cfs in Above Normal water years and 799 cfs in Below Normal water years.

These interim measures shall be in place until consultation and agreement with appropriate resource agencies results in a new binding minimum instream flow.

The new owner, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, shall perform an instream flow analysis and develop appropriate minimum flows that balance the protection of the stream section's fisheries resources with hydroelectric operations. The interim flow(s) identified above shall remain in effect until the new owner and resource agencies develop a binding agreement implementing the new minimum instream flows.

Implementation of the interim flows combined with consultation with the appropriate agencies and adoption of minimum instream flows will reduce the number of instances in which project operations would affect listed salmonids; however, it will not eliminate significant impacts because the details of future operations and their relationship to baseline is poorly understood. For this reason it is necessary to classify this significant impact as *significant and unavoidable*, because with the implementation of the recommended minimum flow schedule, there remains some potential for significant impacts.

Bundle 10: Potter Valley

Potter Valley (FERC 0077)

Mitigation Measure 4-1g: Prior to or concurrent with the transfer of title for the Potter Valley Bundle, and in order to provide suitable flows, the new owner shall, by binding written instrument, agree to maintain the interim flow schedule as developed and currently voluntarily implemented by Pacific Gas and Electric Company (Reid 1999) until such time as FERC amends the Potter Valley license establishing a permanent and new flow schedule.

By requiring that the interim schedule be maintained until such time that FERC issues an order amending the license, the significant impact to the migration and spawning of chinook and steelhead and juvenile chinook and steelhead outmigration, will be reduced to *less-than-significant*.

Mitigation Measure 4-1h: Prior to or concurrent with the transfer of title for the Potter Valley Project, and in order to provide suitable flows for steelhead rearing habitat between Scott and Cape Horn dams, the new owner shall by binding written instrument agree to maintain an interim minimum flow of 140 cfs between Scott and Cape Horn dams between June 1 and September 30.

This agreement shall remain in place until such a point that the license is amended by FERC as discussed in Mitigation Measure 4-1g

By requiring that the interim schedule be maintained until such time that FERC issues an order amending the license, the significant impact to rearing steelhead will be reduced to *less-than-significant*.

Mitigation Measure 4-1i: The new owner shall, by binding written instrument, agree to maximize releases from the surface of Lake Pillsbury when the water is available (above the crest of Scott Dam) and when the temperature of this water would be beneficial in triggering the outmigration of juvenile chinook. Such releases will be made to the best of the new owner's ability upon receiving a written request for this action from CDFG.

Implementation of this mitigation measure will reduce this significant impact to the delay in migration to a level considered *less-than-significant*.

Mitigation Measure 4-1j: No mitigation is feasible. Reduction of instream flows in the East Branch Russian River below those provided under baseline conditions could result in significant impacts to aquatic resources. According to the modeling, a significant reduction of instream flows by a new owner could occur in the East Branch Russian River during the trout rearing season. This is not expected to be an impact to the recreational fishery supported by CDFG. However, it would result in a significant impact to the resident native rainbow trout and non-salmonid species. Successful mitigation would require an increase in diversions from the Eel River. Because there are Federally listed species in the Eel River Basin, any increase in diversion away from this basin would lead to significant impacts to these species. For this reason, it is not possible to mitigate for the reduction in streamflows in the East Branch Russian River as a result of a new owners operations of Pacific Gas and Electric Company's Potter Valley Project. Therefore, this significant impact is considered *significant and unavoidable*.

Bundle 11: South Yuba River

Drum-Spaulding (FERC 2310)

Mitigation Measure 4-1k – Prior to or concurrent with the transfer of title for the South Yuba River Bundle, and in order to provide spawning habitat for brown trout, the new owner shall by binding written instrument agree to maintain an interim minimum flow of 94 or 42 cfs in Above and Below Normal water years respectively, as measured below Fordyce Lake during the months of October and November until consultation and agreement with appropriate resource agencies results in a new binding minimum instream flow.

The new owner, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, shall perform an instream flow analysis and develop appropriate minimum flows that balance the protection of the stream section's fisheries resources with hydroelectric operations. The interim flow(s) identified above shall remain in effect until the new owner and resource agencies develop a binding agreement implementing the new instream flows.

Implementation of this mitigation measure will reduce this significant impact to a level considered *less-than-significant*.

Mitigation Measure 4-1l: Prior to or concurrent with the transfer of title for the South Yuba River Bundle, and in order to provide spawning habitat for brown trout, the new owner shall by binding written instrument agree to maintain the following interim minimum flow schedule as measured below Jackson Meadows Reservoir:

- Between April 1 and May 31 a minimum instream flow of 215 cfs in Above Normal water years and 84 cfs in Below Normal water years;
- Between June 1 and September 30 a minimum instream flow of 175 cfs in Above Normal water years and 39 cfs in Below Normal water years;
- Between October 1 and November 30 a minimum instream flow of 93 cfs in all water year types.

This flow schedule shall remain in place until consultation and agreement with appropriate resource agencies results in a new binding minimum instream flow agreement.

The new owner, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, shall perform an instream flow analysis and develop appropriate minimum flows that balance the protection of the stream section's fisheries resources with hydroelectric operations. The interim flow(s) identified above shall remain in effect until the new owner and resource agencies develop a binding agreement implementing the new instream flows.

Implementation of this mitigation measure will reduce this significant impact to a level considered *less-than-significant*.

Motherlode Regional Bundle

Bundle 13: Mokelumne River

Mokelumne River (FERC 0137)

Mitigation Measure 4-1m: Prior to or concurrent with the transfer of title for the Mokelumne River Bundle, and in order to provide rearing and spawning habitat for resident rainbow trout and spawning brown trout, the new owner shall by binding written instrument agree to maintain an interim minimum flow of 119 and 39 cfs in Above and Below Normal water years respectively, for the months of June through September. Additionally, a flow of 37 or 12 cfs in Above and Below Normal water years respectively, shall be released in the months of October and November. This schedule shall remain in place until consultation and agreement with appropriate resource agencies results in a new binding minimum instream flow.

The new owner, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, shall perform an instream flow analysis and develop appropriate minimum flows that balance the protection of the stream section's fisheries resources with hydroelectric operations. The interim flow(s) identified above shall remain in effect until the new owner and resource agencies develop a binding agreement implementing the new instream flows.

Implementation of this mitigation measure will reduce this significant impact to a level considered *less-than-significant*.

Mitigation Measure 4-1n: Prior to or concurrent with the transfer of title for the Mokelumne River Bundle, and in order to provide rearing and spawning habitat for resident rainbow trout and spawning brown trout, the new owner shall by binding written instrument agree to maintain an interim minimum instream flow of 35 cfs between April 1 and September 30 as measured below Lower Bear Reservoir in all water year types. This schedule shall remain in place until consultation and agreement with appropriate resource agencies results in a new binding minimum instream flow.

The new owner, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, shall perform an instream flow analysis and develop appropriate minimum flows that balance the protection of the stream section's fisheries resources with hydroelectric operations. The interim flow(s) identified above shall remain in effect until the new owner and resource agencies develop a binding agreement implementing the new instream flows.

Implementation of this mitigation measure will reduce this significant impact to a level considered *less-than-significant*.

Mitigation Measure 4-1o: Prior to or concurrent with the transfer of title for the Mokelumne River Bundle, and in order to provide rearing and spawning habitat for resident rainbow trout and spawning brown trout, the new owner shall by binding written instrument agree to maintain the following interim minimum flows between October 1 and November 30 at the specified locations:

- Below the tailrace of the Salt Springs #1 Powerhouse, a flow of 58 cfs in Above Normal water years and 35 cfs in Below Normal water years;
- Below the Bear River, a 130 cfs flow in Above Normal water years and 51 cfs flow in Below Normal water years;
- Below Panther Creek, a 134 cfs flow in Above Normal water years and 55 cfs flow in Below Normal water years;
- Below the Tiger Creek Afterbay, a 116 cfs flow in Above Normal water years and 22 cfs flow in Below Normal water years;
- Below the Electra Powerhouse Discharge, a 607 cfs flow in Above Normal water years and 486 cfs flow in Below Normal water years;

All minimum flows will be measured at the upstream end of the respective stream reach. This schedule shall remain in place until consultation and agreement with appropriate resource agencies results in a new binding minimum instream flow.

The new owner, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, shall perform an instream flow analysis and develop appropriate minimum flows that balance the protection of the stream section's fisheries resources with hydroelectric operations. The interim flow(s) identified above shall remain in effect until the new owner and resource agencies develop a binding agreement implementing the new instream flows.

Implementation of the minimum flows in this mitigation measure will reduce these significant impacts to a level considered *less-than-significant*.

Bundle 14: Stanislaus River

Spring Gap-Stanislaus River (FERC 2130)

Mitigation Measure 4-1p: Prior to or concurrent with the transfer of title for the Stanislaus River Bundle, and in order to provide fall spawning habitat for brown trout, the new owner shall by binding written instrument agree to maintain an interim minimum 27 cfs instream flow as measured below Relief Reservoir between October 1 and November 30 until consultation and agreement with appropriate resource agencies results in a new binding minimum instream flow.

The new owner, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, shall perform an instream flow analysis and develop appropriate minimum flows that balance the protection of the stream section's fisheries resources with hydroelectric operations. The interim flow(s) identified above shall remain in effect until the new owner and resource agencies develop a binding agreement implementing the new instream flows.

Implementation of this mitigation measure would reduce the significant impact to a level considered *less-than-significant*.

Mitigation Measure 4-1q: Prior to or concurrent with the transfer of title for the Stanislaus River Bundle, and in order to provide rearing and spawning habitat for spawning rainbow and brown trout, the new owner shall by binding written instrument agree to maintain the following interim minimum flows from the Spring Gap Powerhouse discharge to the confluence with South Fork Stanislaus River:

- In April and May, the minimum flows shall be 391 cfs regardless of water year type (based on WUA provided under baseline conditions);
- In October and November, the minimum flows shall be 158 cfs in all water year types (based on WUA provided under baseline conditions).

All minimum flows will be measured at the upstream end of the respective stream reach. This schedule shall remain in place until consultation and agreement with appropriate resource agencies results in a new binding minimum instream flow.

The new owner, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, shall perform an instream flow analysis and develop appropriate minimum flows that balance the protection of the stream section's fisheries resources with hydroelectric operations. The interim flow(s) identified above shall remain in effect until the new owner and resource agencies develop a binding agreement implementing the new instream flows.

Implementation of this mitigation measure would reduce the significant impact to a level considered *less-than-significant*.

Phoenix (FERC 1061)

Mitigation Measure 4-1r: Prior to or concurrent with the transfer of title for the Stanislaus River Bundle, and in order to provide fall spawning habitat for brown trout, the new owner shall by binding written instrument agree to maintain an interim minimum flow of 61 cfs below Pinecrest Reservoir during the months of October and November until consultation and agreement with appropriate resource agencies results in a new binding minimum instream flow.

The new owner, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, shall perform an instream flow analysis and develop appropriate minimum flows that balance the protection of the stream section's fisheries resources with hydroelectric operations. The interim flow(s) identified above shall remain in effect until the new owner and resource agencies develop a binding agreement implementing the new instream flows.

