DRAFT

ENVIRONMENTAL DOCUMENT

ANALYZING THE

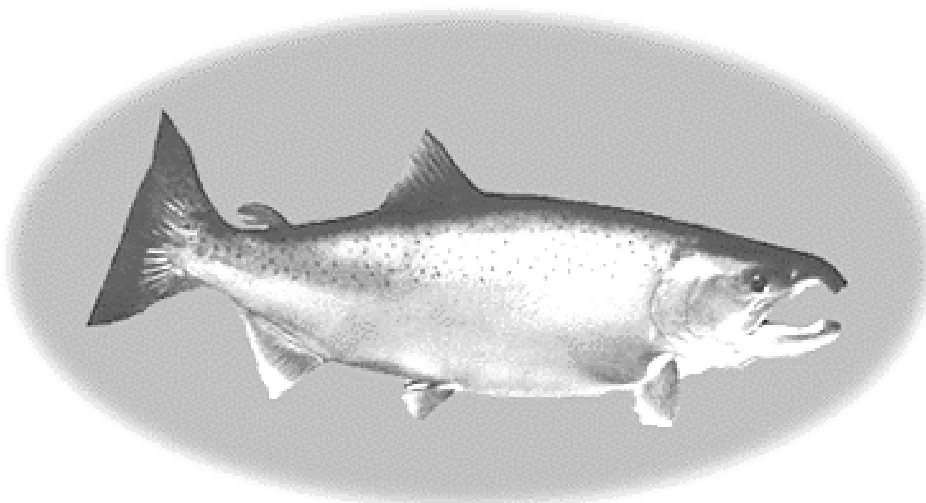
CALIFORNIA FISH AND GAME COMMISSION'S

SPECIAL ORDER RELATING TO INCIDENTAL

TAKE OF

COHO SALMON NORTH OF SAN FRANCISCO

DURING THE CANDIDACY PERIOD



STATE OF CALIFORNIA
RESOURCES AGENCY
CALIFORNIA DEPARTMENT OF FISH AND GAME
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At its April 5, 2001 meeting, the California Fish and Game Commission (Commission) voted to accept a petition to list the coho salmon (*Oncorhynchus kisutch*) north of San Francisco as an endangered species pursuant to the California Endangered Species Act (CESA). Coho salmon north of San Francisco thereby became a "candidate" species. Fish and Game Code provides that all of the provisions protecting species that are actually listed as threatened or endangered under CESA apply to species that are designated as candidates. These protections consist primarily of the prohibition on the "take" of such species. The Fish and Game Code also authorizes the Commission, subject to the terms and conditions it prescribes, to allow the taking of any candidate species during the candidacy period.

Also in April 2001, the Commission adopted a Special Order Relating to Incidental Take of Coho Salmon During the Candidacy Period (the "2084 Order"). This 2084 Order was issued in the form of an emergency regulation. The 2084 Order addresses incidental take for inland and ocean sport and commercial fishing, suction dredging, research and monitoring, hatchery operations, habitat restoration, gravel mining, water diversions, Stream Alteration Agreements, the Pacific Lumber Company Habitat Conservation Plan, and forest practices. The California Environmental Quality Act (CEQA) requires all public agencies in the State to evaluate the environmental impacts of projects that they approve, including regulations, that may have a potential to significantly affect the environment.

This document analyzes the environmental impacts associated with adopting the 2084 Order during the candidacy period for coho salmon. In addition, this document analyzes alternative terms that could be contained in any revised order for activities covered in the final 2084 Order. It should be noted that this document is not intended to, and in fact does not, analyze the environmental effects of a decision by the Commission to list coho salmon north of San Francisco as threatened or endangered under CESA. At this time, the listing of this species is uncertain.

In addition, it is neither the objective nor the function of this document to evaluate the impacts of on-going activities in the project area. The environmental baseline, under CEQA, includes on-going activities. This document focuses on assessing changes to the existing environmental baseline resulting from the proposed project (the 2084 Order). To the extent that there are already on-going activities that have affected and may continue to affect the physical conditions, these are also part of the existing environmental baseline. Such on-going activities, permitted by law, that have the potential to impact biological resources may include agriculture, timber operations, gravel mining, water diversions, and other activities addressed in the 2084 Order. This document only evaluates changes in the environmental baseline resulting from the 2084 Order during the candidacy period. Except for the discussion in the cumulative effects section, this document does not analyze the environmental effects, or the significance of those effects, that may result from the following activities after the coho salmon candidacy period: sport and commercial fishing, suction dredging, habitat restoration activities, research and monitoring activities, activities covered by streambed alteration agreements, hatchery operations, gravel mining, water diversions, and forest practices. These impacts will be analyzed more thoroughly at the time discretionary decisions are made by the department.

Public Input

CEQA encourages public input. One of the primary purposes of the environmental document review process is to obtain public comment, as well as to inform the public and decision makers of the environmental impacts of the proposed project and alternatives to the project. It is the intent of the Department of Fish and Game (Department) to encourage public participation in the environmental review process.

Prior to preparing this environmental document, the Department developed a Notice of Preparation (NOP), which was distributed to land management agencies in the state that have an interest in the project area. This NOP was also provided to individuals and/or organizations that expressed an interest in the 2084 Order. The Department also held a public hearing in Santa Rosa to further encourage public comment and input on the 2084 Order.

Impacts Of The Proposed Project

Through the analyses contained in this document, it was determined that the project (the 2084 Order) will not cause significant unmitigated impacts to the environment during the candidacy period. Mitigation, in the form of alternative regulations, is explored in Chapter 5 (see the following Summary Table).

Summary Table of Impacts of the Proposed Project and Alternatives	
Inland and Ocean Sport and Commercial Fishing	
Proposed Project	No retention of coho salmon. Impact: No significant impact.
No Project	No retention of coho salmon. Impact: No significant impact.
Alternative 1	Retention of hatchery-marked coho salmon (maxillary clip). Impact: May slightly lessen the impacts that hatchery-produced fish may have on wild populations, but may increase the inadvertent take of a wild fish. Would reduce total number of coho. Requires change in regulations and a new education program. More information is needed to fully evaluate the effects of this alternative.
Alternative 2	Retention of hatchery-marked coho salmon and begin marking 100% with an identifiable fin-clip. Impact: May slightly lessen the impacts that hatchery-produced fish may have on wild populations, but may increase the inadvertent take of a wild fish. Would reduce total number of coho. Requires change in regulations and significant increase in hatchery staffing and funding to implement marking program. More information is needed to fully evaluate the effects of this alternative.
Suction Dredging	
Proposed Project	Comply with existing regulations. Impact: No significant impact
No Project	Close waters to suction dredging. Impact: Greater protection for the species; would constrict economic and recreational activity

Summary Table of Impacts of the Proposed Project and Alternatives	
Research and Monitoring	
Proposed Project	Department to comply with existing regulations; others to comply with provisions in Appendix A. Impact: No significant impact.
No Project	No take provisions for research and monitoring. Impact: No significant impact; however, sacrifices long-term benefits to the species that are provided by research and monitoring activities.
Hatchery Operations	
Proposed Project	Comply with existing regulations. Impact: No significant impact.
No Project	Cease hatchery operations involving coho salmon. Impact: No significant impact.
Habitat Restoration	
Proposed Project	Comply with existing regulations. Impact: No significant impact.
No Project	No take authorization for habitat restoration. Impact: Would impair long-term recovery of these listed species.
Alternative 1	Comply with existing regulations, inclusive of the U.S. Army Corps Regional General Permit for Fish Passage/Sediment Reduction Projects at water crossings (RGP-1). Impact: No significant impact.
Extraction of Gravel Resources	
Proposed Project	Comply with the 2084 Order in Exhibit C, Appendix A. Impact: No significant unmitigated impacts.
No Project	No take authorization for gravel extraction. Impact: No significant impact; would allow project-specific mitigation of impacts, but may also reduce aggregate production at least in the short-term while permits are processed.
Alternative 1	Allows take only for operators that comply with the U.S. Army Corps of Engineers Letter of Permission for Humboldt County. Impact: Potential for significant adverse impacts to the environment outside of Humboldt County.
Alternative 2	Allows take for those operations in counties without an adopted aggregate management plan if they adhere to Exhibit C, Appendix A; and allows take for those operators in counties with adopted aggregate plans if they adhere to those plans, as amended by any requirements under a Streambed Alteration Agreement. Impact: Level of impact not significantly different from the proposed project, i.e., no significant unmitigated impacts.
Alternative 3	Take provisions require retention of proper geomorphology, within a defined sediment budget. Impact: Unknown, difficult to implement.
Alternative 4	Take provisions require turbidity monitoring guidelines. Impact: Unknown, difficult to implement.

Summary Table of Impacts of the Proposed Project and Alternatives	
Extraction of Gravel Resources continued	
Alternative 5	Comply with the 2084 Order in Exhibit C, Appendix A with respect to annual replenishment, except where it can be demonstrated that there is significant aggradation above historic levels, which would then allow for extraction in excess of annual replenishment. Impact: May reduce the level of impact should a mass wasting event occur during the candidacy period.
Alternative 6	Change the 2084 Order in Exhibit C, Appendix A to allow an operator to leave large woody debris in place, and operate around the debris. Impact: May reduce the level of impacts, should this situation occur during the candidacy period.
Alternative 7	Delete paragraph 7 in Exhibit C, Appendix A of the 2084 Order, restricting tree removal. Impact: May slightly increase the level of significant unmitigated impacts, should this situation occur during the candidacy period.
Water Diversions	
Proposed Project	Existing unscreened diversions may continue; new or repaired diversions must comply with Exhibit D, Appendix A. Impact: No significant impact.
No Project	Diverters in the project area to obtain §2081 permits or to restrict diversions to periods during which take of coho salmon is not likely. Impact: May reduce the take of coho salmon, it could require adjustment to or temporary disruption of diversions while necessary take authorizations are obtained, which may impact agriculture and public services.
Alternative 1	Add to 2084 Order, no new diversions to be permitted during candidacy, unless the river/stream is not over-appropriated. Impact: Potentially beneficial, however, jurisdiction for permits lies with the State Water Resources Control Board. Infeasible for Department to deny permits; however, Department protest permits for over-appropriated waters.
Alternative 2	Unscreened diverters in the project area to obtain §2081 permits or to restrict diversions to periods during which take of coho salmon is not likely. Impact: May reduce the take of coho salmon, it could require adjustment to or temporary disruption of diversions while necessary take authorizations are obtained, which may impact agriculture and public services.
Alternative 3	Take authorized only for diversions in compliance with Fish and Game Code §5937. Impact: May provide substantial environmental benefits; would be infeasible for the Department to locate all diversions and then determine whether or not the diversion is in compliance with 5937.

Summary Table of Impacts of the Proposed Project and Alternatives	
Department of Fish and Game Streambed Alteration Agreements	
Proposed Project	Take authorized for projects that comply with regulations, inclusive of this 2084 Order, as long as mitigative measures identified by the Department are incorporated and implemented. Impact: Beneficial impact to the environment.
No Project	No take authorized for activities specified in Streambed Alteration Agreements, without §2081 permit. Impact: Could require adjustment to or temporary disruption of services while necessary take authorizations are obtained.
Pacific Lumber Company Habitat Conservation Plan (HCP)	
Proposed Project	Take authorized for Covered Activities in the HCP. Impact: No change in implementation of the HCP; therefore, no significant impact.
No Project	Coho salmon were included in the HCP prior to the proposed listing; therefore, no difference between proposed project and no project alternatives. Impact: No change in implementation of the HCP; therefore, no significant impact.
Forest Practices	
Proposed Project	Take authorized for operations that comply with existing laws and regulations. Impact: No significant impact.
No Project	No take authorized for timber operations without §2081 permit. Impact: Could delay THPs while necessary take authorizations are obtained.
Alternative 1	Take authorized for timber operations that comply with Option 9 of the Northwest Forest Plan. Impact: Beneficial impact to the environment; but may exceed relevant standard.
Alternative 2	Take authorized for timber operations that comply with National Marine Fisheries Service Short-Term HCP Guidelines. Impact: Beneficial impact to the environment; but may exceed relevant standard.
Alternative 3	Take authorized for timber operations that comply with the Pacific Lumber Company HCP. Impact: Beneficial impact to the environment; but may exceed relevant standard.
Alternative 4	Take authorized only for timber operations that incorporated all mitigations suggested by the Department and the Regional Water Quality Control Board. Impact: Potentially beneficial impact to the environment; but requires changes outside the Department's jurisdiction.
Alternative 5	Take authorized for timber operations only where operations are fully supervised by a Registered Professional Forester. Impact: Potentially beneficial impacts to the environment; infeasible due to time constraints and lack of necessary resources.
Alternative 6	Take authorized for operations that comply with existing laws and regulations, excluding the Threatened and Impaired Watershed rule. Impact: Significant adverse impact to the environment.

Summary Table of Impacts of the Proposed Project and Alternatives	
Additions, Modifications, or Revocation	
General Modification 1	Exempt all hatchery-produced coho salmon from the listing action. Impact: Would adversely impact the overall population of coho salmon (inclusive of hatchery fish), would have an unknown effect on wild populations of coho salmon, and would have a beneficial effect on recreation by allowing fishing for marked coho salmon. More information is needed to adequately evaluate this alternative.
General Modification 2	Take authorized only for the listed 2084 activities on only 2 percent or less of any river or tributary. Impact: Beneficial impact to the environment, but infeasible within the timeframe and may cause socio-economic impacts.

Areas of Controversy

Allowing take of a species that may warrant listing remains a controversial issue. A segment of the public has contended that any loss in the coho population is a significant impact because of their declining numbers. CEQA requires a mandatory finding of significance and the preparation of an Environmental Impact Report (or its equivalent) for any reduction in numbers of a listed or candidate species.

Another area of controversy is the relationship of hatchery-produced coho salmon to wild stocks. Some contend that a few of the runs originated from hatchery stock or are not genetically distinct from hatchery stocks. Some also contend that hatchery stock has an adverse impact on wild stocks of coho and should, therefore, be subject to different regulations. The Department is currently reviewing this issue as part of the status review; however, the Commission did not differentiate between wild and hatchery-produced coho salmon for the purposes of this 2084 Order.

Conclusion And Recommendations

This document concludes that no significant impacts to the environment will result from the adoption of the 2084 Order during the candidacy period. Alternatives to the 2084 Order are discussed in Chapter 5, Alternative Analysis.

1.0 PROJECT DESCRIPTION

1.1 History Of The Proposed Project

On July 28, 2000, the California Fish and Game Commission (Commission) received a petition from the Salmon and Steelhead Recovery Coalition to list coho salmon (*Oncorhynchus kisutch*) north of San Francisco as an endangered species pursuant to the California Endangered Species Act (CESA) (Fish and Game Code §2050 et seq.). At its April 5, 2001 meeting, the Commission voted to accept the petition for further consideration. Pursuant to Fish and Game Code §2074.2, the Commission published notice to this effect on April 27, 2001. Coho salmon, north of San Francisco thereby became a "candidate" species.[1]

A candidate species is the designation established by statute to cover species during the period between the acceptance of a petition by the Commission and the actual determination by the Commission as to whether listing is warranted (Fish and Game Code §2074.2). During this period, the Department of Fish and Game (Department) conducts a status review of the species and makes a recommendation for Commission action. This status review must be accomplished within 12 months of the publication of notice that the petition to list has been accepted (Fish and Game Code §2074.6). For coho salmon north of San Francisco, the status review will be transmitted by the Department to the Commission by April 26, 2002.