Implementation of this mitigation measure will reduce the significant impact to a level considered *less-than-significant*.

Mitigation Measure 4-1s: Prior to or concurrent with the transfer of title for the Stanislaus River Bundle, and in order to provide fall spawning habitat for brown trout, the new owner shall by binding written instrument agree to maintain an interim minimum flow of 15 cfs in the river below Lyons Reservoir during the months of October and November until consultation and agreement with appropriate resource agencies results in a new binding minimum instream flow.

The new owner, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, shall perform an instream flow analysis and develop appropriate minimum flows that balance the protection of the stream section's fisheries resources with hydroelectric operations. The interim flow(s) identified above shall remain in effect until the new owner and resource agencies develop a binding agreement implementing the new instream flows.

Implementation of this mitigation measure will reduce the significant impact to a level considered *less-than-significant*.

Kings Crane-Helms Regional Bundle

Bundle 16: Crane Valley

Crane Valley (FERC 1354)

Mitigation Measure 4-1t: Prior to or concurrent with the transfer of title for the Crane Valley Bundle, and in order to ensure protection of aquatic and fisheries habitat, the new owner, in a manner consistent with Pacific Gas and Electric Company's current informal practice, shall by binding written instrument agree to maintain a minimum 1 cfs flow below the Crane Valley Reservoir Dam year-round and 4 cfs or natural inflow (whichever is less) below Browns Creek Diversion Dam.

Implementation of this mitigation measure would reduce the significant impact to a level considered *less-than-significant*.

4.4.8.8 Impact 4-1: Level of Significance After Mitigation

The identified significant impacts in the Shasta, DeSabla, Motherlode, and Kings Crane-Helms regional bundles, and South Yuba-Bear (Bundle 11) within the Drum Regional Bundle, will be reduced to *less-than-significant* if the proposed mitigation measures are implemented (Table 4.4-50). Within the Drum Regional Bundle, mitigation to the less-than-significant level is not feasible for the Narrows Project (Bundle 9) or Potter Valley Project (Bundle 10) due to constraints involving State and Federally listed salmonids. As a result, the project could have *significant unavoidable impacts* to fisheries resources in the streams and rivers associated with them (Table 4.4-50).

4.4.9 IMPACT 4-2: IMPACT AND ANALYSIS

Impact 4-2 Changes in the timing, magnitude, duration and frequency of reservoir levels as a result of new owner operation of Pacific Gas and Electric Company's hydroelectric facility assets could adversely affect fishery and aquatic resources, especially special-status species, through habitat or water quality degradation (Significant).

4.4.9.1 Impact 4-2: Shasta Regional Bundle

The primary function of Pacific Gas and Electric Company storage reservoirs is to collect water during high runoff periods and use this stored water for hydroelectric generation throughout the summer and fall, when runoff is minimal. After filling in the spring, the water level in most of these storage systems gradually declines until it reaches the minimum annual pool level in winter. Some reservoirs are held high throughout the summer recreational season and then drawn down rapidly to winter pool levels.

The majority of reservoirs located in the Shasta Regional Bundle are small, and generally operate as either run-of-river diversions or as power peaking reservoirs with limited storage capacity capable of operating in weekly time steps. Most of the power peaking reservoirs, like Pit 4, 5, 6, and 7 reservoirs, do not provide any substantial sport fisheries because of their small size, fluctuating water levels, difficult access, poor habitat (steep sided), and abundant nongame native species. Other small run-of-river reservoirs, like the Hat 1 and Hat 2 reservoirs, have stable water surface elevations and limited storage capacity, good water quality and water temperatures, and provide good trout fishing opportunities. Because of the limited operational flexibility and storage capacity, OASIS hydrologic modeling was not conducted for all of these reservoirs and it is assumed that under all project alternatives, operation of these reservoirs would remain essentially the same as baseline conditions.

The larger storage reservoirs associated with Pacific Gas & Electric Company's hydropower generation facilities are limited to the Pit River Bundle (Lake Britton, Lake McCloud, and Iron Canyon Reservoir) and Battle Creek Bundle (North Battle Creek Reservoir and Lake Macumber). Operation of these reservoirs for hydropower generation has the potential to impact fishery resources depending on the timing and duration of reservoir draw down and fill rates.

Variation in reservoir water levels may result in the following:

- repeated exposure of large areas of shoreline littoral zone, preventing the establishment of littoral aquatic plant beds valuable for shelter and food production;
- reduction in the production of the invertebrate community, a key food resource for fish;
- dewatering spawning and rearing habitat and destruction of established nests;
- denying salmonid access to spawning tributaries.

Assessment of impacts to reservoir fisheries in the following sections is focused on these larger project reservoirs. Assessments of impacts on fish within each of the individual FERC projects are based on the results of OASIS modeling for the baseline condition and the PowerMax Scenario (Appendix C). OASIS Hydrologic Modeling was not conducted for the WaterMax Scenario because of the lack of seasonal storage capacity in the Pit River System. Therefore, it is assumed that impacts that may occur under the WaterMax Scenario would be essentially the same as impacts that may occur under the PowerMax.

Bundle 1: Hat Creek

Hat Creek 1 and 2 (FERC 2661)

Cassel Pond and Baum Lake are the only two reservoirs associated with Hat Creek 1 and 2. Because both lakes are operated as run-of-river diversions, lake elevations in each are maintained at stable levels. These stable elevations provide favorable conditions that contribute to the healthy fishery conditions that exist. OASIS hydrologic modeling was not conducted for either of these reservoirs because they are small in size, operate as run-of-river (have stable elevations), and have very limited operational flexibility and useable storage. Operation of Hat Creek 1 and 2 by a new owner would be substantially the same as baseline conditions and therefore the project would have ***no impact*** on fisheries and aquatic resources.

Bundle 2: Pit River

Pit 1 (FERC 2687)

The Pit 1 Diversion Dam and Pit 1 Forebay Dam are the only reservoirs associated with the Pit 1 project (FERC 2687).

The global thresholds of significance established for assessment of impacts to reservoir fisheries do not apply to the Pit 1 Forebay. The small volume of useable storage available in the Pit 1 Forebay greatly limits the operational flexibility of the Pit 1 project. In addition, terms of the new FERC license will attach additional environmental conditions on the operation of Pit 1 that will enhance fishery and aquatic resource conditions downstream. A new owner of Pit 1 will be required to operate the facility under existing conditions and agreements, including those proposed in the new FERC license. Therefore, operations under each of the alternative Scenarios would be substantially the same as the baseline condition; thus the project would have *no impact* on fisheries and aquatic resources.

Pit 3, 4, and 5 (FERC 0233)

Lake Britton (Node 730) is the largest diversion reservoir of the Pit 3, 4, and 5 system with a usable storage of 41,877 af and a gross storage of 41,907 af. The reservoir serves as the diversion point to the Pit 3 Tunnel and is operated as a power peaking facility. Under normal operating conditions the reservoir is drawn down between 3 to 7 feet during the week and is then refilled over the weekend.

For warmwater fishery resources assessment of potential impacts is focused on spawning habitat requirements for largemouth bass and other centrarchid species, which are sensitive to changes in water elevation during the spawning season. The established significance threshold describes the primary spawning period from the end of April through June. However, for Lake Britton, the largemouth bass spawning season extends into the month of July. Therefore, the period of analysis from which assessment of potential impacts to warmwater fishery resources for Lake Britton is made, is expanded to include the month of July. The threshold significance criteria are also based on reservoir elevation changes greater than 15 feet, up or down. For Lake Britton the primary bass spawning area occurs in Burney Creek Cove and CDFG have determined that decreases in reservoir elevation below 2,732 feet impact bass spawning habitat. Therefore, for this assessment, in addition to the significance threshold already stated, a reduction in reservoir elevations below 2,732 feet that occurs in more than 10 percent of the years sampled from the end of April through July would also be considered a significant impact to warmwater fishery resources.

The May through October storage analysis comparing baseline operation against the PowerMax Scenario indicates that there would not be a 20 percent reduction in water storage volumes in any year for the period of record (Appendix H: Shasta Table-15). Although minor reductions in storage volumes occur, these reductions would result in a *less-than-significant impact* to coldwater reservoir fishery resources.

Results of the assessment of potential impacts to warmwater fishery resources under baseline and the PowerMax Scenario are presented in Table 4.4-51 and Table 4.4-52.

Table 4.4-51 Assessment of End of Month Reservoir Storage Elevations and Change in Storage That Would Occur in Lake Britton Under Baseline Conditions Based on OASIS Mean Monthly Hydrologic Model Data Results

Water Year	Water Year Type	End of Month Storage (ft)				Change in Elevation (ft)		
		Apr	May	Jun	Jul	May	Jun	Jul
1975	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0
1976	Critical	2738.47	2738.47	2738.47	2738.47	0	0	0
1977	Critical	2729.67	2738.47	2738.47	2729.67	8.8	0	-8.8
1978	Above Normal	2738.47	2738.47	2738.47	2738.47	0	0	0
1979	Below Normal	2738.47	2738.47	2738.47	2738.47	0	0	0
1980	Above Normal	2738.47	2738.47	2738.47	2738.47	0	0	0
1981	Dry	2738.47	2738.47	2738.47	2738.47	0	0	0
1982	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0
1983	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0
1984	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0
1985	Dry	2738.47	2738.47	2738.47	2738.47	0	0	0
1986	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0
1987	Dry	2738.47	2738.47	2738.47	2735.87	0	0	-2.6
1988	Critical	2738.47	2738.47	2738.47	2729.67	0	0	-8.8
1989	Dry	2738.47	2738.47	2738.47	2729.67	0	0	-8.8
1990	Critical	2738.47	2738.47	2738.47	2738.47	0	0	0
1991	Critical	2738.47	2738.47	2738.47	2738.47	0	0	0
1992	Critical	2738.47	2738.47	2738.47	2729.67	0	0	-8.8
1993	Above Normal	2738.47	2738.47	2738.47	2738.47	0	0	0
1994	Critical	2738.17	2738.47	2738.47	2738.47	0.3	0	0
1995	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0
1996	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0

Table 4.4-51 Assessment of End of Month Reservoir Storage Elevations and Change in Storage That Would Occur in Lake Britton Under Baseline Conditions Based on OASIS Mean Monthly Hydrologic Model Data Results

Water Year	Water Year Type	End of Month Storage (ft)				Change in Elevation (ft)		
		Apr	May	Jun	Jul	May	Jun	Jul
1997	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0
1998	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0

Table 4.4-52 Assessment of End of Month Reservoir Storage Elevations and Change in Storage That Would Occur in Lake Britton Under the PowerMax Scenario Based on OASIS Mean Monthly Hydrologic Model Data Results

Water Year	Water Year Type	End of Month Storage (ft)				Change in Elevation (ft)		
		Apr	May	Jun	Jul	May	Jun	Jul
1975	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0
1976	Critical	2724.27	2738.47	2738.47	2738.47	14.2	0	0
1977	Critical	2724.27	2738.47	2738.47	2725.87	14.2	0	-12.6
1978	Above Normal	2738.47	2738.47	2738.47	2732.77	0	0	-5.7
1979	Below Normal	2724.27	2738.47	2738.47	2733.67	14.2	0	-4.8
1980	Above Normal	2728.47	2738.47	2738.47	2737.87	10	0	-0.6
1981	Dry	2734.67	2738.47	2738.47	2738.47	3.8	0	0
1982	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0
1983	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0
1984	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0
1985	Dry	2725.97	2738.47	2738.47	2738.47	12.5	0	0
1986	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0
1987	Dry	2724.27	2738.47	2738.47	2735.87	14.2	0	-2.6
1988	Critical	2724.27	2738.47	2738.47	2733.17	14.2	0	-5.3
1989	Dry	2736.17	2738.47	2738.47	2726.37	2.3	0	-12.1
1990	Critical	2724.27	2738.47	2738.47	2738.47	14.2	0	0
1991	Critical	2724.27	2738.47	2738.47	2738.47	14.2	0	0
1992	Critical	2724.27	2738.47	2738.47	2731.27	14.2	0	-7.2
1993	Above Normal	2738.47	2738.47	2738.47	2738.47	0	0	0
1994	Critical	2724.27	2738.47	2738.47	2738.37	14.2	0	-0.1
1995	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0
1996	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0

Table 4.4-52 Assessment of End of Month Reservoir Storage Elevations and Change in Storage That Would Occur in Lake Britton Under the PowerMax Scenario Based on OASIS Mean Monthly Hydrologic Model Data Results

Water Year	Water Year Type	End of Month Storage (ft)				Change in Elevation (ft)		
		Apr	May	Jun	Jul	May	Jun	Jul
1997	Wet	2729.27	2738.47	2738.47	2738.47	9.2	0	0
1998	Wet	2738.47	2738.47	2738.47	2738.47	0	0	0

Assessments of the change in reservoir elevations under the PowerMax Scenario indicate that substantial changes (> 15 feet) in reservoir elevations do not occur during the 75 months assessed. However, lake elevations drop below 2,732 feet on 3 occurrences during the 75 months assessed, or for 4 percent of the time period assessed (Appendix H: Shasta Figure-15 through 18). Under the baseline condition, reservoir elevations do not fall below 2,732 feet (Appendix H: Shasta Table-16). Based on the modeling results, operation of the Pit 3, 4, and 5 project by a new owner under the PowerMax Scenario would result in *no impact* to warmwater fishery resources in Lake Britton relative to the baseline condition.

McCloud-Pit (FERC 2106)

The storage reservoirs with substantial fishery resources situated in the McCloud-Pit Project include Lake McCloud (Node 78) and Iron Canyon Reservoir (Node 790).

Examination of the cumulative May-October storage analysis reveals that under the PowerMax Scenario, Lake McCloud (Appendix H: Shasta Table-17) would experience minor reductions in cumulative storage when compared to baseline and thus impacts to fishery resources would be *less-than-significant*. At Iron Canyon Reservoir (Appendix H: Shasta Table-23) there would be substantial reductions from baseline in cumulative reservoir storage in all years under the PowerMax Scenario, and thus the project is expected to have a *significant impact* to these coldwater reservoir fishery resources when compared to the baseline condition.

Bundle 3: Kilarc-Cow Creek

Kilarc-Cow Creek (FERC 0606)

There are no large storage reservoir facilities associated with Kilarc-Cow. The system is operated as a run-of-river facility and is comprised of small diversion dams that feed water to the diversion canals, project forebays, and powerhouses. The largest reservoirs associated with Kilarc-Cow is the

Kilarc Forebay, with a storage capacity of 30.4 af, and the Cow Creek Forebay with a storage capacity of only 5.4 af. Because the system is operated as a run-of-river facility, and has very little storage capacity, OASIS hydrologic modeling was not conducted.

Given the limited storage capacity and operational flexibility, a new owner would operate the project substantially the same as Pacific Gas and Electric Company. Therefore, the project would result in *no impact* to reservoir fisheries and aquatic resources.

Bundle 4: Battle Creek

Battle Creek (FERC 1121)

The Battle Creek system consists of two small storage reservoirs located on the upper reaches of the North Fork Battle Creek, small forebay reservoirs, and several small run-of-river diversion dams located on the North and South Forks of Battle Creek and on smaller tributary feeder streams. No OASIS hydrologic modeling was conducted for the Battle Creek system because it is operated as a run-of-river facility and has only limited storage capabilities.

FERC License Article 33 requires that North Battle Creek Reservoir be maintained at or above 1,039 af capacity during the annual recreation season from June 1 to September 10. In addition, the article stipulates that an elevation at or above a minimum pool of 75 af (elevation 5,544 feet) be maintained from September 11 through May 31 (except for purposes of maintaining stream flow releases, maintenance and repairs, or emergencies). FERC License Article 33 also specifies that Macumber Reservoir must be full to provide for recreational uses between April 1 and September 10.

Given the current operational constraints and FERC License conditions, operation of the Battle Creek system under any modeled Scenario operation would be essentially the same as baseline conditions. Therefore, the project is expected to have *no impact* on reservoir fisheries and aquatic resources.

4.4.9.2 Impact 4-2 DeSabla Regional Bundle

Assessments of impacts on fish in the DeSabla Regional Bundle is based both on results of the OASIS modeling and on additional referenced material about changes under the three operations Scenarios.

Bundle 5: Hamilton Branch

Hamilton Branch (non-FERC)

The cumulative May-October storage analysis comparing baseline operation against the PowerMax and WaterMax Scenarios for Mountain Meadows Reservoir (Node 1) indicates that there would not be a 20 percent reduction in storage volumes in any year under any of the Scenarios (DeSabla Appendix Table-23 through 24). Therefore, the cumulative storage comparisons do not exceed the 20 percent significance threshold. In addition, reservoir fluctuations in the representative water year types (Appendix H: DeSabla Figure-23 through Appendix H: DeSabla Figure-26), bears out that management of the reservoir under the three operating Scenarios would be very similar. This is certainly due, in great part, to the 1989 Fish and Wildlife Agreement between Pacific Gas and Electric Company and CDFG. Based on the modeling analysis it is concluded that a future owner's operation would be substantially the same as baseline, and therefore the project would result in a *less-than-significant impact* on fisheries and aquatic resources.

Ninety percent of Mountain Meadows Reservoir is less than 10 feet deep at maximum water surface elevation; therefore the reservoir elevation change significance criterion of 15 feet does not readily apply. However, close review of the April to May and May to June change in reservoir elevation data (Appendix H: DeSabla Table-18) shows that over the period of record that reservoir elevation changes never exceed 3 feet under any of the Scenarios. A closer look at the data reveals that over the period of record, operation of the reservoir would be nearly identical for all the Scenarios. The extremely similar elevation levels for all of the Scenarios lead to the conclusion that the 1989 Fish and Wildlife Agreement would constrain any future owner's operation of the facility, ensuring that reservoir levels would be consistent with baseline, and therefore the project would have *no impact* to warmwater fisheries.

Bundle 6: Upper North Fork Feather River

Upper North Fork Feather River (FERC 2105)

Lake Almanor. The cumulative May-October storage analysis comparing baseline operation against the PowerMax and WaterMax Scenarios for Lake Almanor (Node 4) indicates that there would be no 20 percent reduction in storage volumes in normal or wet years under any of the Scenarios (Appendix H: DeSabla Table-25). However, the PowerMax Scenario exceeds the 20 percent significance criteria in six critically dry years and two dry years, ranging from a 20 percent to 22 percent reduction in cumulative storage volume.

Reservoir fluctuations in the representative water year types (Appendix H: DeSabla Figure-27 through DeSabla Figure-24) generally support the above conclusions. For the representative dry, normal, and wet years, the WaterMax Scenario consistently provides more storage in Lake Almanor; however, during the late summer and early fall months of the critically dry year, WaterMax draws down the reservoir close to the 500 af minimum. The PowerMax Scenario is consistently below baseline in the representative critically dry, dry, normal, and wet years, with 20 percent mean monthly storage volume reductions in every month throughout the entire critically dry water year.

Neither the WaterMax nor the PowerMax Scenarios results in an April to May or May to June change in reservoir elevation of 15 feet or greater for any year for the period of record (Appendix H: DeSabla Table-26).

The state of the fishery at Lake Almanor is, in general, related to management techniques, not to lake level changes. However, there could be a substantial change from baseline under the

PowerMax Scenario in dry and critically dry years and this change has the potential to reduce the availability of physical habitat for fish populations during their critical growing season. Basing a level of impact on hydrologic data alone for Lake Almanor is very difficult. Nonetheless, based on the modeling information, it is concluded that a future owner's operation could be substantially different than baseline, and therefore the project would result in a *significant impact* on fisheries and aquatic resources.

Butt Valley Reservoir. According to the cumulative May-October storage analysis comparing baseline operation to the PowerMax and WaterMax Scenarios for Butt Valley Reservoir (Node 6), there would be no 20 percent reductions in storage volumes in any of the years for the period of record (Appendix H: DeSabla Table-27). The representative water year analysis (Appendix H: DeSabla Figure-31 through Appendix H: DeSabla Figure-34) confirms this conclusion, but also shows distinctly different operation patterns under the different Scenarios.

None of the project Scenarios in any year results in an April to May or May to June change in reservoir elevation of 15 feet or greater (Appendix H: DeSabla Table-28). Therefore the warmwater fishery significance criteria are not exceeded.

Under the modeling analysis, a new owner's management of Butt Valley Reservoir would not be different from baseline operation. Based on the modeling information it is concluded that a future owner's operation would be substantially the same as baseline, and therefore the project would have a *less-than-significant impact* on fisheries and aquatic resources in this reservoir.

Belden Reservoir. Belden Reservoir is a small run-of-the-river reservoir with a very short water retention time and extreme fluctuation levels. The short retention time and constant fluctuations are due to the hourly, daily, weekly, and monthly variability in inflow from the Caribou 1&2 Powerhouse tailraces and withdrawals at the Belden Powerhouse intake. The reservoir additionally captures inflow from the NFFR, which consists of FERC minimum releases made below the Almanor Dam.

Because the shoreline within the reservoir fluctuation zone is steep and rocky and without substantial aquatic vegetation, the littoral zone in the reservoir is not well developed. Littoral areas are important as juvenile fish nursery areas and as producers of aquatic insects that are important fish food. In addition, the reservoir contains significant populations of non-game fish, which reduce trout populations.

Because the reservoir does not provide a well-developed littoral zone, the impact of a new owner, also operating the reservoir with a high degree of variability, on the benthic and fishery resources would be slight. Because of the limited operational flexibility and storage capacity, OASIS hydrologic modeling was not conducted for this reservoir. Based on the foregoing information it is concluded that a future owner's operation would have a similar degree of variability as baseline, and therefore the project would have a *less-than-significant impact* on fisheries and aquatic resources.