The designation of candidate species carries with it certain statutory protections. Fish and Game Code §2085 provides that all of the provisions protecting species that are actually listed as threatened or endangered under CESA also apply to species that are designated as candidates. These protections include prohibitions on the "take" of such species. Take is defined by the Fish and Game Code as "...hunt, pursue, catch, capture, or kill..." or an attempt to do any of these activities (Fish and Game Code §86). This definition has been found to prohibit take of individuals of the species not just in the hunting and fishing context, but also as the result from otherwise lawful activities such as water delivery and pumping (Department of Fish and Game v. Anderson-Cottonwood Irrigation District (1992) 8 Cal. App. 4th 1554).

Prohibitions on take can have great impacts even before the Commission has determined that a species warrants the designation as threatened or endangered. The Fish and Game Code, therefore, authorizes the Commission, subject to the terms and conditions it prescribes, to allow the take of any candidate species (Fish and Game Code §2084).

At its April 5, 2001, meeting, the Commission issued a Special Order Relating to Incidental Take of Coho Salmon During the Candidacy Period (hereinafter referred to as the "2084 Order"). This 2084 Order was issued in the form of an emergency regulation that was approved by the Office of Administrative Law, with an effective date of April 26, 2001. It authorized the take of coho salmon during the candidacy period (estimated to be 12 to 14 months) for certain specified activities.

[1] Coho salmon south of San Francisco were previously listed as endangered by the state in 1994. The National Marine Fisheries Service (NMFS) listed coho salmon in the Central California Coast Evolutionarily Significant Unit (ESU) as threatened in 1996, and in the Southern Oregon/Northern California Coast ESU as threatened in 1997, under the federal Endangered Species Act of 1973.

1.2 Proposed Agency Action / Intended Uses Of This Document

Emergency regulations expire 120 days after approval, if no further agency action is taken (Government Code §11346.1). On August 3, 2001, the Commission reauthorized the same emergency regulation for another 120-day period to provide additional time for the Department to complete its environmental analysis and obtain public comments on the regulation. At the expiration of the reauthorization, the Commission can take one of the following actions:

a) Adopt the existing provisions of the emergency 2084 Order as the final regulation for the remainder of the candidacy period.
b) Adopt a final regulation or reauthorize an emergency regulation containing different terms than those contained in the current 2084 Order. The effect of this depends on the terms included in any revised order.
c) Let the emergency 2084 Order expire with no action. The effect of this action would be to eliminate programmatic take authorization for coho salmon north of San Francisco during the remainder of the candidacy period and require that any take of coho salmon be authorized using other provisions of law, namely the permitting process under Fish and Game Code §2081(b).

The California Environmental Quality Act (CEQA) (Pub. Resources Code, §21000 et seq.) requires all public agencies in the State to evaluate the environmental impacts of projects that they approve, or carry out, that may have a potential to significantly affect the environment. Most agencies satisfy this requirement by preparing an Environmental Impact Report (EIR) or Negative Declaration (ND). However, the State Legislature created an alternative to the EIR/ND requirement for State agencies whose activities include the protection of the environment within their regulatory programs (Public Resources Code §21080.5). Under this alternative, an agency may request certification of its regulatory program from the Secretary for Resources, after which the agency may prepare functionally equivalent environmental documents in lieu of EIRs or NDs. The regulatory program of the Commission has been certified by the Secretary for Resources, and the Commission may prepare and rely on this environmental document under CEQA in lieu of an EIR or ND (CEQA Guidelines, §15251, subd. (o), 15252)[2].

This document analyzes the environmental impacts associated with adopting the existing 2084 Order during the 12-month candidacy period for coho salmon. In addition, this document analyzes alternative terms that could be contained in any revised order for activities covered in the existing 2084 Order. Included in these alternatives is an analysis of the impacts associated with having no take authorization for activities covered in the existing 2084 Order during the candidacy period for this species.

This document is not intended to analyze whether a decision by the Commission to list coho salmon north of San Francisco as threatened or endangered under CESA might result in potentially significant adverse impacts on the environment. A decision by the Commission whether to list coho salmon north of San Francisco is an action distinct from the decision whether to adopt the 2084 Order, and will be made only after recommendations of the Department's status review of the species are submitted to the Commission. At this juncture, the outcome of the Department's review, as well as the related recommendation, is not known. This document also is not designed to analyze subsequent take authorizations that may be issued by the Department if coho salmon are ultimately listed by the Commission under CESA. Even so, this document may be used in the future as part of an analysis to support subsequent take authorization to the extent permitted by CEQA. At this time, however, the Commission contemplates that any such authorization would be supported by its own CEQA compliance.

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[2] The CEQA Guidelines are found in Title 14 of the California Code of Regulations, commencing with §15000.

1.3 Proposed Project

The Commission is proposing to continue the terms of the existing 2084 Order by the adoption of a permanent regulation for the remainder of the candidacy period. The terms of the 2084 Order can be found at Title 14, California Code of Regulations, §749.1 and the associated appendices, and are reproduced as Appendix A of this report.

In tabular form, the 2084 Order covers incidental take of coho salmon associated with the following activities:

1. Inland and Ocean Sport and Commercial Fishing, provided that incidentally hooked or netted coho salmon are immediately released unharmed

2. Suction Dredging that complies with Title 14 CCR §228

3. Research and Monitoring, in accordance with Exhibit 2-B

4. Hatchery Operations in accordance with 14 CCR §783.1 (c)

5. Habitat Restoration in the following areas:
   a. Habitat restoration under the Department's Fisheries Restoration Grants Program that meets specified criteria
   b. Fish barrier mitigation and rescue as authorized pursuant to Title14 CCR §783.1(c)

6. Extraction of gravel, in accordance with Exhibit 2-C

7. Water Diversions as follows:
   a. Existing unscreened diversions
   b. Diversions approved and constructed after April 26, 2001, that are screened and meet the conditions of Exhibit 2-D
   c. Existing screens that are repaired, upgraded, or reconstructed that meet the conditions of Exhibit 2-D

8. Department of Fish and Game Streambed Alteration Agreements, provided that:
   a. Measures identified by the Department as necessary to protect coho salmon are incorporated into the agreement
   b. The project otherwise complies with other relevant provisions of the 2084 Order

9. Pacific Lumber Company Habitat Conservation Plan activities that comply with relevant Operating Conservation Plans

10. Forest Practices that comply with the Board of Forestry's final rule for "Protection for Threatened and Impaired Watersheds, 2000"

1.4 Project Objectives

The objective of the project is to adopt an order governing take of coho salmon north of San Francisco that will conserve the species and its habitat during the candidacy period to the greatest extent feasible, taking into account economic, legal, social, technological, biological, and other factors.

In addition, it is neither the objective nor the function of this document to evaluate the impacts of on-going activities in the project area. The environmental baseline, under CEQA, includes on-going activities. This document focuses on assessing changes to the existing environmental baseline resulting from the proposed project (the 2084 Order). To the extent that there are already on-going activities that affect the physical conditions, these are also part of the existing environmental baseline. Such on-going activities, permitted by law, that have the potential to impact biological resources may include agriculture, timber operations, gravel mining, water diversions, and other activities addressed in the 2084 Order. This document only evaluates changes in the environmental baseline resulting from the 2084 Order.

1.5 Project Location

Figure 1.5 is a detailed map showing the known distribution of coho salmon, separated by the southern California range (south of San Francisco), which was previously listed, and the northern California range (north of San Francisco), which is the subject of the 2084 Order. The northern California range, including much of the Northern California marine environment, may be affected by the proposed project.

Figure 1.5 Coho Salmon North of San Francisco

2.0 ENVIRONMENTAL SETTING

This section describes the environment in the vicinity of the project as it exists before the commencement of the project from a local, regional, and statewide perspective, and describes rare or unique resources closely associated with these resources.

2.1 Smith River Watershed

2.1.1 SMITH RIVER

2.1.1.1 Overview

The Smith River is California's fourth largest coastal river, with a watershed of approximately 610 mi^2 (1,580 km^2) in California, and 115 mi^2 (298 km^2) in Oregon (Figure 2.1.1, Smith River Watershed). The precipitous upper canyon areas are forested in fir, spruce, cedar, and pine with groves of tall redwoods in Redwood National and State Parks. A large portion of the Smith River watershed supports a unique flora, which exists on unusual soils derived from ultramafic parent materials. At its terminus, the Smith River flows through an agriculturally developed coastal plain, and enters the Pacific Ocean four miles (6.4 kilometers) south of the Oregon border.

The main stream Smith River is fed by three forks, the North, South, and Middle. The North Fork's headwaters lie in Oregon while the Middle and South Fork's headwaters lie in the Siskiyou Mountains at 4,400 and 5,400-foot (1,341 and 1,646-meter) elevation, respectively. Hurdygurdy Creek, a major tributary of the South Fork Smith, has headwaters in the Siskiyou Mountains at the 4,000-foot (1,219-meter) elevation.

2.1.1.2 Climate

This drainage receives an average of over 100 inches (254 cm) of precipitation annually, which mainly falls as rain. The highest recorded annual rainfall in California occurred within this drainage. At Crescent City, the mean minima and maxima are 40^o F (4.4^o C) and 55^o F (12.7^o C), respectively in winter and 50^o F (12.7^o C) and 65^0 F (18.3^o C) in summer (CARA 1997).

2.1.1.3 Geologic Setting

The Smith River watershed lies within two distinct geologic provinces. The eastern two-thirds of the watershed lies in the Klamath Mountains geologic province while the remaining third lies in the Coast Ranges geologic province. The oldest rocks in the watershed are in the Klamath Mountains province and lie in the Western Jurassic Belt. The Western Jurassic Belt is composed of dark slaty mudstones, graywacke, conglomerates, meta-andesite flows and breccias and some schist. This terrane has abundant intrusions of both ultramafic and granitic rocks and lies in the eastern two-thirds of the watershed. The soils derived from the ultramafic rocks are unusually high in heavy metals and have a calcium/magnesium ratio that is unfavorable to many plant species.

Figure 2.1.1 Smith River Watershed

The older rocks of the Western Jurassic Belt overlie the younger rocks of the Coast Ranges' Franciscan Complex by way of the Coast Range Thrust Fault (aka South Fork Mountain Thrust Fault), which trends generally northwest. The Franciscan Complex is Jurassic in age and consists of blueschist, greenstone, eclogite, chert, and greywacke in a highly sheared mudstone matrix with pods of ultramafic rocks. The youngest material in the watershed is recent, mainly Holocene, alluvial, coastal and aeolean deposits. These deposits are located along the coast in the northwest corner of the watershed and overlie the Franciscan Complex.

2.1.1.4 Hydrology / Water Quality

The river has the greatest annual discharge per square mile of any major California watershed. The runoff is estimated at 2.9 million acre-feet annually. Flow, as measured near the mouth, has ranged from 160 to 228,000 cfs through the period of record: 1932-1999. The river has no imports of surface water, and therefore it has come to be known as one of the cleanest and most pristine rivers in California.

The flow of the Smith River responds rapidly to storm precipitation because of steep gradients and narrow canyons. The Smith is known as the quickest clearing stream of the coastal rivers. After major storms, the river is fishable in a couple of days, where as some of the other rivers can take up to 2 weeks. This is due to the free-flow nature of the river, which has allowed it to carve its bed down to bedrock.

The USGS, in 1990, estimated the total water use from the Smith River (surface and ground) amounted to 9.6 million gallons per day (mg/d) (licensed, permitted or pending water rights are depicted in Figure 2.1.1). The total included 2.8 mg/d for domestic use and 6.8 mg/d for agricultural use. The total acreage in irrigated agriculture was estimated at 4,760 acres (19.2 square kilometers).

2.1.1.5 Fish Resources

Along with steelhead trout and chinook salmon, the Smith also has runs of coho salmon and cutthroat trout. The chinook salmon runs start in late August, going through late December, peaking in November. Steelhead trout start their runs in early December and go through March, peaking in January. Coho salmon start their runs in December and go through mid-February, peaking in late December to mid-January.

The Smith River is home to 22 species of native fish (see table below).

Table 2.1.1 Native Fish Species Known To Occur In The Smith River Watershed.

Common Name:	Scientific Name:
chinook salmon	*Oncorhynchus tshawytscha*
chum salmon	*Oncorhynchus keta*
coastrange sculpin	*Cottus aleuticus*
coho salmon	*Oncorhynchus kisutch*
cutthroat trout	*Oncorhynchus clarki*
eulachon	*Thaleichthys pacificus*
green sturgeon	*Acipenser medirostris*
Klamath smallscale sucker	*Catostomus rimiculus*
longfin smelt	*Spirinchus thaleichthys*
Pacific lamprey	*Lampetra tridentata*
Pacific staghorn sculpin	*Leptocottus armatus*
prickly sculpin	*Cottus asper*
steelhead/rainbow trout	*Oncorhynchus mykiss*
river lamprey	*Lampetra ayresi*
shiner perch	*Cymatogaster aggregata*
speckled dace	*Rhinichthys osculus*
starry flounder	*Platichthys stellatus*
surf smelt	*Hypomesus pretiosus*
threespine stickleback	*Gasterosteus aculeatus*
tidewater goby	*Eucyclogobius newberryi*
topsmelt	*Atherinops affinis*
western brook lamprey	*Lampetra richardsoni*

2.1.1.6 Fish Facilities

Rowdy Creek Hatchery (RCH) is located on Rowdy Creek, a tributary to Smith River, whose mouth is about three miles (4.8 kilometers) upstream from the ocean. RCH began operations in the mid-70s as an enhancement hatchery, designed to increase fishing opportunity in the Smith River. RCH, a privately run program, has produced chinook salmon and coho salmon and steelhead trout. Typical production is 70,000 chinook salmon, 10,000 coho salmon, and 120,000 steelhead trout, all released as yearlings. However, they have not been permitted to produce coho salmon either last year or this year. Locations of fish rearing facilities are depicted in Figure 2.1.1.

2.1.1.7 Recreational/Commercial Fishing Interests

The Smith River is the largest free-flowing river in the state, producing the largest steelhead trout and chinook salmon. The state record steelhead trout, weighing 27 lbs 4 oz and the state's second largest chinook salmon, weighing 86 lbs, were both caught in the Smith River. Steelhead trout of approximately 20 lbs are caught on a regular basis and chinook salmon commonly average 20-36 lbs. Currently, this is the only river in California where the take of wild steelhead trout is permitted. Department regulations allow anglers to harvest five wild steelhead trout per year.

The Department has conducted annual creel surveys in the Smith River since the 1997/98 season. Over the last three years, anglers expended an average of 114,000 hours/season fishing the Smith River.

2.1.1.8 Land-Use/Planning

The Smith is located in a sparsely populated area of California and southern Oregon. The Smith River is part of the state Wild and Scenic Rivers system, and a National Recreation Area in Six Rivers National Forest. Total human population within the watershed in 1990 was estimated at only 16,200. There are a total of 198 miles (318 kilometers) of "near stream" roads within the watershed.

The Smith River watershed ownership includes about 26% in private lands with the remainder in public ownership. The public land includes 79,805 acres (322.9 square kilometers) (18% of total) in protected land and 255,578 acres (1,034 square kilometers) (66% of total) in multiple-use lands.

Management Level Explanation	
Protected Lands:	An area with an active management plan in operation that is essentially maintained in its natural state and within which natural disturbance events are either allowed to proceed without interference or are mimicked through management.
Public Multiple Use Lands:	Most non-designated public lands managed for multiple uses, including biodiversity. Legal mandates prevent permanent conversion to anthropogenic habitat types (with some exceptions, such as tree plantations) and confer protection to populations of Federally listed and/or candidate species.
Private Lands:	Other private lands without existing easement or irrevocable management agreement that maintains native species and natural environment.

A few in-stream mining permits are located on the Smith River (Figure 2.1.1).

2.2 Klamath River Watershed

The Klamath River watershed is commonly divided into the Lower Klamath River and the Upper Klamath River (which is in Oregon). The Klamath River has its origins at Link River, the outflow of Upper Klamath Lake (UKL), north of Klamath Falls, Oregon. UKL is shallow and hypereutrophic, causing the water of the Klamath River at this point to be poor in quality for much of the year and to be listed by the EPA as impaired for temperature, dissolved oxygen and nutrients. The Upper Klamath River Watershed has been highly modified over the past ninety years, with 80-90% of historic wetlands having been reclaimed for agricultural, urban and other development. On average, approximately 500,000 acre-feet of water are diverted near the outlet of UKL to provide irrigation deliveries to 200,000 acres (809 square kilometers) of farm land within the U.S. Bureau of Reclamation's Klamath Project (DOI 2000). Some of this water, in a warmed and more nutrified condition, reenters the Klamath River at Keno, Oregon. Habitat alteration and water diversions have degraded Klamath River water quality, reduced total annual discharge and altered the magnitude, timing and duration of flow so that more water runs downstream during winter months and less during the spring and summer than occurred historically. Anadromous fish have been blocked from the upper watershed since 1918 when Copco #1 Dam was constructed.

There are six dams on the Klamath River between Upper Klamath Lake in Oregon and Iron Gate Dam (IGD) in California (Link River, Keno, J.C. Boyle, Copco #2, Copco #1 and Iron Gate Dams) and one on Fall Creek, tributary to Iron Gate Reservoir. The dams are part of PacifiCorp's Klamath Hydroelectric Project (PP 2082), which generates a total of 155 megawatts of electricity. The Klamath Hydroelectric Project license expires in 2006 and the relicensing process is presently underway. IGD, constructed in 1962, reregulates peaking flows generated by upstream facilities and is the present upper limit of anadromous fish distribution in the Klamath River. It demarcates the boundary between the upper and lower Klamath watersheds.

2.2.1 LOWER KLAMATH RIVER

2.2.1.1 Overview

The Lower Klamath River flows a distance of 190 miles (306 kilometers) through a relatively unpopulated region from Iron Gate Dam northeast of Yreka, near the Oregon border in Siskiyou County, to the Pacific Ocean at Requa, Del Norte County (Figure 2.2.1). It is California's second largest river, draining a watershed of approximately 979, 816 acres (3,965 sq km). The Lower Klamath River Watershed has 1,832 miles (2,948 kilometers) of waterways, of which 1,780 miles (2,865 kilometers) (97%) are naturally occurring and 1,535 miles (2,470 kilometers) (84%) are perennial in nature (CARA 1997). Major tributaries include the Trinity, Salmon, Scott and Shasta rivers. Numerous other tributaries enter the Lower Klamath River along its entire length.

Elevations along the mainstem Lower Klamath River range from 2,162 ft. at Iron Gate Dam to 0 ft. at the mouth. Tributary watersheds are generally steep in nature rising to elevations of 5,000 to 9,000 ft. The watershed is characterized by having 69.6% of its slopes over 15%, indicating a high to very high erosion potential.

2.2.1.2 Climate

Precipitation in the watershed is highly variable year to year and at different locations, with the heaviest near the coast and at high elevations. Precipitation averages 79.62 inches (202 centimeters (cm)) per year and ranges from over 100 inches (254 cm) to less than 20 inches (50.8 cm). The average amount of snow that falls along the mainstem Klamath is 4.6 inches (11.6 cm) per year. At Orleans, mean annual precipitation for the period 1948-2000 is 53.23 inches (135.2 cm) and it has ranged from 79.89 (202.9 cm) to 25.88 inches (65.7 cm). Air temperatures also vary greatly throughout the watershed. Average minima are higher and maxima lower near the coast whereas in upstream areas, there is a greater range of temperatures with generally lower minima and higher maxima. At Orleans, the mean minima and maxima are 35.9^o F (4.2^o C) and 52.5^o F (11.4^o C), respectively in winter and 51.8^o F (11^o C) and 90.0^o F (32.2^o C) in summer. The average number of days that air temperatures at Orleans exceed 90^o F (32.2^o C) is 51.8 (CARA 1997).

2.2.1.3 Geologic Setting

The Lower Klamath River watershed lies within three distinct geologic provinces. The eastern portion of the watershed lies in the Cascades geologic province, the middle portion in the Klamath Mountains geologic province, while the remaining watershed lies in the Coast Ranges province. The oldest rocks in the watershed are in the Klamath Mountains province and are differentiated into 3 terranes: the Central Metamorphic Belt, the Western Paleozoic and Triassic Belt, and the Western Jurassic Belt. The Central Metamorphic belt is the oldest (Devonian in

Figure 2.2.1 Lower Klamath River

age) and is composed mostly of schist, marble, and dark amphibole gneiss. This terrane has minor amounts of ultramafic and granitic intrusions and lies in the center of the watershed. The Central Metamorphic Belt is delineated from the Western Paleozoic and Triassic Belt by the Siskiyou Thrust Fault, which trends generally north. The Western Paleozoic and Triassic Belt is composed of phyllitic detrital rocks, thinly bedded radiolarian chert, mafic volcanic rocks, and lenses of coarsely crystalline limestone. The interbedded rocks are metamorphosed to a low-grade greenschist facies with a few areas metamorphosed to a high-grade amphibolite facies. This terrane has abundant intrusions of both ultramafic rocks and granitic rocks. The Western Paleozoic and Triassic Belt is delineated from the Western Jurassic Belt by the Orleans Thrust Fault, which trends generally north. The Western Jurassic Belt is composed of dark slaty mudstones, graywacke, conglomerates, meta-andesite flows and breccias and some schist. This terrane has abundant intrusions of both ultramafic rocks and granitic rocks and lies on the western edge of the watershed.

The older rocks of the Western Jurassic Belt overlie the younger rocks of the Coast Range's Franciscan Complex by way of the Coast Range Thrust Fault (aka South Fork Mountain Thrust Fault), which trends generally northwest. The Franciscan Complex is Jurassic in age and consists of blueschist, greenstone, eclogite, chert, and greywacke in a highly sheared mudstone matrix with pods of ultramafic rocks. The youngest material in the watershed is Cenozoic sedimentary basin deposits composed of mainly sandstones and shales, which overlie the Franciscan Complex.

2.2.1.4 Hydrology/Water Quality

Annual mean stream flows below Iron Gate Dam (USGS Gage #11516530) have ranged from 649 cubic feet per second (cfs) in 1992 to 3,753 cfs in 1983 for the period of record 1961-1999. In the lower river near the town of Klamath (USGS Gage # 11530500), annual mean flows have ranged from 7,432 cfs in 1991 to 39,830 cfs in 1983 for the period of record 1911-1998, excluding 1926-1950 and 1994-1997 when the gage was not operated (CDEC 2001).

Minimum instream flow releases at Iron Gate Dam have been established by the Federal Energy Regulatory Commission (FERC) as part of the 1956 Klamath Hydroelectric Project license (FERC No. 2082). The flow requirements read as follows:

> "The licensee shall release to the streambed below Iron Gate Dam no less than the flows specified in the following schedule:

Periods	Flow (cfs)
September 1 - April 30	1,300
May 1 - May 31	1,000
June 1 - July 31	710
August 1 - August 31	1,000

> Provided that Licensee shall not be responsible for conditions beyond its control nor required to release more water than it has lawful right to use for hydroelectric purposes, and Provided further that Licensee shall restrict the changes of release rates to not more than 250 second-feet per hour or a 3-inch change in river stage per hour whichever produces the least change in stage as measured at a gauge located not less than 0.5 mile (0.8 kilometers) downstream from Iron Gate Dam" (KRBFTF 1991).

FERC minimum flows at Iron Gate Dam have frequently not been met during the period 1961 - 2000 due to the fact that the US Bureau of Reclamation's Klamath Project controls most of the flow in the Klamath River. In the past, the water project has favored providing water to irrigation at the expense of downstream deliveries during below average water years. This situation is especially pronounced during droughts. For example, the monthly mean streamflow below Iron Gate Dam did not meet FERC minimums from February, 1991, through February, 1993, a period of 25 consecutive months. Since 1995, the Klamath Project has been operated based on an annual operations plan that considers threatened and endangered fish species needs in the watershed. A number of studies in the Klamath River have been conducted and are ongoing to determine anadromous fish flow needs.

Existing flows in the Lower Klamath River below the Scott River during the summer period have been associated with conditions that can result in lethal combinations of high temperature and low dissolved oxygen, as evidenced by fish kills. Temperatures can reach a high of 80^{o} F (26.6^{o} C) for up to 10 days each year. However, cold water refugia, especially at the mouths of a number of tributaries, are well documented and help ameliorate the effects of thermal stress (Bartholow 1995). Licensed, permitted or pending water rights are depicted in Figure 2.2.1.

2.2.1.5 Fish Resources

The Lower Klamath River supports a number of anadromous fish species including spring, fall and late fall-run chinook salmon, coho salmon, fall, winter and summer-run steelhead trout and coastal cutthroat trout. The mainstem Lower Klamath River provides habitat for all life stages of chinook salmon, coho salmon, and steelhead trout. Adult fall chinook salmon immigrate from mid-July through mid-December; spring chinook salmon from mid-March through June; coho salmon from mid-August through mid December; and steelhead trout from August through June, depending on race. All use the mainstem Lower Klamath River for this purpose. There is substantial fall chinook salmon spawning from Happy Camp upstream with the main concentrations between Klamath and IGD. Some coho salmon and steelhead trout spawning has been observed at the mouths of tributaries and some steelhead trout spawning in the main channel below IGD. However, the greatest proportion of spawning for all three species occurs in the tributaries. Fall chinook salmon spawning occurs from mid-August through mid-December; spring chinook salmon from mid-August through mid-November; coho salmon from mid-October through mid-February and steelhead trout from mid-November through mid-April. All three species rear extensively in the mainstem Lower Klamath River as fry (<55 mm) and juveniles. Most chinook salmon emigrate in the spring and early summer but some emigrate in the fall or the following spring; coho salmon emigrate the following spring to early summer; and steelhead trout reside in fresh water one to three years. There may be substantial movement of coho salmon and steelhead trout back and forth between the mainstem and tributaries.

There is little information available on natural coho salmon in the Klamath River, but indications are that they are widespread, but few in number. Because coho salmon spend 1.5 years in fresh water, they are subject to high levels of mortality and stress due to low flows and poor water quality. Outmigrant trapping during year 2000 showed 212 coho salmon emigrated from the Shasta River and 873 coho salmon from the Scott River (Chesney 2000). These are relatively small numbers when compared to the other species outmigrating at these traps in 2000. However, very rarely are natural coho salmon smolts or yearlings encountered at the U.S. Fish and Wildlife Service Big Bar Trap located just above the confluence with the Trinity River. For example, in 1996, only five smolts and one yearling coho salmon were counted at the Big Bar trap (DOI 1999).

Nearly all adult coho salmon enter the Klamath River from mid-September through January as three-year old fish (USFS 1972). A very small number of coho salmon return to spawn at age four. Egg incubation begins in mid-October with the initiation of spawning activity and continues through March. Hatching occurs in one to three months, depending on water temperature, with fry emergence occurring from February through mid-May. Peak outmigration activity occurs during April and May (Leidy & Leidy 1984).

Spring chinook salmon, prior to 1900, represented the predominate chinook salmon race in the Klamath Watershed (Snyder 1930), but blocking of access to adult holding and spawning habitat above Iron Gate Dam and in several important tributaries, habitat alteration, and water diversions have reduced this race to a single population in the Salmon River drainage. Department has monitored run size, in-river harvest and spawner escapement of fall chinook salmon to the Klamath River Watershed since 1978. During that time, total run size in the Klamath River Watershed (including the Trinity River) has ranged from 34,353 fall chinook salmon in 1991 to 239,366 in 1986. Year class strength appears to be highly dependent on rate of survival of juvenile outmigrants and ocean rearing fish. These two life stages are strongly influenced by spring and early summer river flows and ocean productivity levels, respectively. For example, in years when spring and early summer flows have been high and subsequent ocean conditions favorable, large runs of adult chinook salmon have returned to the Klamath River three and four years later. This relationship most likely also holds true for coho salmon and steelhead trout.

Steelhead trout have declined in numbers throughout the Lower Klamath River and its tributaries, especially since 1989. Iron Gate Hatchery has not been able to attain its steelhead trout production goals during that time. A steelhead trout Research and Monitoring Program has been initiated by Department to investigate some of the factors that may be responsible for the steelhead trout decline, although it is suspected that insufficient flow and poor water quality in the mainstem Klamath River, especially during the fry and juvenile rearing and outmigration period, may be important limiting factors.

American shad (*Alosa sapidissima*) is a non-native anadromous species that occurs in the mainstem Lower Klamath River from Ishi Pishi Falls downstream. Other native fish species are shown in the following table.

2.2.1.6 Fish Facilities

Fish passage was not provided at Iron Gate Dam. To mitigate for lost anadromous fish production for the reach of river from Iron Gate Dam to Copco #1 Dam, Iron Gate Salmon and Steelhead Trout Hatchery was constructed. Operations were started by the California Department of Fish and Game (Department) in 1962. The hatchery produces 5,100,000 fall chinook salmon smolts and 1,080,000 fall chinook salmon yearlings, 75,000 coho salmon yearlings, and 200,000 steelhead trout yearlings, annually. In addition, several non-Department pond rearing operations exist in the mid- and lower reaches of the river that emphasize restoration of local stocks of late fall-run chinook salmon. Locations of fish rearing facilities are depicted in Figure 2.2.1.

Table 2.2.1 Native Fish Species Present In The Lower Klamath River

Common Name:	Scientific Name:
chum salmon	*Oncorhynchus keta*
coastrange sculpin	*Cottus aleuticus*
coho salmon	*Oncorhynchus kisutch*
cutthroat trout	*Oncorhynchus clarki*
eulachon	*Thaleichthys pacificus*
green sturgeon	*Acipenser medirostris*
Klamath smallscale sucker	*Catostomus rimiculus*
longfin smelt	*Spirinchus thaleichthys*
marbled sculpin	*Cottus klamathensis*
Pacific lamprey	*Lampetra tridentata*
Pacific staghorn sculpin	*Leptocottus armatus*
prickly sculpin	*Cottus asper*
steelhead./rainbow trout	*Oncorhynchus mykiss*
reticulate sculpin	*Cottus perplexus*
river lamprey	*Lampetra ayresi*
shiner perch	*Cymatogaster aggregata*
speckled dace	*Rhinichthys osculus*
starry flounder	*Platichthys stellatus*
surf smelt	*Hypomesus pretiosus*
threespine stickleback	*Gasterosteus aculeatus*
topsmelt	*Atherinops affinis*
tui chub	*Gila bicolor*
western brook lamprey	*Lampetra richardsoni*
white sturgeon	*Acipensar transmontanus*

2.2.1.7 Recreational/Commercial Fishing Interests

Rail lines and roads built in the 1920s opened up the Klamath watershed to ocean and sport river fishing. Commercial trollers lined up at the mouth of the Klamath to intercept fish before their river migration, huge congregations of recreational salmon fishers joined them, and Native Americans continued fishing this declining resource. Canneries were established at Klamath Glen, near the mouth of the Klamath River. Competition among commercial and sportfishers and the Native Americans of the area increased harvesting pressure, culminating in the 1933 ban on commercial operations in the river. Meanwhile, ocean trollers outside the mouth went unregulated. Over the decades until the 1970s, numerous legal battles ensued over the right to fish by Native Americans on the continuing declining salmon resource. Eventually, the U.S. Supreme Count upheld the right of the Tribes to fish freely on reservation lands (State Lands Commission 1993).

Fall chinook salmon currently is the most numerous and economically important salmon run in the lower Klamath River, continuing to support extensive recreational, tribal and commercial ocean fisheries. Tribal gill-net fishing is conducted on both the Hoopa and Yurok Reservations. The tribal allowable catch of fall chinook salmon is currently 50% of the total allowable catch for the entire Klamath-Trinity Watershed. Annual quotas are structured for each season and vary according to estimated run size. Tribal fisheries are primarily subsistence, however, limited commercial fisheries are conducted in some years, particularly within the Yurok Reservation.