Rock Creek-Cresta (FERC 1962)

Rock Creek Reservoir. Rock Creek Reservoir is a small run-of-the-river reservoir with a very short water retention time and extreme fluctuation levels. The short retention time and constant fluctuations are due to the hourly, daily, weekly, and monthly variability in inflow from the Belden powerhouse tailrace and withdrawals at the Rock Creek Powerhouse intake. The reservoir additionally captures inflow from the NFFR, which consists of FERC minimum releases made below the Belden Reservoir plus unregulated inflow from the East Branch NFFR. In addition, the reservoir contains significant populations of non-game fish, which reduce trout populations.

Because the shoreline within the reservoir fluctuation zone is steep and rocky and without substantial aquatic vegetation, the littoral zone in the reservoir is not well developed. Littoral areas are important as juvenile fish nursery areas and as producers of aquatic insects that are important fish food. Because the reservoir does not provide a well-developed littoral zone, the impact of a new owner, also operating the reservoir with a high degree of variability, on the benthic and fishery resources would be slight. Because of the limited operational flexibility and storage capacity, OASIS hydrologic modeling was not conducted for this reservoir. Based on the foregoing information it is concluded that a future owner's operation would have a similar degree of variability as baseline, and therefore there would be a *less-than-significant impact* on fisheries and aquatic resources.

Cresta Reservoir. Cresta Reservoir is a small run-of-the-river reservoir with a very short water retention time and extreme fluctuation levels. The short retention time and constant fluctuations are due to the hourly, daily, weekly, and monthly variability in inflow from the Rock Creek Powerhouse tailrace and the Bucks Creek Powerhouse tailrace and withdrawals at the Cresta Powerhouse intake. The reservoir additionally captures inflow from the NFFR, which consists of FERC minimum releases made below the Rock Creek Reservoir plus inflow from a number of small tributaries. In addition, the reservoir contains significant populations of non-game fish, which reduce trout populations.

Because the shoreline within the reservoir fluctuation zone is steep and rocky and without substantial aquatic vegetation, the littoral zone in the reservoir is not well developed. Littoral areas are important as juvenile fish nursery areas and as producers of aquatic insects that are important fish food. Because the reservoir does not provide a well-developed littoral zone, the impact of a new owner, also operating the reservoir with a high degree of variability, on the benthic and fishery resources would be slight. Because of the limited operational flexibility and storage capacity, OASIS hydrologic modeling was not conducted for this reservoir. Based on the foregoing information it is concluded that a future owner's operation would have a similar degree of variability as baseline, and therefore there would be a *less-than-significant impact* on fisheries and aquatic resources.

Poe (FERC 2107)

Poe Reservoir. Poe Reservoir is a small run-of-the-river reservoir with a very short water retention time and extreme fluctuation levels. The short retention time and constant fluctuations are due to the hourly, daily, weekly, and monthly variability in inflow from the Cresta powerhouse tailrace and withdrawals at the Poe Powerhouse intake. The reservoir additionally captures inflow from the NFFR, which consists of FERC minimum releases made below the Cresta Reservoir plus inflow from a number of small NFFR tributaries including Grizzly Creek. In addition, the reservoir contains significant populations of non-game fish, which reduce trout populations.

Because the shoreline within the reservoir fluctuation zone is steep and rocky and without substantial aquatic vegetation, the littoral zone in the reservoirs is not well developed. Littoral areas are important as juvenile fish nursery areas and as producers of aquatic insects that are important fish food. Because the reservoir does not provide a well-developed littoral zone, the impact of a new owner, also operating the reservoir with a high degree of variability, on the benthic and fishery resources would be slight. Because of the limited operational flexibility and storage capacity, OASIS hydrologic modeling was not conducted for this reservoir. Based on the foregoing information it is concluded that a future owner’s operation would have a similar degree of variability as baseline, and therefore there would be a *less-than-significant impact* on fisheries and aquatic resources.

Bundle 7: Bucks Creek

Bucks Creek (FERC 0619)

Bucks Lake. According to the cumulative May-October storage analysis comparing baseline operation over the period of record against the PowerMax and WaterMax Scenarios for Bucks Lake (Node 11), there would be a 20 percent reduction in storage volumes in four dry years and seven critically dry years for the PowerMax Scenario and in one critically dry year for the WaterMax Scenario for the period of record (Appendix H: DeSabla Table-29). Normal and wet water years do not show a 20 percent reduction in storage volume from baseline for either of the Scenarios.

Reservoir fluctuations in the representative water year types (Appendix H: DeSabla Figure-35 through Appendix H: DeSabla Figure-38) reinforce these conclusions. The WaterMax Scenario storage remains above or just at baseline throughout the representative wet, normal, and dry years, and is significantly below baseline in all months during the representative critically dry year. Under the dry and critically dry representative water years, the PowerMax Scenario consistently has less storage than baseline in Bucks Lake (Appendix H: DeSabla Figure-35 and 36), with larger drafts occurring in late summer and into fall. These drawdowns show a distinct deviation from

Pacific Gas and Electric Company's informal practice of carrying over 45,000 af at Bucks Lake and a closer adherence to the minimum FERC license requirements.

The reduced carrying capacity of the smaller pool during the late summer and into the fall of a critically dry year could have detrimental effects on the reservoir's fishery. The reduced carrying capacity is likely to translate into reduced fish population levels both during and following the increased drawdown of the pool.

While Bucks Lake is designed primarily for storage and release of water to generate hydroelectric power, a new owner's management of Bucks Lake would be significantly different from baseline operation, especially under the PowerMax Scenario during critically dry years. This change could reduce the availability of physical habitat and impact water quality to the detriment of self-sustaining fish populations. Based on the modeling, the project would have a *significant impact* on fisheries and aquatic resources in this lake.

Lower Bucks Lake. According to the cumulative May-October storage analysis comparing baseline operation to the PowerMax and WaterMax Scenarios for Lower Bucks Lake (Appendix H: DeSabla Table-31), there would be no 20 percent reductions in storage volumes in any of the years for the period of record (Appendix H: DeSabla Table-31). The representative water year analysis (Appendix H: DeSabla Figure-39 through 42) confirms this conclusion, showing nearly identical operation behavior for this small reservoir under both Scenarios for representative dry, normal, and wet years. In the representative critically dry year (Appendix H: DeSabla Figure-39) the WaterMax Scenario shows a distinct reservoir level decline in September.

Under the modeling analysis, a new owner's management of Lower Bucks Lake would not be different from baseline operation. Based on the modeling information it is concluded that a future owner's operation would be substantially the same as baseline, and therefore the project would have a *less-than-significant impact* on fisheries and aquatic resources in the lake.

Three Lakes and Grizzly Forebay. FERC License Article 13 specifies minimum reservoir elevation levels for these two smaller reservoirs in the Bucks Creek Project.

Because of the limited operational flexibility and storage capacity, no reservoir volume data was generated for these smaller reservoirs because they are anticipated to continue operating in a manner similar to the past. Generally, that is as small supplemental storage for power production in the case of Three Lakes, and as a forebay and afterbay in the case of Grizzly Forebay. In any event, it is anticipated that any future owner will maintain the FERC minimum storage elevations detailed in FERC License Article 13. Based on the foregoing information it is concluded that a future owner's operation would be similar to baseline, and therefore the project would have a *less-than-significant impact* on fisheries and aquatic resources in these lakes.

Bundle 8: Butte Creek

No hydrological modeling was prepared for the Butte Creek Regional Bundle, which includes the DeSabla-Centerville Project, Lime Saddle Powerhouse, and Coal Canyon Powerhouses, because system flexibility is constrained by a general lack of storage, regulatory requirements, and water delivery obligations.

DeSabla-Centerville (FERC 0803)

Philbrook Reservoir and Round Valley Reservoir. There are many future potential Scenarios for drawing down Philbrook and Round Valley reservoirs, but, in general, both reservoirs are drawn down significantly during late summer and early fall and provide only a limited trout fishery. In addition, the 1997 FERC order (discussed above) insures that Pacific Gas and Electric Company, or a new owner, would need to continue working with State and Federal resource agencies to develop reservoir release schedules that strike a balance between water temperature concerns on Butte Creek, hydroelectric development, and water delivery obligations further down the WBFR. A future owner's operation and management of these two reservoirs is constrained by the system's minimal water storage capacity, regulatory requirements, and legal water delivery obligations, and thus would be similar to baseline. Therefore the project would have a *less-than-significant impact* on fisheries and aquatic resources.

DeSabla Forebay. DeSabla Forebay provides intermediate water regulation and storage and serves as the forebay for the DeSabla Powerhouse. Except during the routine annual maintenance period, the forebay is maintained at an almost constant level throughout the year. Like Philbrook Reservoir, the DeSabla Forebay provides a good brown trout and rainbow trout fishery, managed on a put-and-take basis by CDFG. Again, no reservoir volume data was generated for these smaller reservoirs because they are anticipated to continue operating in a manner similar to the past, regardless of ownership. Based on the foregoing information it is concluded that a future owner's operation would be similar to the baseline, and therefore, the project is expected to have a *less-than-significant impact* on fisheries and aquatic resources in this reservoir.

Lime Saddle (non-FERC) and Coal Canyon (non-FERC). The Lime Saddle and Coal Canyon Powerhouses are essentially run-of-the-river projects in the lower section of the West Branch Feather River (WBFR) with minimal storage capacity and little operational flexibility due to binding water delivery constraints. Therefore, no hydrologic model was conducted.

Pacific Gas and Electric Company is contractually obligated to deliver 45 cfs of WBFR water originating above the Upper Miocene Diversion Dam to the California Water Service Company (Section 4.4.8.2) to meet various consumptive uses downstream from Pacific Gas and Electric Company's Coal Canyon Powerhouse. To meet this contractual obligation, a future owner would be obligated to divert similar flows from the WBFR at the Upper Miocene Diversion Dam and ultimately run those flows through the Kunkle Reservoir in a manner consistent with Pacific Gas and Electric Company's past operation. Because of the system's physical constraints and legal delivery obligations, a future owner's operation would be substantially the same as baseline, and therefore the project would have a *less-than-significant impact* on fisheries and aquatic resources.

Summary Impact 4-2 Entire DeSabla Regional Bundle

Operations by future owner would have a less-than-significant impact on a majority of reservoirs in the DeSabla Regional Bundle, including Mountain Meadows, Butt Valley, Belden, Rock Creek, Cresta, Poe, Lower Bucks Lake, Round Valley, Philbrook, DeSabla Forebay, and Kunkle. Significant impacts are expected to occur to Lake Almanor, the largest reservoir in Pacific Gas and Electric Company's hydroelectric system. Significant impacts could also occur at Bucks Lake. Therefore, it is determined that the project could have a *significant impact* for the entire DeSabla Regional Bundle.

4.4.9.3 Impact 4-2: Drum Regional Bundle

The following section analyzes potential impacts on fisheries resources caused by the project in the Drum Regional Bundle. This analysis is based primarily on the results of the hydrologic modeling (Appendix C) and on additional reference material, as appropriate (Section 4.46, Analytical Methods).

Bundle 9: North Yuba River

Narrows (FERC 1403)

Englebright Reservoir. For Englebright Reservoir (Node 197), the cumulative May-October storage analysis is nearly identical in all years under baseline and the two Scenarios (Appendix H: Drum Table-59). Thus, storage comparisons during the growing season for the period of record do not approach the 20 percent threshold (Appendix H: Drum Table-59) and are *less-than-significant* for the entire period of record. During a representative critically dry year, storage is reduced under the PowerMax Scenario when compared to the baseline during the growing season, but not significantly (Appendix H: Drum Figure-67). In a representative dry year, PowerMax and WaterMax storage is greater when compared to baseline (Appendix H: Drum Figure-68). During a representative normal and wet year, storage from May through October is identical or greater when compared to baseline for the two operation Scenarios (Appendix H: Drum Figure-69 and 70).

None of the project Scenarios results in any April to May or May to June change in lake elevation of 15 feet or greater, thus there are no negative affects to the centrarchid nesting habitat (Appendix H: Drum Table-60 and Appendix H: Drum Figure-67 through Appendix H: Drum Figure-70). The greatest change over the entire period of record for these months was 4 feet. Thus, the project is considered to have a *less-than-significant impact* for the entire period of record.

New Bullards Bar Reservoir. Operation of New Bullards Bar Reservoir (Node 133), although not owned by Pacific Gas and Electric Company, is affected by Pacific Gas and Electric Company's contractual obligations with the Yuba County Water Agency (YCWA). Pacific Gas and Electric

Company and YCWA have an agreement over the amount of water released from New Bullards Bar Reservoir.

The cumulative May-October storage analysis for New Bullards Bar Reservoir indicates that when compared to baseline the PowerMax and WaterMax Scenarios are similar over the period of record (Appendix H: Drum Table-63). Thus, storage comparisons during the growing season for the period of record do not approach the 20 percent threshold (Appendix H: Drum Table-63) and the impact of the project is considered *less-than-significant* for fisheries and aquatic resources in this reservoir.

Bundle 10: Potter Valley

Potter Valley (FERC 0077)

Lake Pillsbury (Node 800) is the only reservoir within the PVP where changes in operations could result from a new owner operations of the associated facilities. Review of the modeled storage data for Lake Pillsbury indicates that the PowerMax Scenario typically stores more water through winter, spring and summer months (Appendix H: Drum Figure-79 through Appendix H: Drum Figure-82). During early fall water is discharged from Lake Pillsbury in a greater magnitude under PowerMax operational conditions than baseline. Evaluation of the cumulative storage from May through October results in two instances where storage dropped below the 20 percent threshold chosen; this indicates a *significant impact* to resident lacustrine fisheries resources as a result of the project.

The PowerMax Scenario does not result in April to May or May to June changes in end-of-month elevation in Lake Pillsbury over the 15-foot significance criterion that was selected to evaluate potential impacts to warmwater fishery resources (Appendix H: Drum Table-66). Therefore, the project is expected to have *no impact* on the warmwater fisheries resources in Lake Pillsbury.

Bundle 11: South Yuba River

Drum-Spaulding (FERC 2310)

While the primary purpose of the Drum-Spaulding system is power generation, its operation is also heavily influenced by contracts and agreements between Pacific Gas and Electric Company and other water users in the drainage basin.

The Drum-Spaulding system contains eight forebays, afterbays, and minor impoundments that were not hydrologically modeled. It is assumed that under new ownership the operations of these forebays, afterbays, and minor impoundments would not change. Refer to Appendix C for a detailed explanation why Forebays and Afterbays were not modeled.

Jackson Meadows. The cumulative May-October storage analysis for Jackson Meadows (Node 98) indicates that when compared to the baseline, the WaterMax Scenario varies from baseline operations and would have significant reductions in storage operations over the period of record (Appendix H: Drum Table-51). The cumulative storage volume under the WaterMax Scenario would be reduced by over 20 percent in 4 years, including 50.2 percent, 29.8 percent, 25.6 percent and 23.4 percent reductions over the period of record (Appendix H: Drum Table-51). The WaterMax Scenario exceeds the 20 percent significance criteria during critically dry and dry years.

A new owner's management of Jackson Meadows would not be significantly different from baseline operation under most Scenarios and in most years. However, there would be a significant change from baseline under the WaterMax Scenario during several critically dry year and dry years. This change has the potential to reduce the availability of physical habitat for fish populations during their critical growing season. Based on the modeling results it is concluded that a future owner's operation could be substantially different than baseline, and therefore the project would have a *significant impact* on fisheries and aquatic resources in this reservoir.

Texas-Fall Creek Lakes. The Texas-Fall Creek system (a series of 10 small lakes) serves as high elevation intermediate storage augmenting flows from Bowman Lake via the Bowman-Spaulding Canal for the No. 3 Powerhouse. No reservoir volume data were generated for these smaller reservoirs because they are anticipated to continue operating in a manner similar to baseline operation. Generally, that is as small supplemental storage for power production at the Spaulding 3 Powerhouse. It is anticipated that any future owner will maintain the storage volumes in a manner similar to the baseline operation. Based on the preceding information it is concluded that a future owner's operation of these small storage reservoirs would be similar to baseline, and therefore the project would have a *less-than-significant impact* on fisheries and aquatic resources.

Bowman Lake. The cumulative May-October storage analysis for Bowman Lake (Node 147) indicates that when compared to the baseline, the PowerMax and WaterMax Scenarios are nearly identical in all years, except for one dry year (Appendix H: Drum Table-53). The cumulative storage volume under the PowerMax Scenario is reduced by 22.8 percent from baseline (Appendix H: Drum Table-53). Thus, changes in baseline operation under the PowerMax Scenario would significantly impact biological resources. The WaterMax Scenario during the dry year noticeably decreases; however, it does not exceed the 20 percent threshold (Appendix H: Drum Table-53 and Appendix H: Drum Figure-56).

Based on the modeling results it is concluded that a future owner's operation of Bowman's Lake would exceed baseline during a dry year, and therefore the project would have a *significant impact* on fisheries and aquatic resources.

White Rock Lake, Lake Sterling, and Meadow Lake. White Rock Lake, Lake Sterling, and Meadow Lake are located on the Fordyce Creek drainage and serve as intermediate storage augmenting flows to Lake Spaulding. No modeling volume data was generated for these reservoirs because they are anticipated to continue operating in a manner similar to the baseline operation. Generally, that is as a small supplemental storage for power production for Spaulding 1 and 2

Powerhouses. It is anticipated that any future owner will maintain the storage volumes in a manner similar to baseline operations. Based on the preceding information it is anticipated that a future owner's operation of these small storage reservoirs would be similar to baseline, and therefore there would be a *less-than-significant impact* on fisheries and aquatic resources.

Fordyce Lake. The cumulative May-October storage analysis for Fordyce Lake is almost identical in all years, except for a wet year under the PowerMax Scenario and a critically dry year under the WaterMax Scenario (Appendix H: Drum Table-55). The PowerMax Scenario exceeds the 20 percent significance criteria in 1 of the 24 years over the period of record. The reduction occurred in 1995 during a wet year and the percent change was 21.8 percent (Appendix H: Drum Table-55). The WaterMax Scenario exceeds the 20 percent significance criteria for only one of the 24 years over the period of record (Appendix H: Drum Table-55). The reduction occurred in 1977 during a critically dry year and the percent change was 23.4 percent (Appendix H: Drum Table-55).

The representative critically dry year illustrates both Scenarios below baseline, however; only the PowerMax Scenario is of potential significance (Appendix H: Drum Figure-59). The additional representative water year types illustrate the two Scenarios as equal or similar to baseline (Appendix H: Drum Figure-60 through Appendix Figure-62).

A new owner's management of Fordyce Lake would not be significantly different from baseline operation under most Scenarios and in most years. However, there would be a significant change from baseline under the PowerMax Scenario during one wet year and a significant change under the WaterMax Scenario during one critically dry year. This change has the potential to reduce the availability of physical habitat for fish populations during their critical growing season. Based on the modeling results it is concluded that a future owner's operation could be substantially different than baseline, and therefore the project could have a *significant impact* on fisheries and aquatic resources.

Upper and Lower Peak and Kidd Lakes. Upper and Lower Peak and Kidd Lakes are located on the South Yuba River drainage and supply additional water to Lake Spaulding.

No modeling volume data were generated for these reservoirs because they are anticipated to continue operating in a manner similar to baseline. Generally, that is as a small supplemental storage for power production for the Spaulding 1 and 2 Powerhouses. It is anticipated that any future owner will maintain the storage volumes in a manner similar to baseline operations. Based on the preceding information it is anticipated that a future owner's operation of these small storage reservoirs would be similar to baseline, and therefore the project could have a *less-than-significant impact* on fisheries and aquatic resources.

Lake Spaulding. The cumulative May-October storage analysis for Lake Spaulding is nearly identical in all years under the baseline and the two Scenarios (Appendix H: Drum Table-57). Thus, storage comparisons during the growing season for the period of record do not approach the

20 percent threshold (Appendix H: Drum Table-57) and are less than significant for the entire period of record. During a representative critically dry year and dry year, storage is reduced under the PowerMax and WaterMax Scenarios when compared to the baseline during the growing season, but not significantly (Appendix H: Drum Figure-63 through Appendix H: Drum Figure-66). During a representative normal and wet year, storage from May through October is almost identical or greater when compared to baseline under the two operation Scenarios (Appendix H: Drum Figure-63 through Appendix H: Drum Figure-66). A future owner's operation would not be substantially different than baseline, and therefore the project could have a less-than-significant impact on fisheries and aquatic resources in Lake Spaulding.

Lake Valley Reservoir and Kelley Lake. Lake Valley Reservoir and Kelley Lake are located in the American River watershed and provide intermediate water regulation and storage. Water that is released from these two reservoirs is diverted at the Lake Valley Diversion Dam, eventually discharging into the Drum Canal.

No reservoir volume data were generated for these reservoirs because they are anticipated to continue operating in a manner similar to baseline. It is anticipated that any future owner will maintain the storage volumes in a manner similar to baseline. Based on the preceding information it is concluded that a future owner's operation of these small storage reservoirs would be similar to baseline, and therefore the project would have a *less-than-significant impact* on fisheries and aquatic resources in these lakes.

Rollins Reservoir. The cumulative May-October storage analysis for Rollins Reservoir indicates that when compared to the baseline the PowerMax Scenario is similar (Appendix H: Drum Table-61). Thus, storage comparisons during the growing season for the period of record do not approach the 20 percent threshold (Appendix H: Drum Table-61) for the PowerMax Scenario and are less than significant for the entire period of record. During a critically dry and dry year, storage is reduced under the WaterMax Scenario when compared to baseline during the growing season (Appendix H: Drum Table-61). The WaterMax Scenario shows a reduction of 31.8 percent during one dry year and 27.1 percent during one critically dry year over the period of record (Appendix H: Drum Table-61).

A new owner's management of Rollins Reservoir would not be significantly different from baseline operation under most Scenarios and in most years. However, there would be a significant change from baseline under the WaterMax Scenario during a critically dry and dry year. This change has the potential to reduce the availability of physical habitat for fish populations during their critical growing season. Based on the modeling results it is concluded that a future owner's operation could be substantially different than baseline, and therefore the project could have a *significant impact* on fisheries and aquatic resources.