2.2.1.8 Land-Use/Planning

Fifty-seven percent of the naturally occurring waterways are on public multiple use lands, 28% on private lands, and 15% within protected lands. There are 410 miles (660 kilometers) of major near-stream roads within the watershed (CARA 1997). The Lower Klamath River was included in the National Wild and Scenic Rivers System in 1981. The primary outstanding value that was recognized was its anadromous fishery. One in-stream mining permit is located on the Lower Klamath River (Figure 2.2.2).

2.2.2 SHASTA RIVER

2.2.2.1 Overview

The Shasta River Watershed consists of approximately 508,700 acres (793 mi^2 or 2,058 square kilometers). The Shasta River originates within the higher elevations of the Eddy Mountains lying southwest of the town of Weed in Siskiyou County, California (Figure 2.2.2). It flows for approximately 50 miles (80.5 kilometers) in a northerly direction, passing through the Shasta Valley. After leaving the valley, it enters a steep-sided canyon where it flows for a distance of seven river miles (11 kilometers) before emptying into the Klamath River, 176.6 river miles (RM) (284 kilometers) upstream from the Pacific Ocean. The river drains a portion of the Cascade Province to the east and a portion of the Klamath Province to the west. The Shasta River Watershed is situated almost entirely within Siskiyou County.

Numerous springs and a number of small tributary streams enter the Shasta River as it passes through the Shasta Valley. Glacial melting from Mt. Shasta and mountain precipitation provide the principle source of recharge for the river. Major tributaries include Parks Creek, Big Springs Creek, Little Shasta River, and Yreka Creek. The highest point in the Shasta Watershed is Mt. Shasta at just over 14,000 feet (4,267 meters) high. The Shasta River drains a portion of the Cascade Province to the east and a portion of the Klamath Province to the west. Where the Shasta River enters the Klamath River, the elevation is just over 2,500 (762 meters).

2.2.2.2 Climate

The climate of the Shasta Valley is characterized by warm, dry summers and cool wet winters. Precipitation ranges between 9 and 75 inches (22.3-190.5 cm) depending on the location within the valley. Overall, the valley averages about 25.7 inches (65.2 cm) annually with 75 to 80 percent of it occurring between October and March. The length of the average growing season is about 180 days (DWR 1964). Air temperature averages 71.5^{o} F (21.9^{o} C) in the summer and 33.6^{o} F (0.89^{o} C) in the winter as measured in Yreka.

2.2.2.3 Geologic Setting

By far the most prominent feature of the valley is Mt. Shasta, which last erupted in 1786. The Shasta Valley watershed lies within two distinct geologic provinces. The eastern three-quarters of the watershed lies in the Cascades geologic province while the remaining quarter lies in the Klamath Mountains geologic province. The oldest rocks in the watershed are in Klamath Mountains province. The Trinity peridotite complex, located in the southwest corner, is a well-exposed ophiolite sequence and forms the basement on which the Eastern Klamath Belt sits. The Eastern Klamath belt consists of radiolarian chert, black shale, andesite and limestone. The Trinity Thrust Fault and a linear band of ultramafic rocks, mainly peridotite, delineate the

Figure 2.2.2 Shasta, Scott and Salmon Watersheds

Eastern Klamath Belt from the Central Metamorphic Belt. The Central Metamorphic belt is Devonian in age and is composed mostly of schist, marble, and dark amphibole gneiss, with minor amounts of ultramafic and granitic intrusions. The Central Metamorphic Belt is delineated from the Western Paleozoic and Triassic Belt by the Siskiyou Thrust Fault, which trends generally north. The Western Paleozoic and Triassic Belt consists of phyllitic detrital rocks, thinly bedded radiolarian chert, mafic volcanic rocks, and lenses of coarsely crystalline limestone.

The younger rocks of the watershed are in the Cascades geologic province and consist of layers of lava and pyroclastic flows ranging in composition from olivine basalt to rhyolite. The High Cascades overlie the Western Cascades unconformably and represent recent volcanic activity (Quaternary), with a composition of olive basalt to dacite, but predominately andesite.

2.2.2.4 Hydrology/Water Quality

The Shasta River was dammed at river mile (RM) 37 to form Dwinnell Reservoir (Lake Shastina) in 1928. In 1955, the height of the dam was raised which increased the total storage capacity to 50,000 acre-feet. When full, the reservoir has an average depth of 22 feet (6.7 meters) with a maximum depth of 65 feet (19.8 meters) and a surface area of 1,824 acres (2.85 mi^2 or 7.4 square kilometers). In addition to receiving flow from the Shasta River, Dwinnell Reservoir also carries flow from Beaughton Creek and a major diversion from Park's Creek. Dwinnell Reservoir supplies water through a 20-mile-long (32-kilometer-long) canal to Little Shasta Valley and the northeastern portion of the Shasta Valley for agricultural use.

Seven major diversion dams and several smaller dams or weirs exist on the Shasta River below Dwinnell Dam. Numerous diversions and associated dams exist on other major tributaries as well, including Big Springs Creek, Little Shasta River, and Parks Creek. When all diversions are operating, flows are substantially reduced and, in the case of the Little Shasta River, stream flows cease entirely in the lower several miles of stream during the summer and fall period. Licensed, permitted, or pending water rights are depicted in Figure 2.2.2.

The primary water quality problems in the Shasta River are high water temperatures and periodically depressed dissolved oxygen levels. Both are affected by flows in the river. The middle stretch of the river is low gradient, and it moves slowly across the open, hot valley floor. Unrestricted grazing in riparian zones has led to a decrease in streamside trees and stream shading.

Tail water from agricultural uses, which is diverted from the river or pumped from the ground, is often warm when it flows back into the river. This runoff may be rich in organic matter, which can raise nitrogen and phosphorus levels in parts of the river.
Diversion dams slow the river's flow, which allows the water to warm up in the heat of summer. The dams also create a pond-like environment, rich in nutrients, where algae bloom in abundance. In the daytime as the algae release oxygen through photosynthesis the water may become super-saturated with oxygen. At night, photosynthesis stops but respiration continues. The algae then use the oxygen, leaving little for the fish and aquatic invertebrates.

There are approximately 100 licensed, permitted, or pending water rights within the Shasta River watershed. This number does not include riparian users and other diversions that are not registered with the State Division of Water Rights (State Water Resources Control Board 2001).

2.2.2.5 Fish Resources

The Shasta River is considered to be extremely important for production of chinook salmon in the Klamath Watershed. Historically, spring-run chinook salmon comprised the major portion of the chinook salmon run in the Klamath Watershed, including the Shasta River. In the early 1900's, habitat destruction led to near extirpation of that race (Snyder 1931). Fall chinook salmon have since predominated in the Klamath River watershed and is the only chinook salmon race believed to currently exist in the Shasta River watershed. The Department has monitored the Shasta River fall chinook salmon runs since 1930. Chinook salmon counts have ranged from nearly 82,000 fish in 1931 to only 533 (415 adults) in 1990 (Table 2.2.2.5).

Information for coho salmon and steelhead trout observed at the SRFCF has been reported since 1932. In all but a few cases, the numbers reported do not represent the entire run because field activities were normally terminated before complete counts are made. Available information for coho salmon and steelhead trout is presented in Table 2.2.2.5.

Chinook salmon begin entering the Shasta River in September with adult immigration continuing into November. The majority of spawning occurs during October and November. The period of egg incubation begins as soon as spawning occurs and is usually completed before March (Leidy & Leidy 1984). Emergence takes place in late January through March. Chinook salmon spawning takes place in the Shasta River between the Klamath River confluence and Yreka-Ager Road (RM 10.5). Spawning also occurs in a reach extending from about one mile (1.6 kilometer) below the Big Springs confluence (RM 30) to Louie Road (RM 31.3) and in the lower mile of Big Springs Creek. Very little spawning occurs in the Shasta Valley due to the paucity of gravel (DWR 1981). During years of adequate streamflow, salmon are able to spawn in the Shasta River above Louie Road in the vicinity of Parks Creek and in Parks Creek (DWR 1981). Chinook salmon have been observed in Little Shasta Creek and in Yreka Creek.

Very little information is available regarding the spawning distribution of coho salmon and steelhead trout in the Shasta Watershed. Skinner (1959) reported that adult steelhead trout spawn in the lower seven miles (11.3 kilometers) of the Shasta River, in Big Springs Creek, in the main Shasta River above Big Springs Creek and in Parks Creek when flows were adequate. Steelhead trout are also known to spawn in the lower three miles (4.8 kilometers) of Yreka Creek. Skinner suggested that since coho salmon have similar spawning requirements to steelhead trout, coho salmon probably spawn in the same areas.

Other fish species observed in the Shasta River include largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieui*), yellow perch (*Perca flavescens*), brown bullhead (*Ictalurus nebulosus*), Klamath smallscale sucker (*Catostomus rimiculus*), Marbles sculpin (*Cottus klamathensis*), Pacific lamprey (*Lampetra tridentata*) and speckled dace (*Rhinichthys osculus*).

2.2.2.6 Fish Facilities

No hatchery or pond rearing programs are currently operating in the Shasta River watershed. The nearest fish hatchery is Iron Gate Hatchery located on the Klamath River approximately 20 miles (32 kilometers) upstream of the mouth of the Shasta River. Fish passage facilities exist at most of the larger irrigation diversion structures, except Dwinnell Dam. Many of these diversions are screened to keep fish in the system. However, many of these screens are in need of repair and improvements.

Table 2.2.2.5 Shasta River: Chinook, Coho, and Steelhead Counts

2.2.2.7 Recreational/Commercial Fishing Interests

Historically, the lower few miles of the Shasta River supported a very robust and popular steelhead trout fishery. In more recent years, the number of steelhead trout anglers has dwindled to just a few, most likely in response to reduced numbers of steelhead trout returning to the watershed. The Shasta River is one of three Klamath River tributaries in Siskiyou County which is open to "catch and release" steelhead trout fishing, the others being the Salmon and Scott rivers. The take of "wild" (unmarked) steelhead trout is currently not permitted in any Klamath River watershed water. Department regulations allow anglers to harvest only hatchery trout or steelhead trout from specified Klamath Watershed waters (i.e., Klamath and Trinity rivers).

2.2.2.8 Land-Use/Planning

The population of Siskiyou County was estimated at 44,700 in 1998. Populations in the two largest cities, Yreka and Mt. Shasta City were estimated at 7,500 and 3,700, respectively. Other towns within the Shasta Watershed include Montague, Gazelle, Grenada, Lake Shastina, Big Springs and Weed. The Shasta River Watershed consists of approximately 507,000 acres (793 mi^2 or 2,052 square kilometers). About 28 percent of this acreage (141,000 acres, or 570 square kilometers) is irrigable and exists primarily below Dwinnell Dam (DWR 1964).

Much of the Shasta Watershed and Shasta River is in private ownership, 72% versus 28% in public ownership. Access to the river and its tributaries is limited to a few miles of the lower Shasta River in public ownership, public road crossings, and that provided by a few willing landowners. Approximately 3% of the publicly held river is in protected status. One in-stream mining permit is located on the Shasta River (Figure 2.2.2).

2.2.3 SCOTT RIVER

2.2.3.1 Overview

The Scott River is one of four major tributaries of the Klamath River entering the Klamath at RM 143 at an elevation of 1,580 feet (482.6 meters). The Scott River watershed is a large area with substantial variation in geology, geomorphology, and climate. The watershed drains approximately 520,617 acres (812.2 mi^2 or 2,107 square kilometers). The Scott River is part of the Klamath Mountain Province, which encompasses land in both Southern Oregon and Northern California (Figure 2.2.2).

2.2.3.2 Climate

Average annual precipitation in the Scott River watershed is 36 inches (91 cm). Most of the precipitation in the Scott watershed falls on the west side of the Scott River watershed. The Scott River drainage is bordered to the west by a 7,000 to 8,000-foot (2,134-2,438-meter) elevation mountain range (Marble-Salmon-Scott mountains), which exerts a strong orographic effect on incoming storms. This allows the west side of the Scott drainage to receive between 60-80 inches (152-203 cm) of precipitation annually. In contrast, the rain shadow effect that these west side mountains create reduces the amount of annual precipitation to 12 to 15 inches (30.5-38.1 cm) on the eastside of the watershed. About 90% of the rainfall occurs between the months of October and May. Due to the proximity of the Pacific Ocean, winter storm systems vary between warm and cold fronts. This situation creates a zone that lies between 4,000 and 5,000 feet (1,219-1,524 meters) where precipitation varies between rain and snow, known as the transient snow zone. A cold storm event followed by a warm storm event can result in a "rain-on-snow" event, which can trigger large flood events. Such events have occurred in the relatively recent past including 1955, 1964 and 1997. Since the 1942 Water Year, the mean monthly streamflow (mms) has ranged from a low of 55.2 cfs during the month of September to a high mms of 1,178 cfs for the month of February. Flow on the Scott River, as measured at the USGS gauging station at RM 21, has ranged from a low of 3.7 cfs to a high of 54,600 cfs through the period of record: October 1941- September 2000.

2.2.3.3 Geologic Setting

The Scott River Watershed is a complex area geologically, with a variety of bedrock and several different geomorphic landscapes. The bedrock underlying this area is a complex of meta-sedimentary and meta-volcanic rocks derived from the ocean floor and plastered onto the North American continent. Portions of the original oceanic basement rocks (ultramafic rocks) are exposed in the west half of this landscape. Younger granitic rocks of the Slinkard Creek Pluton have intruded the metamorphic rocks. All of the bedrock has been uplifted as part of the regional uplift of the Klamath Mountains, and subsequently this area has been deeply eroded. The Scott River has cut right through these uplifted mountains. Also, of note there is an area of limestone and marble at Marble Valley, containing a large network of caves. The area can be divided into at least five geomorphic landscapes. A major structural fault runs from Scott Valley to Scott Bar through the middle of this landscape. The gold deposits of Scott Bar are associated with this fault. East of the fault are meta-sedimentary rocks.

West of the fault are four distinct terranes. These include amphibote schist of the Rattlesnake Creek terrain and mica schist of the Condrey Mountain terrane, metasedimentary rocks of the Rattlesnake Creek terrane, granitic rocks of the Slinkard Creek pluton and ultramafic rocks. (USFS, 2000). The mainstem Scott River from Callahan to French Creek was intensively placer-dredged for gold from the 1930's to the 1950's. This dredge mining activity left large-scale tailing piles for a distance of approximately 6 miles (9.6 kilometers). These features dominate the hydraulic nature of the river in this impacted reach.

2.2.3.4 Hydrology / Water Quality

The unstable granitic soils and past human activities (e.g. logging, roads, etc) along the west side of Scott Valley have been contributing to the Scott River's problem of excessive fine sediment. This fine sediment comprises a large percentage of the Scott River's substrate. This, along with the relatively large amount of water diverted from the Scott River and its tributaries, has resulted in reduced river flows and relatively high annual river temperatures. Because of these water quality problems, the Scott River has been listed as an "impaired" waterway under section 303(d) of the Clean Water Act. Under the Clean Water Act, a total maximum daily load (TMDL) plan will provide the method for assessing the environmental problems that resulted in the "impaired" listing of the Scott River and will develop a strategy to reach acceptable water quality standards within a set timeframe. California's Regional Water Quality Control Board for the Scott River region will establish TMDL's by the year 2005.

The January 1997 flood event had a considerable effect on the Lower Scott watershed and contributed large amounts of sediment into area streams. Most significantly affected were Tompkins, Kelsey, Middle, and Deep creeks, and the mainstem Scott River. Riparian area disturbances, including roads, wildfire, timber harvest, and mining, may have compounded and contributed to stream impacts.