Bundle 12: Chili Bar

Chili Bar (FERC 2155)

The Chili Bar Project has no reservoirs or dams owned by Pacific Gas and Electric Company. The project is operated as a run-of-the-river operation. The major storage and water use in the river system is controlled by SMUD. Therefore, it is concluded that a future owner's operation would not be substantially different than baseline, and therefore the project would have a *less-than-significant impact* on fisheries and aquatic resources.

Summary of Impact 4-2 to Entire Drum Regional Bundle

Operation of Pacific Gas and Electric Company facilities by a new owner could have a *significant impact* on the resident coldwater fisheries resources found in Lake Pillsbury, Fordyce Lake, Bowman Lake, Jackson Meadows, and Rollins Reservoir of the Drum Regional Bundle. Therefore, it is determined that the project could have a *significant impact* for the entire Drum Regional Bundle.

4.4.9.4 Impact 4-2: Motherlode Regional Bundle

Bundle 13: Mokelumne River

Mokelumne River FERC (137)

Salt Springs Reservoir. The cumulative May-October storage analyses for Salt Springs Reservoir (Node 306) are nearly identical in all years for baseline and the two Scenarios (Appendix H: Motherlode Table-67 through 70). However, cumulative storage volume under the PowerMax Scenario exceeds the 20 percent significance criteria by 27.9 percent in one dry year for the 24-year period of record (Appendix H: Motherlode Table-59). The cumulative storage volume under the WaterMax Scenario never exceeds the 20 percent significance criteria for the period of record (Appendix H: Motherlode Table-59).

Reservoir fluctuations in the representative water year types (Appendix H: Motherlode Figure-67 through 70) generally support the above conclusions. During May-September the representative critically dry year illustrates the PowerMax and WaterMax Scenarios above baseline. During May-October of the representative dry year the PowerMax Scenario drops below baseline throughout the growing season. The WaterMax Scenario, during the representative dry year, is either equal to or greater than baseline. During the representative normal water year the PowerMax Scenario is below baseline; however, it is not considered a significant impact. The WaterMax Scenario is either equal to or greater than baseline throughout the growing season. For the representative wet water year, the PowerMax and WaterMax Scenarios are nearly identical to baseline throughout May-October.

A new owner's management of Salt Springs Reservoir would not be significantly different from baseline operation under the two Scenarios. However, there is a significant change from baseline under the PowerMax Scenario in one dry year. This change has the potential to reduce the availability of physical habitat for fish populations during their critical growing season. Based on the modeling results it is concluded that a future owner's operation could be substantially different than baseline, and therefore the project could have a *significant impact* on fisheries and aquatic resources.

Twin Lake and Meadow Lake. The cumulative May-October storage analysis comparing baseline operation against the PowerMax and WaterMax Scenarios for Twin Lake and Meadow Lake (Node 304) indicate that there would not be a 20 percent reduction in storage volumes in any year under any of the Scenarios (Appendix H: Motherlode Table-55). Therefore, the cumulative storage comparisons do not exceed the 20 percent significance threshold. In addition, reservoir fluctuations in the representative water year types (Appendix H: Motherlode Table-55 and 56, and Appendix H: Motherlode Figure59 through 62) further illustrate that the management of the reservoir under the three operating Scenarios would be very similar.

A new owner's operation would be substantially the same as baseline operation for Twin Lake and Meadow Lake. Based on the modeling results it is concluded that a future owner's operation would not be substantially different than baseline, and therefore the project is expected to have a *less-than-significant impact* on fisheries and aquatic resources in these lakes.

Blue Lakes. These two high elevation reservoirs are at an approximate elevation of 8,000 feet. Upper Blue Lake has a usable storage capacity of 7,300 af and Lower Blue Lake has a usable storage capacity of 5,091 af. These high elevation lakes are mainly used as storage for Salt Springs Reservoir, located 20 miles downstream on the North Fork Mokelumne River (NFMR).

The cumulative May-October storage analysis comparing baseline operation against the PowerMax and WaterMax Scenarios for Blue Lakes (Node 303) indicate that there would not be a 20 percent reduction in storage volumes in any year under any of the Scenarios (Appendix H: Motherlode Table-57). Therefore, the cumulative storage comparisons do not exceed the 20 percent significance threshold. In addition, reservoir fluctuations in the representative water year types (Appendix H: Motherlode Table-57 and 58, and Appendix H: Motherlode Table-64 through 66), further illustrate that the management of the reservoir under the three operating Scenarios would be very similar.

A new owner's operation would be substantially the same as baseline operation for Blue Lakes. Based on the modeling results it is concluded that a future owner's operation would not be substantially different than baseline, and therefore the project is expected to have a *less-than-significant impact* on fisheries and aquatic resources.

Upper Bear Reservoir. The cumulative May-October storage analysis comparing baseline operation against the PowerMax and WaterMax Scenarios for Upper Bear Reservoir (Node 309) indicate that there would not be a 20 percent reduction in storage volumes in any year under any of the Scenarios (Appendix H: Motherlode Table-51). Therefore, the cumulative storage comparisons do not exceed the 20 percent significance threshold. In addition, reservoir fluctuations in the representative water year types (Appendix H: Motherlode Figure-51 through 54) illustrate that the management of the reservoir under the three operating Scenarios would be very similar.

A new owner's operation would be substantially the same as baseline operation for Upper Bear Reservoir. Based on the modeling results it is concluded that a future owner's operation would not be substantially different than baseline, and therefore the project is expected to have a *less-than-significant impact* on fisheries and aquatic resources in the reservoir.

Lower Bear Reservoir. The cumulative May-October storage analysis comparing baseline operation against the PowerMax and WaterMax Scenarios for Lower Bear Reservoir (Node 310) indicate that there would not be a 20 percent reduction in storage volumes in any year under any of the Scenarios (Appendix H: Motherlode Table-53). Therefore, the cumulative storage comparisons do not exceed the 20 percent significance threshold. In addition, reservoir fluctuations in the representative water year types (Appendix H: Motherlode Figure-55 through 58) illustrate that the management of the reservoir under the three operating Scenarios would be very similar.

A new owner's operation would be substantially the same as baseline operation for Lower Bear Reservoir. Based on the modeling results it is concluded that a future owner's operation would not be substantially different than baseline, and the project is expected to have a *less-than-significant impact* on fisheries and aquatic resources.

Lake Tabeaud. Lake Tabeaud is a small reservoir with a usable storage capacity of 1,246 af. Under current operations, Lake Tabeaud has both a short water retention time and consistent variability in reservoir levels. The short retention time and constant fluctuations are due to daily, weekly, and monthly variability in inflows from the Electra Tunnel, as well as drafts for contractual deliveries to the Amador County Water Agency (ACWA) and for the Electra Powerhouse. A maximum of 15,000-af/year water is released into the ACWA Canal for irrigation and domestic use. The remaining water at Lake Tabeaud is released through a project tunnel to the Electra Powerhouse.

Lake Tabeaud serves as a forebay for Electra Powerhouse and supplies contractual deliveries to the ACWA and is therefore susceptible to extreme fluctuations in water level. It is concluded that a future owner's operation would not be substantially different than baseline, and therefore the project is expected to have a *less-than-significant impact* on fisheries and aquatic resources in the reservoir.

Bundle 14: Stanislaus River

Spring Gap-Stanislaus (FERC 2130)

Strawberry (Pinecrest) Reservoir. The cumulative May-October storage analysis comparing baseline operations against the PowerMax and WaterMax Scenarios for Strawberry Reservoir indicates that there would be no reduction over 20 percent in cumulative storage volumes in dry, normal, or wet years under any of the Scenarios (Appendix H: Motherlode Figure-75 through 78). However, under two critically dry years (1976 and 1988), the PowerMax Scenario exceeds the 20 percent significance criteria, ranging from a 25.7 percent to 27 percent reduction in cumulative storage volume (Appendix H: Motherlode Table-63). The WaterMax Scenario also exceeds the 20 percent significance criteria during one critically dry year (1988) a 21.5 percent reduction from baseline (Appendix H: Motherlode Table-63).

Reservoir fluctuations in the representative water year types (Appendix H: Motherlode Figure-75 through 78) generally support the above conclusions except for the representative critically dry year. The representative critically dry year actually was more closely related to baseline than any other critically dry year for the period of record (Appendix H: Motherlode Table-63).

Under the modeling analysis, a new owner's management of Strawberry Reservoir would be different from baseline operation under the PowerMax and WaterMax Scenarios during several critically dry years. This change has the potential to reduce the availability of physical habitat for fish populations during their critical growing season. Based on the modeling results it is concluded that a future owner's operation could be substantially different than baseline, and therefore the project could have a *significant impact* on fisheries and aquatic resources in this reservoir.

Relief Reservoir. The cumulative May-October storage analyses comparing baseline operation against the PowerMax and WaterMax Scenarios for Relief Reservoir (Node 430) indicate that there would not be a 20 percent reduction in storage volumes in any year under any of the Scenarios (Appendix H: Motherlode Table-61). Therefore, the storage comparisons do not exceed the 20 percent significance threshold. In addition, reservoir fluctuations in the representative water year types (Appendix H: Motherlode Figure-71 through 74) illustrate that the management of the reservoir under the three operating Scenarios would be very similar.

A new owner's operation would not be substantially different as baseline operation for Relief Reservoir. Based on the modeling results it is concluded that a future owner's operation would not be substantially different than baseline, and therefore the project is expected to have a *less-than-significant impact* on fisheries and aquatic resources in this reservoir.

Donnells Reservoir. Donnells Reservoir (Node 435) is located on the Middle Fork Stanislaus River and is owned and operated by Tri-Dam. The modeling analysis shows that a new owner's management would not be significantly different from baseline operation for Donnells Reservoir. The Scenarios throughout the representative water year types are either almost equal to or greater than baseline (Appendix H: Motherlode Figure-87 through 90). Therefore, based on the modeling results it is concluded that a future owner's operation would not be substantially different than baseline, and therefore the project is expected to have a *less-than-significant impact* on fisheries and aquatic resources in this reservoir.

Beardsley Reservoir. Beardsley Reservoir (Node 440) is located downstream of Donnells Reservoir on the MFSR. The reservoir is owned and operated by Tri-Dam. The modeling analysis shows that a new owner's management would not be significantly different from baseline operation for Donnells Reservoir. The Scenarios throughout the representative water year types are similar to baseline (Appendix H: Motherlode Table-67 and 68, Appendix H: Motherlode Figure-83 through 86), except in the representative dry year where both PowerMax and WaterMax Scenarios are below baseline (Appendix H: Motherlode Figure-84). However, they are not significantly lower. Therefore, based on the modeling results it is concluded that a future owner's operation would not be substantially different than baseline, and therefore the project is expected to have a *less-than-significant impact* on fisheries and aquatic resources in this reservoir.