Agriculture is the single largest water user within the Scott Valley. Pasture, alfalfa and grains are the primary agricultural crops. It has been estimated that gross water use for agriculture is 98,100 acre-feet with the net use placed at 78,000 acre-feet after taking into account evapotranspiration and ditch loss. Most of the irrigation diversions on the Scott River operate from April 1 through October 15 pursuant to the 1980 Scott River Adjudication decree of the Superior Court of Siskiyou County. This decree recognizes 680 total water diversions, which cumulatively could divert 894 cfs from the Scott River and its tributaries (CH2M-Hill, 1985). Earlier adjudication decrees allocated water for irrigation, stock-water and domestic use from the Shackleford/Mill Creek drainage under a 1950 adjudication decree and from the French Creek drainage in a 1958 adjudication decree. All previous riparian, pre-1914 claims, and appropriative water rights were included in all of the court adjudicated decrees within the Scott watershed.

Diversions from streams for both stockwater and domestic use were also allocated under these court adjudicated decrees. Many domestic users are scattered throughout the valley and foothills of the Scott watershed. Most of these scattered users utilize ground water from individual wells for their household and landscaping needs. Information on local residential and commercial water use is sparse. However, within the past 6-10 years, improvements in some city water delivery systems and the metering of users within some local municipalities have significantly reduced municipal and domestic usage. In 1990, the average domestic water use within the cities of Etna and Fort Jones, the two largest municipalities, was 266 gallons/person/day and 170 gallons/person/day, respectively. The City of Etna pipes water directly from Etna Creek while Fort Jones pumps water from the underflow of Moffett Creek and the Scott River. Assuming an average local water demand of 200 gallons/person/day, the total urban (i.e., domestic/ residential/municipal) water use in 1990 was estimated at 1,800 acre-feet. (Scott River Fall Flows Action Plan, 1995). Stockwater use is estimated to be 504 acre-feet based on an estimated maximum 30,000 head of cattle within the Scott watershed utilizing an average of 15 gallons per day. The gross use taken under a stock-water right, which would include ditch loss, is not known but is known to be quite high in some instances.

2.2.3.5 Fish Resources

The Department estimated the Scott River's fish population at 10,000 chinook salmon, 2,000 coho salmon and 20,000-40,000 steelhead trout (Calif. Dept. of Fish and Game, 1965). Since 1978, adult fall chinook salmon runs have exceeded the 10,000 chinook salmon spawning estimate during two spawning seasons (1995 & 1996). Fall chinook salmon spawning runs generally begin in early September and extend through mid to late December, with peak spawning occurring in November. Adult steelhead trout begin entering the Scott River in mid-September to early October and the spawning run extends through April, with peak spawning activities occurring from late March to mid April. Steelhead trout spawning was reported to have occurred as late as the first week in June in the Scott River (USFS, Klamath National Forest).

Eight species of native fish occur in the Scott River (Table 2.2.3.5).

Table 2.2.3.5. Native Fish Species Known To Occur In The Scott River Watershed.

Common Name:	Scientific Name:
chinook salmon (fall)	*Oncorhynchus tshawytscha*
coho salmon	*Oncorhynchus kisutch*
rainbow/(steelhead) trout	*Oncorhynchus mykiss*
Klamath smallscale sucker	*Catostomus rimiculus*
tui chub	*Gila bicolor*
speckled dace	*Rhinichthys osculus*
marbled sculpin	*Cottus klamathensis*
Pacific lamprey	*Lampetra tridentata*

2.2.3.6 Fish Facilities

Currently there are no hatcheries operating in the Scott River watershed. The nearest fish hatchery is Iron Gate Hatchery located along the Klamath River at the base of Irongate Dam nearly 50 miles (80.5 kilometers) upstream of the mouth of the Scott River.

2.2.3.7 Recreational/Commercial Fishing Interests

The Scott River supports a local steelhead trout fishery and is one of three Klamath River tributaries in Siskiyou County which is open to "catch and release" steelhead trout fishing, the others being the Salmon and Shasta rivers. The take of "wild" (unmarked) steelhead trout is currently not permitted in any Klamath River watershed. Department regulations allow anglers to harvest only hatchery trout or steelhead trout from Klamath and Trinity rivers.

2.2.3.8 Land-Use/Planning

The mainstem Scott is predominantly surrounded by farm and rangeland comprising 53% of the watershed acreage. Upland areas of the watershed are predominantly private and federally owned timberlands with approximately 35% of the total Scott watershed acreage being federally owned. The Scott River watershed ownership includes about 35% in National Forest lands with the remainder in other public and private ownership. The Scott is located in Siskiyou County in a sparsely populated area of California. Total human population within the Scott watershed in 1990 was estimated at only 8,000.

A variety of human uses occur in the analysis area, including recreation (swimming, fishing, rafting/kayaking, & recreational gold dredging), commodities (timber, mining, etc.), and heritage resources. Two in-stream mining permits are located on the Scott River (Figure 2.2.2). The small community of Scott Bar (pop. approx. 70) is located in the lower Canyon area. Other rural residences are scattered throughout the Canyon area but predominately are located along the lower 8 miles (13 kilometers) of the river.

As a result, water quality and instream habitat conditions are of concern, as well as the condition of streamside vegetation. Another concern is the impact in riparian areas from past and future disturbances. Management has placed the riparian corridor into Riparian Reserve designation. Riparian Reserve management protection is designed to maximize the protection of riparian areas. Klamath National Forest, which manages most of the land bordering the Lower Canyon area of the Scott River and most of the headwater tributaries throughout the Scott River watershed.

The Klamath National Forest manages 34.8% of the lands within the Scott River watershed. The remainder of the lands is in private or other public ownership (65.2%).

2.2.4 SALMON RIVER

2.2.4.1 Overview

The Salmon River is located in remote northwestern California in the Klamath Mountains and is a major tributary to the Klamath River. The Salmon River drains an area of 480,626 acres (751 square miles or 1,945 square kilometers) and can be divided into four major subwatersheds, which include the North Fork (130,468 acres, or 527 square kilometers), South Fork (185,608 acres, or 751 square kilometers), Wooley Creek (95,188 acres, or 385 square kilometers), and the mainstem (69,362 acres, 281 square kilometers) (De la Fuente and Haessig 1994). Elevations in the watershed range from about 500 to 9,000 feet (152-2,743 meters) above sea level. The area contains steep slopes and much of the river, and tributary streams flow through isolated remote canyons with moderate to high gradients. The river bed is formed by bedrock and boulder controls with some alluvial reaches containing gravel and cobble substrates. The headwaters originate in the pristine Marble Mountain, Russian, and Trinity Alps Wilderness Areas, administered by the Shasta-Trinity and Klamath National Forests. There are approximately 1,414 miles (2,275 kilometers) of streams within the watershed, of which, 740 miles (1,191 kilometers) are perennial in nature.

The Salmon River watershed is dominated by forested lands, which cover approximately 90% of the watershed. The remaining landscape is comprised of brush lands (7%), rocky slopes or barren areas (2%), and meadows and grasslands (<2%). The forested lands are comprised of coniferous forests (81%) and hardwood forests (9%). The coniferous forests are comprised of mixed conifer, Douglas-fir, and true fir. The Salmon River watershed contains one of the most species diverse temperate forests in the world. There are fourteen different recognized wildlife habitat community types present in the watershed: barren, blue oak – foothill pine, Douglas-fir, eastside pine, Jeffrey pine, Klamath mixed conifer, montane chaparral, montane hardwood – conifer, montane hardwood, ponderosa pine, red fir, Sierran mixed conifer, white fir, and wet meadow.

2.2.4.2 Climate

Located in the Klamath Mountains of Northern California, summers in the Salmon River watershed are typically warm and dry and winters are generally cool and wet. Snow accumulations occur at elevations above 4,000 feet (1,219 meters). Summer temperatures generally range between about 90^{o} F (32.2^{o} C) and 55^{o} F (12.7^{o} C). Temperatures in the winter typically range from about 20^{o} F (-6.7^{o} C) to 55^{o} F (12.7^{o} C). The average annual precipitation is about 56 inches (142 cm) and can vary greatly within the watershed in any given year. For example, the average annual precipitation at higher elevations in the Wooley Creek subwatershed is about 85 inches (216 cm). At lower elevations along the mainstem, the average annual precipitation is much less at approximately 37.5 inches (95 cm). The annual precipitation at Orleans, located on the Klamath River near the confluence of the Salmon River, has ranged from 26 to 84 inches (66-213 cm) per year for the period from 1904 to 1994. Approximately 90% of the annual precipitation occurs between October and May with the remaining 10% occurring in the form of thundershowers during the spring and summer.

2.2.4.3 Geologic Setting

The Salmon River watershed lies completely within the Klamath Mountains geologic province. The watershed is differentiated into 2 terranes: the Central Metamorphic Belt, and the Western Paleozoic and Triassic Belt. The Central Metamorphic Belt is delineated from the Western Paleozoic and Triassic Belt by the Siskiyou Thrust Fault, which trends generally north. The belts consist of metasedimentary rock including chert, argillite, marble, metavolcanic rock, serpentine, and peridotite. Wooley Creek and English Peak comprise two larger areas that are formed by granite batholiths. Metamorphic rock covers about 322,000 acres (1,303 square kilometers), granitic rock covers about 143,000 acres (578.7 square kilometers), and ultramafic rock covers about 15,000 acres (60.7 square kilometers) of the watershed.

Landsliding is a dominant geomorphic process in the watershed found primarily in the Western Paleozoic and Triassic Belts, which form the ridge divide between the North Fork and South Fork of the Salmon River (De la Fuente and Haessig 1994). The terrain within the watershed is very steep; over 80% of the watershed has slopes greater than 15%. Over the last one hundred years several landslides have occurred in the watershed, some of which formed temporary dams in the Salmon River or its tributary streams resulting in severe impacts to the riparian community and stream channel. During the Christmas flood of 1964, a major landslide occurred at Murderers Bar approximately 5 miles (8 kilometers) upstream of the mouth of the river. Approximately 11.6 million cubic yards of material were estimated to have entered the river, damming the river for a short time. The river was also dammed by the Bloomer Landslide just downstream of Nordheimer Creek. Increased erosion as a result of fire, timber practices, and road construction is the primary threat to salmonid habitat in the Salmon River watershed.

2.2.4.4 Hydrology/Water Quality

The average annual discharge of the Salmon River is approximately 1.2 million acre-feet. For the period of record from 1912 through 1999 (USGS Gage #11522500), the mean average daily flow of the Salmon River is 1,811 cfs. The lowest flow recorded was 70 cfs on August 25, 1931 and the highest flow measured was 100,000 cfs on December 22, 1964. Flood flows in excess of 40,000 cfs were recorded in 1997 (64,400 cfs), 1955 (63,300 cfs), 1971 (54,800 cfs), 1974 (54,100 cfs), 1972 (43,600 cfs), 1953 (43,200 cfs), and 1970 (41,000 cfs). The lowest flows on record occurred in the summer of 1931 when flows fell below 80 cfs for 22 days. The Salmon River has excellent water quality in large part due to the pristine condition of much of the watershed (wilderness lands).

There are no major water development projects in the Salmon River watershed. However, several historic water diversions and dams have been constructed within the watershed since the discovery of gold in 1850. Most of these dams served to divert water for mining, agriculture and domestic use. The Bennet-Smith Dam, constructed in the 1900's, was an 11-foot (3.35 meters) high permanent log structure that was located on the South Fork Salmon River about 4 to 5 miles (6.4-8 kilometers) upstream of Forks of the Salmon (USFS, 1995a). The dam was a barrier to upstream migrating adult salmon and steelhead trout. The diversion was unscreened and may have caused a significant loss in juvenile salmonid production. The dam was washed out during a flood that occurred in October 1950. The Bonally Mining Company Dam was also built in the early 1900's and was located on the North Fork about 6 miles (9.6 kilometers) upstream of the Forks of the Salmon. Although a fish ladder was constructed on the dam in 1914, it proved inadequate and was often blocked by local residents to collect fish. The dam was removed in 1946 (USFS, 1995b). Licensed, permitted, or pending water rights are depicted in Figure 2.2.2.

2.2.4.5 Fish Resources

The Salmon River supports several anadromous species including spring and fall-run chinook salmon, coho salmon, and winter and summer-run steelhead trout. Prior to 1850, the Salmon River produced enough salmon to support the Native American Tribes and was an important component of their economy. Following the discovery of gold in the watershed in 1850, salmon and steelhead trout populations were exposed to several additional pressures that resulted from mining activities in the watershed.

Near the turn of the century, salmon canneries began to operate near the mouth of the Salmon River, and by 1912, three canneries were in operation. Although the canneries were short-lived, there is little doubt that they impacted both chinook salmon and coho salmon populations while in operation. Both the spring and fall-run chinook salmon populations were historically abundant in the Salmon River. However, spring-run chinook salmon populations appeared to have been nearly eliminated from the river, and the other salmon runs were also observed to be in serious decline (Snyder 1931).

The Department began making fall chinook salmon escapement estimates in 1978. Escapement estimates for fall-run chinook salmon are presented in the following table.

Table 2.2.4.5a Salmon River Fall-Run Chinook Salmon Escapement Estimates

Year	Total Escapement	Year	Total Escapement	Year	Total Escapement
1978	4,000	1986	3,665	1994	3,493
1979	1,150	1987	3,950	1995	5,475
1980	1,000	1988	3,600	1996	5,463
1981	1,200	1989	3,610	1997	6,000
1982	1,300	1990	4,667	1998	1,453
1983	1,275	1991	1,480	1999	780
1984	1,442	1992	1,325	2000	1,772
1985	3,164	1993	3,533		

The Salmon River Restoration Council, in a collaborative effort with the Forest Service, the Department, and other resource agencies, conducts annual snorkel counts for adult spring-run chinook salmon and summer steelhead trout that over summer in the Salmon River watershed. These surveys provide the only consistent data for monitoring the status of these two runs of fish. Survey results for both spring-run chinook salmon and summer steelhead trout follow.

Table 2.2.4.5b Number Of Adult Spring-Run Chinook Salmon And Summer Steelhead Trout Observed Within The Salmon River From 1980 To 2000[1/]

Year	Spring Chinook	Summer Steelhead	Year	Spring Chinook	Summer Steelhead
1980	299	400	1991	187	92
1981	193	369	1992	361	137
1982	568	619	1993	1304	156
1983	No Survey	No Survey	1994	1220	109
1984	No Survey	No Survey	1995	1249	80
1985	466	307	1996	1085	71
1986	791	19	1997	1192	31
1987	615	290	1998	295	76
1988	1120	522	1999	380	83
1989	274	262	2000	202	82
1990	170	121			

[1/]Data provided by the Salmon River Restoration Council, 15 June 2001.

Along with chinook salmon and steelhead trout, the Salmon River also provides habitat for coho salmon. Unfortunately, there is only limited anecdotal information available regarding the status of coho salmon populations in the Salmon River. Until recently, the Department has focused its limited resources on quantification and monitoring of chinook salmon stocks within the watershed.

Green sturgeon and American shad are also observed occasionally in the lower reaches of the river in spring and early summer. American shad are not native to the west coast and were introduced into the Sacramento River during the late 1800's and subsequently spread to the Klamath River. Fish species present in the Salmon River are shown in Table 2.2.4.5c.

2.2.4.6 Fish Facilities

There are no fish hatcheries or rearing facilities operating in the Salmon River watershed. Iron Gate Fish Hatchery, located on the Klamath River approximately 125 miles (201 kilometers) upstream of the mouth of the Salmon River, is the nearest salmon and steelhead trout hatchery. The occurrence of hatchery origin chinook salmon within the Salmon River is extremely rare, and although there is only limited data for coho salmon and steelhead trout, the occurrence of hatchery origin fish of these two species in the river is probably very limited. Other fish rearing facilities are depicted in Figure 2.2.2.

Table 2.2.4.5c Fish Species Present in the Salmon River

Common Name	Scientific Name
chinook salmon	*Oncorhynchus tshawystcha*
coho salmon	*Oncorhynchus kisutch*
steelhead trout	*Oncorhynchus mykiss*
Pacific lamprey	*Lampetra tridentata*
speckled dace	*Rhinichthys osculus*
Klamath small scale sucker	*Catostomus rimiculus*
marbled sculpin	*Cottus klamathensis polyporus*
Pacific brook lamprey	*Lampetra pacifica*
green sturgeon	*Acipenser medirostris*
white sturgeon	*Acipenser transmontanus*
American shad	*Alosa sapidissima*

2.2.4.7 Recreational/Commercial Fishing Interests

The Salmon River is known for its salmonid resources and is the destination of many fishing enthusiasts.   The Salmon River supports a popular steelhead trout fishery that is currently open to "catch and release" fishing. The take of "wild" steelhead trout is currently prohibited within the Klamath River watershed. There are no tribal or commercial fishery operations on the Salmon River.

2.2.4.8 Land-Use/Planning

The Karuk Tribe have lived along the Salmon River for thousands of years. The Karuk Tribe depended upon the rich natural resources in the area for their subsistence. The abundant salmon runs formed the primary basis of their economy and was a critical component of their cultural beliefs. Many Karuk Tribal members still live within the watershed and practice their traditional ceremonies. The Karuk are the second largest tribe in California and gained formal recognition in 1979.

Nearly the entire Salmon River watershed is under federal ownership administered by the Forest Service (98.7%), with 45% in wilderness. Therefore, management activities within the watershed are strongly influenced by the Forest Service's Northwest Forest Plan. The Salmon River has been identified as a "Key Watershed" under the Northwest Forest Plan and Klamath River Watershed Assessment. Over 25% of the watershed has been identified as Late Successional Reserve (LSR) as described in the Presidents Forest Plan. The objective of LSR's is to protect and enhance the condition of late-successional and old growth forest ecosystems to help ensure that critical habitats for species dependant on old growth forests are preserved. Riparian Reserves have also been identified throughout the watershed. Riparian Reserves are a major component of the Aquatic Conservation Strategy in the Forest Plan. The primary management goal of Riparian Reserves is to maintain a healthy, functioning link between aquatic and terrestrial ecosystems. One of the primary purposes for establishment of Riparian Reserves is to assure healthy conditions in areas that are important to the production of anadromous salmonids.

The Salmon River was incorporated into the National Wild and Scenic Rivers system in 1981. The river was designated for its anadromous salmonid resources and it's outstanding scenic and recreational values.

Currently, the Klamath National Forest and the Salmon River Restoration Council are developing a restoration strategy for the Salmon River. The first draft of the "Salmon Subbasin Restoration Strategy: Steps to Recovery and Conservation of Aquatic Resources" was completed in 2000. The objective of the strategy is to accelerate rehabilitation of watershed conditions at high priority sites through a collaborative approach that results in restoration of anadromous salmonid resources.

2.2.5 TRINITY RIVER

2.2.5.1 Overview

The Trinity River is the largest tributary to the Klamath River and has significant economical, biological, cultural, and recreational values (Figure 2.2.5). The Trinity River is the largest tributary to the Klamath River and drains approximately 7,680 km^2 (1,304,179 acres) of watersheds in Humboldt and Trinity counties. The headwater streams originate in the pristine wilderness areas of the Trinity Alps and Trinity Mountains located in eastern Trinity County. From its headwaters, the river flows 172 miles (277 kilometers) south and west through Trinity County, then north through Humboldt County and the Hoopa Valley and Yurok Indian reservations until it joins the Klamath River at Weitchpec, about 40 river miles (64 kilometers) from the Pacific Ocean.

The watershed as a whole contains a very diverse plant community structure due to the extreme range of altitudes and microclimates. Conifers are the dominant plant community in upland areas. The riparian corridor is dominated by hardwood trees, primarily willow and alder, shrubs and some scattered forbs, grasses, and grass like plants. Due to controlled flows after completion of Trinity and Lewiston dams, areas below Lewiston Dam are dominated by late-seral vegetation.

2.2.5.2 Climate

The climate within the watershed is highly variable due to the extreme elevation ranges found here. The higher elevation mountainous terrain is characterized by long cold winters (below freezing) that receive precipitation in the form of snow, while lower elevation areas have much milder winters that receive precipitation primarily in the form of rain. Summers are mild (70's) in the higher elevation areas and very hot (100's) in the lower elevation areas. The average precipitation in the watershed is approximately 58 inches (147 cm) per year. Mean daily seasonal temperatures recorded for Weaverville, at an elevation of approximately 2,500 feet (762 meters) are 38.3^o F (3.5^o C) and 50.8 ^{o} F (10.4^o C), and 68.8 ^{o} F (20.4^o C) and 54.6^o F (12.5^o C) for winter through fall, respectively.

Figure 2.2.5 Trinity River

2.2.5.3 Geologic Setting

The Trinity River watershed lies within two distinct geologic provinces. The majority of the watershed lies in the Klamath Mountains geologic province while the Coast Ranges geologic province forms the western boundary of the watershed. The oldest rocks in the watershed are in Klamath Mountains Province and are differentiated into 4 terranes: the Eastern Klamath Belt, the Central Metamorphic Belt, the Western Paleozoic and Triassic Belt, and the Western Jurassic Belt. The Trinity Thrust Fault and a linear band of ultramafic rocks, mainly peridotite, delineate the Eastern Klamath Belt from the Central Metamorphic belt. The Central Metamorphic Belt is delineated from the Western Paleozoic and Triassic Belt by the Siskiyou Thrust Fault, which trends generally north. The Western Paleozoic and Triassic Belt is delineated from the Western Jurassic Belt by the Orleans Thrust Fault, which also trends generally north. These belts consist of radiolarian chert, black shale, andesite, limestone, schist, greenschist, marble, gneiss, dark slaty mudstones, graywacke, conglomerates, meta-andesite flows and breccias, with abundant ultramafic and granitic intrusions.

The older rocks of the Western Jurassic Belt overlie the younger rocks of the Coast Range's Franciscan Complex by way of the Coast Range Thrust Fault (aka South Fork Mountain Thrust Fault), which trends generally northwest. The Franciscan Complex and can be differentiated into 2 belts of rocks: the Eastern Franciscan Belt and the Central Franciscan Belt. These belts consist of mainly blueschist, greenstone, eclogite, chert and greywacke in a highly sheared mudstone matrix, with pods of ultramafic rocks. The Grogan Mule Ridge Fault Zone crosses the watershed along the west central border. The fault's extent in this watershed is approximately 8 miles (12.9 kilometers) and is contained completely within the Central Franciscan Belt. The fault is a left lateral strike slip fault and generally trends to the northwest.

The portion of the Trinity River below Lewiston Dam is characterized as a low gradient alluvial river. Due to the loss of pre-dam flood events, the upper 40 miles (64 kilometers) between the North Fork and Lewiston Dam has lost its ability to effectively transport sediment. This has disrupted the dynamics of point bar formation and has resulted in riparian encroachment and colonization, which does not allow for dynamic streambed mobilization. Consequently, the upper Trinity has become channelized and aggraded. Due to watershed disturbances, large amounts of decomposed granite continue to enter the Trinity, forming deltas at many of the tributaries mouths. Soils in the Trinity River Watershed are generally thin and well drained on moderate to steep slopes over sedimentary, granitic, and metamorphic rocks. Most sediment that comes to the Trinity River comes from decomposed granitic soils, which are extremely erodible.

2.2.5.4 Hydrology/Water Quality

The anadromous portion of the Trinity River extends 112 RM starting at the confluence with the Klamath River at Weitchpec (RM 1) to the upstream limit of fish passage at Lewiston Dam (RM 112). The major tributaries in this reach are the South Fork Trinity River (RM 31), New River (RM 44), French Creek (RM 59), North Fork Trinity River (RM 73) and Canyon Creek (RM 79). The South Fork Trinity River is the largest sub-basin within the Trinity Watershed. Numerous smaller tributaries enter the Trinity throughout this reach.

The Trinity is dammed by Lewiston and Trinity dams, both operated by the Bureau of Reclamation (BOR). The former serves as the main water storage facility and the latter as control facility for regulating releases both in-stream and for export. Trinity Lake has a storage capacity of 2,448,000 acre-feet. Lewiston can store 14,660 acre-feet at capacity. Lewiston Dam, the lowermost, is impassable to anadromous fish migration. Trinity River Hatchery was built and is funded by the BOR as mitigation for lost anadromous fish production above the dam site. The current minimum flow requirements are the following: 15 Oct. - 08 May 300 cfs; 09 May - 14 Oct. flows are ramped up from 300 cfs to a peak of 2000 cfs (14 May) and then slowly ramped down to 450 cfs (18 July); flows are held at 450 cfs from 18 July - 14 Oct. Minimum releases during the year total 340,065 acre-feet. This flow regime currently accounts for an average of 30% of the available inflow above Trinity Dam to be allocated for in-river purposes; the remaining 70% is exported to the Central Valley Project.

A twelve year flow study conducted by the U.S. Fish and Wildlife Service culminated in a recommendation that instream flows be increased to approximately 47% of the inflow above Trinity Dam and be based on five water year types ranging from critically dry to extremely wet water year types. This recommendation was adopted by former Secretary of the Interior Bruce Babbit in a Record of Decision (ROD), January 2001. Subsequent to the signing of the ROD, several water and power users challenged the decision. A ruling was issued that prevented the implementation of the new flow regime until such time as a supplemental EIS/EIR could be completed that more fully considered issues such as economic impacts from lost water, power generation, and the effect of lost instream flow on threatened and endangered species in the Sacramento River system. Licensed, permitted or pending water rights are depicted in Figure 2.2.5.

In terms of stream temperature, the Trinity can be rated as fair. Temperatures in the upper 40 miles (64.4 kilometers) rarely exceed 70^{o} F, due to cold releases from Lewiston dam. However, lower river stream temperatures typically exceed 70 degrees during the summer months of late July through early September. The Trinity has been classified by the EPA as sediment impaired. This is partially due to the lack of unregulated flows required to mobilize and transport sediments. Other water quality parameters such as dissolved oxygen, nitrogen, phosphorous, etc. do not appear to be affecting stream health at this time.

2.2.5.5 Fish Resources

The Trinity supports several anadromous fish populations, including chinook salmon, coho salmon, and steelhead trout. The Klamath-Trinity Watershed supports the second largest run of chinook salmon in the State, second only to the Sacramento River watershed.
Coho salmon were once thought to occupy most suitable areas throughout the Trinity Watershed. Currently, naturally producing populations are scattered throughout the watershed. Recent observations of juveniles and/or adults have been recorded from the following areas: mainstem Trinity River, New River, Horse Linto Creek, Sharber/Peckem Creeks, Old Campbell Creek (tributary to the South Fork Trinity River), Deadwood Creek, Rush Creek, Canyon Creek, Grass Valley Creek, Weaver Creek, Indian Creek and several of the tributaries located within the Hoopa Valley Reservation. There are no tributary coho salmon population estimates available. However, available redd and carcass data compiled by Department for upper Trinity tributary streams indicate that coho salmon populations are not robust (>100 adult fish) in any of these tributaries. Estimates of coho salmon run-size, spawner escapement, and angler harvest have been conducted since 1977 in the Trinity Watershed. Run-size estimates (grilse and adults combined) are presented in the table below.

Table 2.2.5.5a Trinity River Coho Salmon Run-size, Escapement and Angler Harvest Estimates Upstream of Willow Creek Weir, 1977-1999.

Year	Run-size	Natural Escapement	Hatchery Escapement	Angler Harvest
1977	3,858	1,781	1,928	149
1978	9,132	5,477	3,655	0
1979	11,624	7,262	3,535	827
1980	6,094	2,771	3,323	0
1981	10,970	5,481	4,523	966
1982	11,529	6,255	4,798	476
1983	1,971	1,083	706	182
1984	19,694	9,159	8,861	1,674
1985	38,933	26,384	11,786	763
1986	27,972	19,281	7,991	700
1987	59,079	32,373	23,338	3,368
1988	38,904	24,127	12,816	1,961
1989	18,752	13,482	4,970	300
1990	3,897	1,981	1,635	47
1991	9,124	6,327	2,688	109
1992	10,339	6,733	3,582	24
1993	5,621	3,440	2,117	64
1994	852	558	294	0
1995	16,111	11,050	4,767	294
1996	36,660	26,457	9,955	248
1997	7,935	6,135	1,758	42
1998	12,480	7,489	4,991	0
1999	5,535	1,930	3,507	98
Means:	15,959	9,880	5,545	191

In an effort to identify the number of hatchery-produced versus naturally-produced coho salmon within the watershed, Department initiated a 100% marking program at Trinity River Hatchery for coho salmon beginning with the 1994 brood year. Beginning with the 1997 return year, all hatchery-produced coho salmon were marked. The data for 1997-99 indicate that Trinity coho salmon populations above Willow Creek are comprised of 87-92 % hatchery produced fish. This indicates that the naturally spawning component of escapement is composed primarily of hatchery strays.

Typically, Trinity River coho salmon rear in fresh water for 12 to 16 months, emigrate to the ocean, and return as either two year old grilse or three year old adults two to three years later. Trinity coho salmon return from the ocean from September through November, spawn during late October through January, juveniles emerge during January through March, rear in freshwater until the following spring, and begin their seaward emigration from February through July.

Factors that appear to be limiting natural coho salmon production in the watershed are high summer stream temperatures, lack of spawning habitat due to sedimentation, lack of winter rearing habitat (deep pools, instream cover, interstitial benthic areas) fragmentation of populations, and possibly genetic swamping from hatchery strains.

Fish species present in the Trinity River are listed in Table 2.2.5.5b.

Table 2.2.5.5b: Fish Species Present In The Trinity River

Common Name	**Scientific Name**
cinook Salmon	*Oncorhynchus tschawytscha*
coho salmon	*Oncorhynchus kisutch*
steelhead/rainbow trout	*Oncorhynchus mykiss*
pink salmon	*Oncorhynchus gorbuscha*
chum salmon	*Oncorhynchus keta*
Kokanee salmon	*Oncorhynchus nerka*
Pacific lamprey	*Entosphenus tridentatus*
Klamath River lamprey	*Entosphenus folleti*
brown trout	*Salmo trutta*
American shad	*Alosa sappidissima*
green sturgeon	*Acipencer medirostrus*
white sturgeon	*Acipencer transmontanus*
Klamath smallscale sucker	*Catostommus rimiculus*
speckled dace	*Rhinichthys osculus*
prickly sculpin	*Cottus asper*
threespine stickleback	*Gasterosteus aculeatus*

In addition to the species above, non-native fish have been introduced into the Trinity and Lewiston Reservoirs, such as crappie, bullhead, golden shiner, largemouth and smallmouth bass, green sunfish, and fathead minnow are occasionally observed in the Trinity River. None of these species are known to have self-sustaining riverine populations.

2.2.5.6 Fish Facilities

Trinity River Hatchery, located in Lewiston at the base of Lewiston Dam, was constructed concurrently with the construction of Trinity and Lewiston Dams to mitigate for lost anadromous fish production above the dam sites. The hatchery currently spawns and rears spring and fall chinook salmon, coho salmon, and steelhead trout. The hatchery initially reared brown trout as well, but this program was discontinued due to the lack of returns and the perception that the brown trout in the Trinity River were primarily a resident rather than anadromous. Table 2.2.5.6 summaries the production goals for this facility. Locations of fish rearing facilities are depicted in Figure 2.2.5.