Phoenix (FERC 1061)

Lyons Reservoir. The cumulative May-October storage analyses comparing baseline operation against the PowerMax and WaterMax Scenarios for Lyons Reservoir (Node 410) indicate that there would not be a 20 percent reduction in storage volumes in any year under any of the Scenarios (Appendix H: Motherlode Table-65). Therefore, the storage comparisons do not exceed the 20 percent significance threshold for coldwater fisheries. In addition, reservoir fluctuations in the representative water year types (Appendix H: Motherlode Figure-79 through 82) illustrate that the management of the reservoir under the three operating Scenarios would be very similar.

For warmwater fisheries, the baseline Scenario has more events where reservoir changes were over 15 feet in elevation than the PowerMax and WaterMax Scenarios. Therefore, no significant change in warmwater fisheries would occur under a new owner.

Under the modeling analysis, a new owner's management of Lyons Reservoir would not be significantly different from baseline operation, and therefore the project is expected to have a *less-than-significant impact* on fisheries and aquatic resources in the reservoir.

Bundle 15: Merced River

Merced Falls (FERC 2467)

Merced Falls Reservoir. Merced Falls Reservoir has a usable storage capacity of only 603 af. Since Merced Falls Reservoir is a run-of-the-river reservoir that simply regulates flow from one powerhouse to another powerhouse it is concluded that a future owner's operation would not be substantially different than baseline, and therefore the project is expected to have a *less-than-significant* on fisheries and aquatic resources in this reservoir.

Summary of Impact 4-2 on the Entire Motherlode Regional Bundle

Operation of Pacific Gas and Electric Company facilities by a new owner would have a *less-than-significant impact* to warmwater fisheries found in Lyons Reservoir and could have a *significant impact* to the resident coldwater fisheries resources found in the Salt Springs Reservoir and Strawberry (Pinecrest) Reservoir. Therefore, it is determined that the project could have a *significant impact* for the entire Motherlode Regional Bundle.

4.4.9.5 Impact 4-2*:* Kings Crane-Helms Regional Bundle

Bundle 16: Crane Valley

Crane Valley (FERC 1354)

Bass Lake. Bass Lake, with a maximum storage capacity of 45,410 af, is the principal storage facility of the Crane Valley Project.

The cumulative May through October storage volumes under the Scenario for baseline conditions are quite different than those under the PowerMax and WaterMax Scenarios in many years (Appendix H: Kings Crane-Helms Appendix Table-9). The cumulative storage volume under the PowerMax Scenario was more than 20 percent lower than that under the baseline Scenario for nine of the 24 years of the period of record. Under the WaterMax Scenario, the storage exceeded 20 percent in three of the 24 years. The reductions in storage volume and surface elevation are excessive for both the PowerMax and WaterMax Scenarios during critically dry years, as illustrated by the representative critically dry year (Appendix H: Kings Crane-Helms Appendix Figure-9). In dry years, the reductions are large for the PowerMax Scenario as represented in the representative dry year, but there are essentially no reductions for the WaterMax Scenario (Appendix H: Kings Crane-Helms Appendix Figure-10). In the representative normal and wet years, differences from the baseline condition are minor under both the PowerMax and WaterMax Scenarios for the May through October growth period (Appendix H: Kings Crane-Helms Appendix Figure-11 through 13).

Neither of the Scenarios in any year result in an April to May or May to June change in lake elevation of 15 feet or greater (Appendix H: Kings Crane-Helms Appendix Table-8).

Changes in reservoir storage or elevation can affect water temperatures of fish habitat, which may adversely affect the fish populations, especially the kokanee salmon population (Biosystems, 1985a). When the storage volume of Bass Lake falls below about 5,900 af, the volume of cold, well-oxygenated hypolimnetic water required for the coldwater fishery may be threatened (CVPC, 1997). The storage volume does not fall below 5,300 af in any year of the period of record under either Scenario, although it falls to this level in two of the years (1977 and 1988, both critically dry years) under the WaterMax Scenario.

Water temperatures in the shallow water habitat where largemouth bass and black crappie nest could also be affected by changes in a new owner's operation. December lake elevations of the reservoir are typically much lower under the PowerMax Scenario than under baseline conditions (Appendix H: Kings Crane-Helms Appendix Figure-9 through 12), so the reservoir must be filled more rapidly in the spring. The more rapid filling causes nests produced early in the spring to end up at greater depths, where water temperatures are colder (Biosystems, 1985a). The reduction in water temperatures could affect hatching success of the nests.

Changes in lake elevation for the WaterMax Scenario and, more especially, for the PowerMax Scenario are often greater than those for the baseline Scenario, but none of the lake level fluctuations exceeds the 15-foot threshold for significance. Therefore, the PowerMax and WaterMax Scenarios are considered to have a less-than-significant impact on the warmwater fishery of Bass Lake. For both the PowerMax and WaterMax Scenarios, the cumulative May-October storage of Bass Lake is reduced more than 20 percent from the baseline in many years. Kokanee salmon are stocked as fingerlings in the lake and the success of their fishery is therefore dependent on habitat conditions in the lake. Therefore, both the PowerMax and WaterMax alternatives are considered to have a *significant impact* on the kokanee fishery of Bass Lake.

Bundle 17: Kerckhoff

Kerckhoff (FERC 0096)

Kerckhoff Reservoir is the only reservoir in the Kerckhoff Project. The reservoir has very little storage capacity compared to the typical inflows from the San Joaquin River and, therefore, is operated much like a run-of-the-river project reservoir. As such, the operational flexibility of the project is limited.

OASIS modeling for baseline conditions and the two Scenarios, PowerMax and WaterMax, indicated that storage and surface elevations of the reservoir were identical under all Scenarios. Since there is no change in storage or elevations between baseline conditions and the two Scenarios, the project is considered to have *no impact* on fishery and aquatic resources in the reservoir.

Bundle 18: Kings River

Helms Pumped Storage (FERC 2735)

Haas-Kings River (FERC 1988)

Balch (FERC 0175)

The Helms Pumped Storage Project, the Haas-Kings River Project, and the Balch Project include two major reservoirs, Courtright Lake and Wishon Lake, a small reservoir, Black Rock Reservoir, and an afterbay, Balch Afterbay. The two Scenarios, PowerMax and WaterMax, are expected to have little effect on the operation of these FERC-licensed projects. Therefore, no hydrologic modeling was conducted for this bundle and reservoir storage and surface elevations for the two Scenarios are expected to be essentially the same as those under baseline conditions. The project is considered to have *no impact* on fishery and aquatic biological resources in any of these reservoirs.

Bundle 19: Tule River

Tule River (FERC 1333)

This analysis does not apply to the Tule River Project, which is a run-of-the-river project with no reservoir.

Bundle 20: Kern Canyon

Kern Canyon (FERC 0178)

Kern Canyon Reservoir is very small, 26 af. The entire project operates as a run-of-the-river facility dependant on releases from upstream USCOE facility. For this reason, there is limited potential flexibility in project operations. Therefore, the project is expected to have ***no impact*** on aquatic resources in this area.

Summary of Impact 4-2 on the Entire Kings Crane-Helms Regional Bundle

Operation of Pacific Gas and Electric Company facilities by a new owner would have no impact to fisheries resources at Kings Crane-Helm Regional reservoirs except at Bass Lake. Future operations of Bass Lake could result in *significant impacts*. Therefore, it is determined that the project could have a *significant impact* for the entire Kings Crane-Helms Regional Bundle.

4.4.9.6 Evaluation of Impact 4-2 to Entire System

The proposed project could result in *significant impacts* to the anadromous and resident fisheries resources found within the lakes and reservoirs of the project's hydroelectric system (Table 4.4-53, Summary of Reservoir Impacts).

4.4-53 Summary of Potential Impacts to Reservoirs Before Mitigation and Status After Mitigation

Before Mitigation				After Mitigation			
Regional Bundle	No Impact	Less Than Significant	Significant	No Mitigation Required	Less Than Significant	Significant	Significant and Unavoidable
Shasta							
Bundle 1: Hat Creek Hat Creek 1 and 2 (FERC 2661)	X			X			
Bundle 2: Pit River Pit 1 (FERC 2687)	X			X			
Pit 3, 4, and 5 (FERC 0233)		X		X			
McCloud-Pit (FERC 2106)			X		X		
Bundle 3: Kilarc-Cow Creek Kilarc-Cow Creek (FERC 0606)	X			X			

4.4-53 Summary of Potential Impacts to Reservoirs Before Mitigation and Status After Mitigation

Before Mitigation				After Mitigation			
Regional Bundle	No Impact	Less Than Significant	Significant	No Mitigation Required	Less Than Significant	Significant	Significant and Unavoidable
Bundle 4: Battle Creek Battle Creek (FERC 1121)	X			X			
DeSabla							
Bundle 5: Hamilton Branch Hamilton Branch (non-FERC)		X		X			
Bundle 6: Feather River Upper North Fork Feather River (FERC 2105)			X		X		
Rock-Creek-Cresta (FERC 1962)		X		X			
Poe (FERC 2107)		X		X			
Bundle 7: Bucks Creek Bucks Creek (FERC 0619)			X		X		
Bundle 8: Butte Creek DeSabla-Centerville (FERC 0803)		X		X			
Lime Saddle (non-FERC)		X		X			
Coal Canyon (non-FERC)		X		X			
Drum							
Bundle 9: North Yuba River Narrows (FERC 1403)		X		X			
Bundle 10: Potter Valley Potter Valley (FERC 0077)			X		X		
Bundle 11: South Yuba–Bear Drum-Spaulding (FERC 2310)			X		X		
Bundle 12: Chili Bar Chili Bar (FERC 2155)		X		X			
Motherlode							
Bundle 13: Mokelumne River Mokelumne River (FERC 0137)			X		X		
Bundle 14: Stanislaus River			X		X		

4.4-53 Summary of Potential Impacts to Reservoirs Before Mitigation and Status After Mitigation

	Before Mitigation			After Mitigation			
Regional Bundle	**No Impact**	**Less Than Significant**	**Significant**	**No Mitigation Required**	**Less Than Significant**	**Significant**	**Significant and Unavoidable**
Spring Gap-Stanislaus River (FERC 2130)							
Phoenix (FERC 1061)		X		X			
Bundle 15: Merced River Merced Falls (FERC 2467)		X		X			
Kings Crane-Helms							
Bundle16: Crane Valley Crane Valley (FERC 1354)			X		X		
Bundle 17: Kerckhoff Kerckhoff (FERC 0096)	X			X			
Bundle 18: Kings River Helms Pumped Storage (FERC 2735)	X			X			
Haas-Kings River (FERC 1988)	X			X			
Balch (FERC 0175)	X			X			
Bundle 19: Tule River Tule River (FERC 1333)	X			X			
Bundle 20: Kern Canyon Kern Canyon (FERC 0178)	X			X			

4.4.9.7 Impact 4-2: Mitigation Measures

Mitigation Measures Proposed as Part of the Project

Within the PEA, Pacific Gas and Electric Company does not provide specific mitigation measures for each FERC and non-FERC licensed project as part of the sale of hydroelectric assets to a new owner. Instead, Pacific Gas and Electric Company states that because a new owner will be required to operate according to existing agreements, and will be subject to environmental and resource regulations and directives in the same way that Pacific Gas and Electric Company is and has been, that aquatic resources will be protected. Pacific Gas and Electric Company offers to assist a new owner in understanding aquatic resource issues at each project, by providing the new owner with all non-privileged informational materials in its possession related to sensitive biological resources. Additionally, Pacific Gas and Electric Company proposes to transfer its BMPs to a new owner to provide guidance on procedures for complying with license conditions and applicable laws.

Mitigation Measures Identified in This Report

Development of Mitigation Measures

The preceding impact analysis has indicated that a new owner of Pacific Gas and Electric Company's facilities could operate said facilities in such a manner that could result in significant impacts to the fisheries resources found within project reservoirs. Analysis of the PowerMax and WaterMax Scenarios involved evaluation of the cumulative storage from May through October. When the cumulative storage value of a Scenario was reduced by 20 percent or more in comparison to baseline, it was determined that it could result in a potential impact to reservoir fisheries resources (Section 4.4.6, Analytical Methodology).

Mitigation measures must establish storage patterns that will prevent undue reservoir level fluctuations harmful to aquatic resources. The logical approach to establishing appropriate mitigation measures involves setting appropriate minimum cumulative storage volumes for reservoirs with significant impacts. The project assumes that there is no impact under baseline conditions. Additionally, the preceding analysis indicates that reductions of less than 20 percent of cumulative May to October storage could result in less-than-significant impacts to aquatic resources; these impacts do not require mitigation. To establish acceptable levels of reservoir storage, the May through October cumulative storage under baseline conditions was calculated for each year over the modeled 24-year period of record. Water year types as developed by DWR (2000) (Sacramento River Index) were utilized to separate the years within this record into two categories. DWR calculates five water year types: wet, above normal, below normal, dry, and critical (DWR 2000). These were combined into above normal and wetter or below normal and drier for the generation of reservoir storage values. This resulted in two subsets of data, one with 12 years of modeled data consisting of Above Normal water conditions and the other with 12 years of modeled data consisting of Below Normal conditions.

Within each group of data, 80 percent of the cumulative storage was calculated for each water year. The maximum of the 80 percent values generated by this process was selected as the required minimum cumulative May through October storage value. For example, if modeled cumulative storage ranged from 33 to 52 thousand acre-feet (taf) during the 12 above normal water years, then 80 percent of the maximum value of 52 taf, 42 taf, would be selected as the cumulative storage target at which the new owner must operate Pacific Gas and Electric Company's facilities to avoid significant impacts to aquatic resources in this specific reservoir. For some reservoirs, the resulting storage values (above normal versus below normal) were extremely close. When the difference between the above and below normal values was less than or equal to 3 taf, the higher of the two storage values was selected as the most conservative number. This value was then utilized as the storage target for all water year types. Mitigation is only identified for those reservoirs in which impact analysis indicated that there was a significant impact from a modeled change in operations (Table 4.4-53).

Shasta Regional Bundle

McCloud-Pit (FERC 2106)

Mitigation Measure 4-2a: Prior to or concurrent with the transfer of title for the Pit River Bundle, and in order to provide adequate rearing habitat for rainbow, brook, and brown trout, the new owner shall by binding written instrument agree to maintain an interim cumulative (May through October) storage of at least 74,000 af at Iron Canyon Reservoir in all water year types. This interim measure will remain in place until consultation and agreement with appropriate resource agencies results in new binding minimum pool levels.

Where appropriate, a new owner shall perform, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, reservoir pool analysis and recommend appropriate minimum pool levels, which balance the protection of the reservoir's fisheries resources with hydroelectric development. The interim minimum pool level(s) identified above shall remain in effect until the new licensee and resource agencies either develop a binding agreement or reach an understanding, which results in a submitted recommendation to FERC, and FERC issuance of an Order amending the project license.

Implementation of this mitigation measure will reduce this significant impact to *less-than-significant*.

DeSabla Regional Bundle

Bundle 5: Hamilton Branch

Hamilton Branch (non-FERC licensed)

Based on the preceding impact analysis, there will be a less-than-significant impact to aquatic resources from a new owner operations of Pacific Gas and Electric Company's non-FERC licensed Hamilton Branch facilities. Therefore no mitigation measures to protect fisheries and aquatic resources would be required for a transfer of Pacific Gas and Electric Company's hydroelectric assets to a new owner.

Bundle 6: Upper North Fork Feather River

Upper North Fork Feather River (FERC 2105)

Mitigation Measure 4-2b: Prior to or concurrent with the transfer of title for the Upper North Fork Feather River Bundle, the new owner, in a manner consistent with Pacific Gas and Electric Company's current informal operation, shall by binding written instrument agree to hold Lake Almanor above 800,000 af until September 1 of all years (except for dry and critically dry years), as well as maintain a minimum end-of-year reservoir storage volume carryover of 650,000 af.

Implementation of this mitigation measure will reduce this significant impact to *less-than-significant*.

Bundle 7: Bucks Creek

Bucks Creek (FERC 0619)

Mitigation Measure 4-2c: Prior to or concurrent with the transfer of title for the Bucks Creek Bundle, the new owner, in a manner consistent with Pacific Gas and Electric Company's current informal operation, shall by binding written instrument agree to maintain in Bucks Lake a minimum end-of-year reservoir storage volume carryover of 45,000 af.

Implementation of this mitigation measure will reduce this significant impact to *less-than-significant*.

Drum Regional Bundle

Bundle 10: Potter Valley

Potter Valley (FERC 0077)

Mitigation Measure 4-2d: Prior to or concurrent with the transfer of title for the Potter Valley Bundle, and in order to provide suitable rearing habitat for resident salmonid species, the new owner shall by binding written instrument agree to maintain the following interim cumulative (May through October) storage volumes. These interim measures will remain in place until consultation and agreement with appropriate resource agencies results in new binding minimum pool levels.

- Maintain minimum cumulative storage of 77,330 af for Lake Pillsbury for the months of May through October in a wet year;
- Maintain minimum cumulative storage of 35,920 af for Lake Pillsbury for the months of May through October in a below normal year;

Where appropriate, a new owner shall perform, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, reservoir pool analysis and recommend appropriate minimum pool levels, which balance the protection of the reservoir's fisheries resources with hydroelectric development. The interim minimum pool level(s) identified above shall remain in effect until the new licensee and resource agencies either develop a binding agreement or reach an understanding, which results in a submitted recommendation to FERC, and FERC issuance of an order amending the project license.

Implementation of this mitigation measure will reduce this significant impact to *less-than-significant*.

Bundle 11: South Yuba River

Drum-Spaulding (FERC 2310)

Mitigation Measure 4-2e: Prior to or concurrent with the transfer of title for the South Yuba River Bundle, and in order to provide suitable rearing habitat for resident salmonid species, the new owner shall by binding written instrument agree to maintain the following interim cumulative (May through October) storage volumes. These interim measures will remain in place until consultation and agreement with appropriate resource agencies results in new binding minimum pool levels.

- Maintain minimum cumulative storage of 318,000 af for Jackson Meadows Reservoir for the months of May through October in all water year types;
- Maintain minimum cumulative storage of 315,000 af for Bowman Lake for the months of May through October in all water year types;
- Maintain minimum cumulative storage of 193,000 af for Fordyce Lake for the months of May through October in all water year types;
- Maintain minimum cumulative storage of 292,000 af in Above Normal water years and 274,000 af in Below Normal water years for Rollins Reservoir for the months of May through October.

Where appropriate, a new owner shall perform, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, reservoir pool analysis and recommend appropriate minimum pool levels, which balance the protection of the reservoir's fisheries resources with hydroelectric development. The interim minimum pool level(s) identified above shall remain in effect until the new licensee and resource agencies either develop a binding agreement or reach an understanding, which results in a submitted recommendation to FERC, and FERC issuance of an order amending the project license.

Implementation of this mitigation measure will reduce this significant impact to *less-than-significant*.

Motherlode Regional Bundle

Bundle 13: Mokelumne River

Mokelumne River (FERC 0137)

Mitigation Measure 4-2f: Prior to or concurrent with the transfer of title for the Mokelumne River Regional Bundle, and in order to provide rearing habitat for resident salmonid species, the new owner shall by binding written instrument agree to maintain an interim cumulative (May through October) storage of at least 618,000 af in Above Normal water years and 567,000 af in Below Normal water years at Salt Springs Reservoir. This interim measure will remain in place until consultation and agreement with appropriate resource agencies results in new binding minimum pool levels.

Where appropriate, a new owner shall perform, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, reservoir pool analysis and recommend appropriate minimum pool levels, which balance the protection of the reservoir's fisheries resources with hydroelectric development. The interim minimum pool level(s) identified above shall remain in effect until the new licensee and resource agencies either develop a binding agreement or reach an understanding, which results in a submitted recommendation to FERC, and FERC issuance of an Order amending the project license.

Implementation of this mitigation measure will reduce this significant impact to *less-than-significant*.

Bundle 14: Stanislaus River

Spring Gap-Stanislaus River (FERC 2130)

Mitigation Measure 4-2g: Prior to or concurrent with the transfer of title for the Mokelumne River Regional Bundle, and in order to provide suitable rearing habitat for salmonid species, the new owner shall by binding written instrument agree to maintain an interim cumulative (May through October) storage of at least 78,000 af at Strawberry Reservoir in all water year types. This interim measure will remain in place until consultation and agreement with appropriate resource agencies results in new binding minimum pool levels.

Where appropriate, a new owner shall perform, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, reservoir pool analysis and recommend appropriate minimum pool levels, which balance the protection of the reservoir's fisheries resources with hydroelectric development. The interim minimum pool level(s) identified above shall remain in effect until the new licensee and resource agencies either develop a binding agreement or reach an understanding, which results in a submitted recommendation to FERC, and FERC issuance of an Order amending the project license.

Implementation of this mitigation measure will reduce this significant impact to *less-than-significant*.

Kings Crane-Helms Regional Bundle

Bundle 16: Crane Valley

Crane Valley (FERC 1354)

Mitigation Measure 4-2h: Prior to or concurrent with the transfer of title for the Kings Crane-Helms Regional Bundle, and in order to provide rearing habitat for salmonid species, in particular kokanee salmon, and warmwater species, including centrarchids, largemouth bass, spotted bass, and black crappie, the new owner shall by binding written instrument agree to maintain an interim cumulative (May through October) storage of at least 179,000 af at Bass Lake in all water year types. This interim measure will remain in place until consultation and agreement with appropriate resource agencies results in new binding minimum pool levels.

Where appropriate, a new owner shall perform, in consultation with State and Federal resource agencies, and in a manner satisfactory to the CPUC, reservoir pool analysis and recommend appropriate minimum pool levels, which balance the protection of the reservoir's fisheries resources with hydroelectric development. The interim minimum pool level(s) identified above shall remain in effect until the new licensee and resource agencies either develop a binding agreement or reach an understanding, which results in a submitted recommendation to FERC, and FERC issuance of an Order amending the project license.

Implementation of this mitigation measure will reduce this significant impact to *less-than-significant*.

4.4.9.8 Impact 4-2: Level of Significance After Mitigation

The identified significant impacts will be reduced to *less-than-significant* if the proposed mitigation measures are implemented.

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