Table 2.2.5.6 Trinity River Hatchery Annual Production Goals

	Release type	
Species	**Fingerling**	**Yearling**
spring chinook salmon	1,000,000	400,000
fall chinook salmon	2,000,000	900,000
coho salmon	0	500,000
steelhead trout	0	800,000

2.2.5.7 Recreational/Commercial Fishing Interests

The Trinity River supports a thriving recreational fishing industry. Analysis of steelhead trout report card information for 1993 through 1995 showed that an average of 65,694 angler-days were spent fishing for steelhead trout in the Smith and Klamath-Trinity River systems during these years. An estimated 3,638 anglers fished for salmon in the upper Trinity River (Cedar Flat to Lewiston) in 1999. The ocean recreational and lower Klamath recreational fisheries also rely, in part, on salmon produced in the Trinity.

Trinity salmon were once a major part of the ocean commercial salmon fishery based out of the north coast ports of Eureka and Crescent City. However, due to the decline in chinook salmon numbers, the ocean commercial salmon fishery has been severely curtailed.

Tribal gill-net fishing is conducted on both the Hoopa and Yurok reservations. The tribal allowable catch of fall chinook salmon is currently 50% of the total allowable catch for the entire Klamath-Trinity Watershed. Annual quotas are structured for each season and vary according to estimated run strength. Tribal fisheries are primarily subsistence, however, limited commercial fisheries are conducted in some years, particularly within the Yurok Reservation.

2.2.5.8 Land-Use/Planning

Most of the Trinity watershed is in public ownership (69% of land is managed as public multiple use lands, 7% as protected lands). Only 24% of the watershed is in private ownership.

Historically, gold mining was an important economic activity in the region, and today the watershed supports limited suction dredge mining. A few in-stream mining permits are located on the Trinty River (Figure 2.2.5). Commercial timber harvest supports the largest industry within the watershed.

The Hoopa and Yurok Tribes have reservations located all or in-part within the Trinity Watershed. Both of these tribes subsisted historically on anadromous fish and continue to do so. Much of their culture and tradition is derived from natural resources found within the watershed.

The Trinity supports many recreational uses including fishing, white-water rafting, swimming, sightseeing, birding, and camping. Many of the smaller communities located along the river cater to and depend on these activities. The South Fork Trinity, North Fork Trinity and New River include 83 miles (134 kilometers) of wild and scenic designations.

The Hoopa Valley Tribal reservation encompasses the lower 12 miles (19 kilometers) of the Trinity River and has a population of approximately 4,000. Upstream of the reservation, there are two towns, Willow Creek and Weaverville, with populations of approximately 1,000 and 3,500, respectively. Several smaller communities such as Salyer, Hawkins Bar, Del Loma, Junction City, Douglas City, and Lewiston are scattered along the river course. However the populations of these communities are generally fewer than 500 people.

The Trinity is paralleled by two major roads, Highway 299 which is the east-west artery linking the coastal communities with Redding, and Highway 96 which connects Highway 299 to the downstream community of Hoopa. Highway 299 parallels the Trinity for approximately 50 miles (80 kilometers).

2.3 Mad River and Redwood Creek Watersheds

The four major hydrologic units that occur within this area are Redwood Creek Watershed, Trinidad Watershed, Mad River Watershed, and Eureka Plain Watershed (Figure 2.3). The climate of these watersheds varies dependent upon location within the watershed and time of year. Coastal areas have a moderate climate due to proximity to the ocean, and differ from upland areas that experience more variable high and low temperatures. Summers are typically cool and moist on the coast, and hot and dry inland. In Eureka, the mean monthly temperature varies by only 10^{o} F (-12.2^{o} C) through the year, with the low mean in January (47^{o} F) and high in August (57^{o} F) (Barnhart et al., 1992).

About 75% of the annual precipitation falls between November and March, and can vary from 40 inches (100 cm) along the coast, to 80 inches (200 cm) near the eastern central portion of the area. Winter temperatures can go below freezing, and snow is common at elevations above 1,200 meters (4,000 ft). Average annual snowfall is 11.8 - 78.7 inches (0.3 to 2 m), and may remain on the higher mountain peaks through mid-June. Most of the runoff occurs rapidly during and shortly after storms due to steep slopes and impermeable soils of the watershed. The average annual runoff during water years 1963 – 1998 is estimated to be 1,000,000 acre-feet. A U.S. Geological Service (USGS) gauging station is located on the lower Mad River at US Highway 299 bridge, near Arcata, California. The period of record for the gauging station is 1910 to 1913, and 1950 to the present. Average flows in the Mad River range from < 300 cubic feet per second (cfs) to flood stages of 40,000 - 81,000 cfs. Monthly mean discharge over water years 1963 - 1998 was 1,381 cfs, and ranged from 44.9 cfs (August) to 3,646 cfs (January).

These watersheds lie completely within the Coast Ranges geologic province. The Coast Ranges province is mainly composed of the Franciscan Complex. The Franciscan Complex is Jurassic in age and can be differentiated into two belts of rocks: the Eastern Franciscan Belt and the Central Franciscan Belt. These highly unstable and easily eroded rock units consist of isolated blocks of exotic serpentine, greenstone, blueschist, eclogite, chert, ultramafic rocks and greywacke in a highly sheared mudstone matrix.

The Grogan Mule Ridge Fault Zone is a prominent feature of these watersheds. The Grogan Mule Ridge Fault Zone runs down the center of the entire length of the Redwood Creek Watershed, approximately 50 miles (80 kilometers), and bisects the watershed separating schist (west) from coherent sandstone and incoherent sandstone-mudstone units (east). The Mad River drainage basin is elongate in a northwesterly direction, consistent with the Grogan Fault.

Figure 2.3 Mad River and Redwood Creek Watersheds

The geomorphic province consists of complex folding, faulting, tectonic uplift, volcanism, alluvial valleys, and a broad deltaic floodplain at the terminus of the rivers. These rivers and creeks experience naturally high sediment yields because of tectonic activity, relatively weak geologic materials, steep slopes, and high precipitation rates. Landslides (natural and human induced) contribute a large amount of sediment to the streams, and most of the sediments are moved during high flow events during infrequent, large storms. These conditions, combined with land use activities such as timber harvest, road construction and grazing, give the region one of the highest erosion rates in the United States. For example, the Mad River may take weeks to clear after major storm events. Large amounts of gravel aggregation in the lower river have supported gravel extraction for numerous years. Most of the gravel extraction occurs downstream of the town of Blue Lake.

2.3.1 REDWOOD CREEK

2.3.1.1 Overview

Redwood Creek watershed is a narrow, elongated fault-controlled basin that drains an area of approximately 282 square miles (180,594 acres or 730 square kilometers). The creek flows for 65 miles (105 kilometers) from its headwaters to the Pacific Ocean with widths ranging from 4 to 7 miles (6-11 kilometers), and a maximum relief of 5,300 feet (1,615 meters). The primary vegetation types within the Redwood Creek watershed include coniferous forest (92%), oak woodland (9%), and prairie (9%). Distribution depends on available soil moisture during the summer months and is influenced by proximity to the coast, soil types, land disturbance, and the occurrence of fire. The coast redwood is the dominant tree, and is generally found in association with other tree species, principally Douglas-fir, Sitka spruce, big leaf maple, tanoak and red alder. Nine species of ferns decorate the redwood forest along with several flowering species such as salal, oxalis, western azalea, rhododendron, trillium, huckleberry, salmonberry, blackberry, and numerous other herbs.

2.3.1.2 Hydrology/Water Quality

The physical and biological functions of the Redwood Creek estuary and adjacent wetlands have been impaired with construction of a flood control project by the U.S. Army Corps of Engineers in 1968. The levees and channelization drastically altered the aquatic resources of the lower 3.4 miles (5.5 kilometers) of Redwood Creek and estuary by confining the river channel, removing streamside riparian vegetation and tree cover, reducing adjacent wetlands, altering valley drainage patterns, decreasing instream woody debris structures, and reducing pool depths along the lower creek. Approximately 50% of the lower estuary has filled with ocean-derived sediment reducing circulation between the sloughs and embayment and resulting in degraded water quality conditions. These degraded estuary conditions act as a bottleneck to salmon and trout juvenile production, subsequent ocean survival, and eventual return as spawning adults.

There are two seasonal dams proposed for installation this summer. Summer dam sites are located upstream of the park. Potential effects to water temperature or other related impacts associated with these impoundments are not well documented and should be monitored further. Licensed, permitted or pending water rights are depicted in Figure 2.3.

2.3.1.3 Fish Resources

Redwood Creek supports runs of anadromous adult salmonids including chinook salmon, coho salmon, and steelhead and cutthroat. Except for cutthroat trout, all anadromous salmonids in Redwood Creek are federally protected.

2.3.1.4 Fish Facilities

In 1928, the Prairie Creek Experimental Station was built as a temporary hatchery and egg-taking station. The Department used the facility to propagate chinook and coho salmon, steelhead trout, and cutthroat trout to contribute to diminishing stocks and to sustain the recreational fishery for the community of Orick. The State conveyed the hatchery property to Humboldt County in 1961, making it the only county-owned and operated hatchery in the country at that time. Operations were sustained with Department financial support until 1990. In 1992, the facility was closed in response to water quality concerns, lack of funding, and natural genetic stock protection issues. The federal government acquired ownership of the hatchery, which has now been designated as an historical site protecting the character and physical nature of the site in perpetuity. Efforts are underway to convert the facility into the Redwood Creek National Watershed Center to provide watershed-related education, field programs and unique recreation opportunities for ecotourists. Locations of fish rearing facilities are depicted in Figure 2.3.

2.3.1.5 Recreational/Commercial Fishing Interests

Portions of Redwood Creek support trout and steelhead trout recreational fishing.

2.3.1.6 Land-Use/Planning

Public lands (79,452 acres) comprise 44% or the ownership within the watershed, mostly managed by Redwood National and State Parks (73,316 acres). The remaining public lands (6,136 acres) are within Bureau of Land Management and U.S. Forest Service ownership. Private lands comprise 55% of the land ownership (101,142 acres), primarily upstream of the park boundaries with eight large ownerships (90%, each is >3000 acres) and numerous small ownerships (10%, each <3000 acres). Private lands downstream of the park within the estuary area represent the remaining 1%. One valid in-stream mining permit is located on Redwood Creek (Figure 2.3).

Redwood National Park was established to protect and restore all significant examples of old-growth coastal redwood forests, and have included anadromous fish as a keystone species. In 1978, Public Law 95-250 added 48,000 acres to Redwood National Park and authorized Congress to appropriate up to $33 million to implement a watershed rehabilitation program. Restoration efforts concentrate on preventing human-induced erosion and encouraging the return of natural vegetation patterns in the watershed. Redwood Creek has been the focus of significant ongoing scientific research in cooperation with USGS, Humboldt State University, Redwood Sciences Laboratory and other partners. Fourteen percent of the watershed remains as uncut redwood forests (24,315 acres), all protected within parks' boundary. Little Lost Man Creek is the least impacted tributary watershed where approximately 2,109 acres of old growth remains (89% of watershed).

Redwood National and State Parks are jointly recognized as a World Heritage Site and one of the 337 International Biosphere Reserves designated by the United Nations Educational, Scientific and Cultural Organization (UNESCO) to maximize protection of resources cherished by citizens of many nations.

Two major highways bisect Redwood Creek. Highway 299 crosses the upper watershed area and connects the coastal communities with Redding to the east. In Orick, near the estuary, Highway 101 is the primary north/south artery along the coastal corridor extending to Crescent City and Oregon.

2.3.2 MAD RIVER

2.3.2.1 Overview

The Mad River flows through Trinity and Humboldt Counties 100 miles (161 kilometers) to the Pacific Ocean, and drains a watershed area of 497 mi^2. The Mad River has numerous tributaries, some of which are located upstream of Ruth Reservoir: South Fork Mad River, North Fork Mad River, and Barry Creek. Downstream of Ruth Reservoir, the following tributaries drain into the Mad River: Pilot Creek, Deer Creek, Bug Creek, Graham Creek, Blue Slide Creek, Boulder Creek, Maple Creek, Black Creek, Devil Creek, Simpson Creek, Canon Creek, North Fork Mad River, Lindsay Creek, Mill Creek, and Strawberry Creek, among others.

Headwaters of the Mad River originate at an elevation of 6,070 feet (1,850 meters) and converge to form the main channel headwaters at an elevation of 2,900 feet (884 meters). The Mad River watershed has a variety of vegetation types, often associated with location within the watershed. For example, upland regions are predominately prairie/Douglas-fir/oak grassland and lower elevation areas near the coast are dominated by redwood/Douglas-fir.

2.3.2.2 Hydrology/Water Quality

Two dams were built on the Mad River: Sweasey and Ruth (Robert W. Matthews). Sweasey Dam was built in 1938 about 17 river-miles (27 kilometers) upstream of the mouth of the Mad River to provide a domestic water supply to the town of Eureka. Although the dam structure was 45 feet (13.7 meters) high, a fish ladder was installed and used by anadromous salmonid adults. Juvenile salmonids migrating downstream to the ocean used the spillway at certain times of the year. High sediment load accumulation caused the dam to fill in by 1960, and in 1970, the dam was removed. In 1995, it was estimated that it will take 35 - 40 years for the channel to recover downstream of the dam.

Ruth Dam (Robert W. Matthews) was built in 1961 about 80 miles (129 kilometers) upstream of the mouth of the Mad River in Trinity County to provide water for industrial use (e.g. pulp mills), domestic use, and hydroelectric power. The Humboldt Bay Municipal Water District (HBMWD) operates Ruth Dam. The reservoir lies at 2,675 feet (815 meters) above sea level. It is a barrier to adult salmonids, and has a considerable influence on streamflow for 80 miles (129 kilometers) below the dam. The earthen dam structure is 150 ft (46 m) tall, 30 ft (9 m) wide, and has a crest length of 630 ft (192 m). The surface area of Ruth Reservoir is 1,180 acres, has a drainage area of 120 square miles (310.8 sq km) and the historical active storage capacity is 51,800 acre-feet (64 million cubic meters) of water at full pool. The monthly storage from July 1999 through May 2001 ranged from 23,029 to 51,685 acre-feet. The water level fluctuates about 32 feet (10 meters) annually and is usually at its lowest point in the fall. Ruth Reservoir is regularly stocked with catchable rainbow trout and it also supports a modest fishery for both largemouth and smallmouth bass.

HBMWD also operates five Ranney collector wells in the lower portion of the Mad River (e.g. Essex, near Arcata) that have a design capacity of drawing 75 million gallons per day (mgd) to supply drinking water to Eureka, McKinnleyville, Blue Lake, Freshwater, Arcata, and other smaller surrounding communities. Licensed, permitted or pending water rights and dam locations are depicted in Figure 2.3.

2.3.2.3 Fish Resources

The Mad River supports runs of anadromous salmonids including chinook salmon, coho salmon, and steelhead and cutthroat trout. Except for cutthroat trout, all anadromous salmonids in the Mad River are federally protected.

Adult chinook salmon generally enter the Mad River from September – January, with peak numbers probably occurring in the months of November and December. During low flow periods in October, chinook salmon can be seen jumping and splashing in lower river sections. The presence and status of spring run chinook salmon in the Mad River is anecdotal, and largely unknown. Coho salmon generally enter the Mad during November, December, and probably January. Important tributaries to the Mad River that support annual runs of coho salmon include Lindsay Creek and Canon Creek. It is currently unknown how many tributaries in the Mad River watershed support coho salmon sub-populations. Steelhead trout are probably the most numerous anadromous salmonid present in the Mad River. Steelhead trout are known to enter the Mad River all year round. The largest population is the winter-run steelhead trout, which enter the Mad River from November through February. The Mad River is home to at least 13 species of native fish (see table below).

Table 2.3.2.3. Native Fish Species Known To Occur In The Mad River.

Common Name	**Scientific Name**
chinook salmon	*Oncorhynchus tshawytscha*
Coast Range sculpin	*Cottus aleuticus*
coho salmon	*Oncorhynchus kisutch*
cutthroat trout	*Oncorhynchus clarkii*
Klamath smallscale sucker	*Catostomus rimiculus*
longfin smelt	*Spirinchus thaleichthys*
prickly sculpin	*Cottus asper*
Pacific lamprey	*Lampetra tridentata*
Pacific staghorn sculpin	*Leptocottus armatus*
steelhead/rainbow trout	*Oncorhynchus mykiss*
speckled dace	*Rhinichthys osculus*
starry flounder	*Platichthys stellatus*
threespine stickleback	*Gasterosteus aculeatus*

2.3.2.4 Fish Facilities

Mad River Fish Hatchery is located about 10 river miles (16 kilometers) upstream of the confluence of the Mad River with the Pacific Ocean, near the town of Blue Lake, Humboldt County, California. Hatchery operation began in 1971 to maintain and enhance chinook salmon, coho salmon, and steelhead trout populations in the Mad River. Currently, the Mad River Hatchery raises winter-run steelhead trout to enhance the sport fishery, and no longer raises Mad River chinook salmon. A limited number of coho salmon were raised and released into the Mad

River during 2000, but the hatchery no longer operates a coho salmon program due to insufficient coho salmon returns.

Mad River Hatchery also raises rainbow trout for local put and take fisheries (e.g. Freshwater Lagoon). The hatchery primarily spawns returning hatchery winter-run steelhead trout, mixed with a small number of wild steelhead trout (e.g. 3%). The number of 1-year-old juvenile steelhead trout released annually at the hatchery from 1990-2000 ranged from 134,000 – 1,440,460 fish. About 368,000 adipose fin clipped yearlings were released from the hatchery site in 2000, and about 220,000 in 2001. All hatchery juvenile steelhead trout are given an adipose fin clip usually in January – February, and released into the Mad River during late March – April. The adipose fin clip enables anglers and Department personnel to later identify and differentiate hatchery and naturally-produced winter-run adult steelhead trout. Locations of fish rearing facilities are depicted in Figure 2.3.

2.3.2.5 Recreational/Commercial Fishing Interests

Winter-run steelhead trout in the Mad River support a very important fishery in Humboldt County. As shown by a Department creel report from November 1999 through March 2000, anglers in the Mad River expended 62,837 hours, and caught an estimated 7,288 steelhead trout. Eighty four percent (84%) of the winter-run steelhead trout catches were estimated to be hatchery fish, which indicates the importance of the Mad River hatchery production of winter-run steelhead trout to the sport fishery. The Mad River may be the best river in California for the average steelhead trout angler to catch steelhead trout, as indicated by a catch per unit effort of 0.116 for the 1999/2000 season. Specific fishing restrictions limit species captured, seasonal time, areas fished, method of catch, and daily bag limit within the Mad River Watershed. Currently, only hatchery marked adult steelhead trout can be harvested. The daily bag limit is 2 hatchery fish, with no annual limit. Steelhead trout anglers are required to fill out steelhead trout report cards on a daily basis. The fishing season in the Mad River begins on the fourth Saturday in May and extends through March 31st. April and most of May are closed to fishing to protect downstream migrating juvenile salmonids (e.g., smolts). From May 23rd through October 31st, only artificial lures with barbless hooks can be used, and from November 1st through March 31st, bait or artificial lures with barbless hooks are allowed. In addition, the Mad River upstream of the Hammond Trail Railroad Trestle is subject to low flow closures from October 1st through January 31st when flow at the gauging station at US Highway. 299 is less than 200 cfs.

2.3.2.6 Land-Use/Planning

The Bureau of Land Management and the U.S. Forest Service manage 39% of the watershed, which is mostly contained in the southern portion. Private land ownership comprises 61% of the watershed, and two timber companies own nearly half of the private land. A few in-stream mining permits are located on the Mad River, as it approaches the coastal plain (Figure 2.3).

2.3.3 EUREKA PLAIN (HUMBOLDT BAY) WATERSHED

2.3.3.1 Overview

Humboldt Bay is the largest estuary between San Francisco and Coos Bay, Oregon. The watershed is 223 square miles (578 square kilometers) in area (Barnhart et al., 1992). The Bay, which is classified as a multi-watershed coastal lagoon, is separated from the ocean by long narrow sand spits with a centrally channelized mouth to the Pacific Ocean. The Bay is fourteen miles (22.5 kilometers) long and from one-half to four miles (0.8-6.4 kilometers) wide and has high and low tidal areas of twenty-four (62 square kilometers) and eight square miles (20.7 square kilometers), respectively. Geographically, the Bay is split into three bodies: South Bay, Entrance Bay and the North Bay. Known for its unpolluted water and diverse biotic community, this coastal estuary contains abundant populations of both juvenile and adult populations of several economically important fish and shellfish.

All of the main streams of the Eureka Plain Watershed that flow into Humboldt Bay support wild populations of salmon, steelhead trout, and cutthroat trout. The four major tributaries (and watershed areas) are Jacoby Creek (17.3 sq. mi.), Freshwater Creek (30.9 sq. mi.), Elk River (28.6 sq. mi.), and Salmon Creek (16.8 sq. mi.). Jacoby and Freshwater Creeks drain into Arcata Bay to the north, Elk River into Entrance Bay near Eureka, and Salmon Creek into South Bay. The combined drainage areas of the Bay's smaller tributaries drain a total of approximately 35 square miles (90 square kilometers). These smaller streams flow primarily into the North Bay including Rocky and Washington Gulches, and Beith, Grotzman, Campbell, Jolly Giant and Janes Creeks.

At least two-thirds of the total watershed is steep and heavily forested, and is primarily owned by commercial timber companies. The headwaters of the Bay's tributaries originate in these forest-covered hills and descend to meet with the outer edge of an extensive alluvial plain that rims the Bay. This plain consists of both tidal marshes and stream floodplain surrounding the Bay's edge. Elevation of the ridges forming the boundary of the watershed to the east is generally around 1,500 feet (457 meters). The highest point in the watershed, in upper Freshwater Creek, is about 2,300 feet (701 meters) in elevation.

2.3.3.2 Hydrology/Water Quality

Stream flows in the Humboldt Bay Watershed typically increase in the fall, peak in the winter and reach their lowest points during the summer. Streamflow was measured by the USGS at two locations within the watershed, Jacoby Creek and Elk River. These gauging stations have been discontinued and only local efforts are currently underway. Records indicate that the mean annual maximum flow for Jacoby Creek was approximated at 737 cfs, with a range of peaks between 380 cfs and 2,510 cfs (Hedlund, 1978).

Streamflow is highest from November through March. The largest floods in the watershed tend to occur during December and January. In the summer and fall, flow varies little and is relatively low. The size and timing of floods also varies considerably from year to year. While the size or number of floods in any given year is not directly related to total rainfall for the year, the periodicity of floods for any specific sub-basin over the period of record appears closely related to the cyclic nature of total rainfall. However, the magnitude of a particular flood is not necessarily correlated with total annual rainfall, but is more closely tied to the intensity of individual storms. For example, in 1955 an unusually large flood occurred in Jacoby Creek, though total annual rainfall was average. Licensed, permitted or pending water rights are depicted in Figure 2.3.

2.3.3.3 Fish Resources

There are five species of anadromous salmonids found in the Humboldt Bay watershed: coho salmon, chinook salmon, chum salmon, steelhead trout, and coastal cutthroat trout. Steelhead trout and cutthroat trout are found in all streams capable of supporting salmonids. Chinook salmon are generally found only in the four largest streams (Jacoby, Freshwater, and Salmon

Creeks, and Elk River); and coho salmon, while widespread, are most abundant in the low-gradient, complex streams (Freshwater Creek, Ryan Slough, Jacoby Creek, and Elk River). Occasionally, chum salmon are observed, but it is unknown if successful spawning has occurred, or if these fish are a remnant of former runs, or if they are strays from river systems farther north.

Salmon and steelhead trout populations are impacted by changes in stream habitat. In the Humboldt Bay Watershed, increased sediment and turbidity levels are the most often cited factors known to be affecting salmonid spawning and rearing habitat. Other fish present in the watershed include tidewater goby, Pacific lamprey, brook lamprey, threespine stickleback and prickly and coast range sculpin.

2.3.3.4 Fish Facilities

Salmon and steelhead trout were occasionally planted in Humboldt Bay tributaries, including Freshwater Creek, from 1900 to 1950. These fish usually came from hatcheries in the Eel River watershed. Some non-native stocks of coho salmon were also imported in the early periods of Humboldt Fish Action Council (HFAC) enhancement efforts. Oregon and Washington hatcheries as well as the Noyo River, Klamath River and Trinity River hatcheries in California supplied eggs for the project (Brown et al., 1994). More recently, the HFAC egg taking station has collected eggs from chinook salmon and coho salmon captured at their Freshwater Creek weir and transferred them to Mad River Hatchery where they were hatched and reared through the fry stage. Fry have been returned to the Freshwater drainage, where they were reared to yearling size in ponds, then released.

The City of Arcata and Humboldt State University, in conjunction with the Arcata Marsh and Wildlife Sanctuary project, have conducted a salmon rearing pilot project to rear coho salmon, chinook salmon, and steelhead trout smolts in salt water ponds fertilized with domestic wastewater. Returning adults have been monitored in traps on Jolly Giant Creek since the 1970's.

Freshwater Creek has a history of stock introductions as part of state and local hatchery operations. Despite salmon and steelhead trout being imported, it is unlikely that fitness of local populations has been compromised (Higgins 2000). Recent hatchery supplementation by HFAC increases adult salmon returns and may be masking declines of naturally spawning populations.

Plants of coho salmon by HFAC in Freshwater Creek ceased in 1995 but chinook salmon supplementation has continued. The HFAC hatchery program for Freshwater Creek may be inflating adult chinook salmon and coho salmon adult returns in some years since 1978. Hull et al. (1989) as cited in Brown et al. (1994) estimated that although 854 adult coho salmon spawned in Freshwater Creek in 1988-89, 68% of those were of hatchery origin. Coho salmon have a three-year life history and adult returns could have been affected through 1998. Chinook salmon may spawn from two to five years old. Therefore, adult returns will reflect recent planting through 2004-05. The returning hatchery fish make it more difficult to discern coho salmon and chinook salmon declines as a result of changing habitat conditions in the Freshwater Creek watershed. Locations of fish rearing facilities are depicted in Figure 2.3.

2.3.3.5 Recreational/Commercial Fishing Interests

As one of California's largest estuaries, Humboldt Bay provides critical habitat to over 100 different fish species and other wildlife. The Bay serves as a nursery for juvenile and adult populations of several commercially significant species of fish and shellfish. In 1995, Humboldt Bay's fishing port was ranked 43 among the top 60 nationwide (RCAA 1997). There are five major fisheries out of Humboldt Bay: groundfish, salmon, shrimp, crab and albacore. Presently, the ground fishery is the largest fishery out of the bay, providing fish year-round to local processors and consumers. However, consistent with statewide trends, the reported license sales for all commercial vessels, anglers and party boats continue to decline in Humboldt Bay.

Aquaculture in the Humboldt Bay watershed currently consists of oyster culture (oyster, mussels, and clams), and some small salmon propagation facilities. With over 70% of California's oyster production coming from Humboldt Bay, oyster harvesting is the largest commercial fishery in the Bay.

With declining populations of chinook salmon and coho salmon, and steelhead trout, federal Endangered Species Act restrictions limit recreational river sport fishing within Humboldt Bay's tributaries. Downstream anadromous portions of Elk River and Freshwater Creek are currently managed as a catch and release fishery for salmon and steelhead trout.

2.3.3.6 Land-Use/Planning

The Wiyot people inhabited the Humboldt Bay watershed when Europeans first arrived in the mid 1800's. Wiyot villages were located around the Bay and nearby streams to take advantage of abundant salmon harvests and other bay resources including crabs, shellfish, smelt, sardines, eel, and sturgeon from the Mad River (Loud 1918; Benson et al. 1977).

Over the past hundred years, stream environments and aquatic habitat conditions within the Humboldt Bay watershed have been significantly altered by land use activities including timber harvest, residential development, and agricultural activities. Today, the major urban areas contiguous with the Humboldt Bay watershed are Eureka, the county seat, and Arcata, along with five smaller rural communities with a total population of about 77,000. Scattered farms and residential homes are found upstream of the Bay.

Agriculture and forestry are the dominant land uses with almost all of the upper portion of the watershed owned by commercial timber companies. Agricultural use dominates the lower, flatter reaches of all streams surrounding the Bay. Residential use mixes in the middle reaches of these drainages and is more developed in Jacoby and Freshwater Creeks than in Elk River or Salmon Creek. Public ownership is sparse and scattered throughout the watershed, including the City of Arcata's demonstration forest in Jacoby Creek, Humboldt County's small recreational park in Freshwater Creek, the Humboldt Bay National Wildlife Refuge in portions of the South and North Bay managed by the U.S. Fish & Wildlife Service, and the Headwaters Forest Reserve in upper Elk River and Salmon Creek owned by the BLM.

Presently, a salmon and steelhead trout conservation plan is being developed for the Humboldt Bay watershed by the Humboldt Bay Watershed Advisory Committee (HBWAC). Since 1997, the HBWAC has worked to plan and guide cooperative salmon conservation efforts between local stakeholders while also considering regional ecological and socio-economic needs. Final plan completion is targeted for 2001/2002.

2.4 Eel River Watershed

The Eel River is the third largest river system in California, encompassing approximately 3,684 square miles (sq. mi.) (9,542 square kilometers) within Humboldt, Mendocino, Trinity, Lake, and a small portion of Colusa and Glen Counties (Figure 2.4). There are approximately 3,488

Figure 2.4 Eel River Watershed

miles (5,613 kilometers) of streams within the Eel River watershed that contribute to a mean annual discharge of approximately six million acre-feet (Steiner 1998; Downie et al. 1995; Trush 1992). Major sub-basins of the Eel River system include the mainstem (1477 sq. mi.), North Fork (283 sq. mi.), Middle Fork (753 sq. mi.), South Fork (690 sq. mi.), Van Duzen (428 sq. mi.), and the estuary and delta (50 sq. mi). Other major tributaries include the Black Butte River, Kekawaka Creek, Outlet Creek, Tomki Creek, Dobbyns Creek, and Larabee Creek.

2.4.1 EEL RIVER

2.4.1.1 Overview

The principal features of the Eel River watershed are the rugged northwest-southeast trending ridges and canyons. The highest headwater peaks in the watershed are at elevations of 7,581 feet (2,310 meters) on Soloman Peak in Trinity County, 7,056 feet (2,150 meters) on Snow Mountain in Lake County, and 6,739 feet (2,054 meters) on Bald Mountain in Mendocino County. Three relatively flat valleys (Laytonville, Willits, and Round Valley) are located in the mountainous part of the watershed (Downie et al. 1995). Lake Pillsbury is located on the mainstem, approximately 150 miles (241 kilometers) from the mouth and is 1,818 feet (554 meters) above sea level. Nearly flat alluvial valleys and tidal plains characterize the coastal area. Waters from the Eel River flow through its estuary to the Pacific Ocean approximately 14 miles (22.5 kilometers) south of the city of Eureka in Humboldt County.

2.4.1.2 Climate

The Mediterranean climate of the inland Eel River watershed produces cool, wet winters with high runoff and hot, dry summers with greatly reduced flows. Annual inland air temperatures range from approximately –18 ^{o}C to 43^{o}C. The Coastal region air temperatures range from -1^{o}C to 30 ^{o}C and average approximately 11^{o}C. Annual rainfall varies greatly within the watershed. Watershed-averaged annual rainfall is approximately 60 inches (152 cm), however headwaters of Bull Creek average 115 inches (292 cm) of rain per year and the Eel River delta near Ferndale averages 35 inches (88.9 cm) per year (Steiner 1998; Trush 1992). Average annual rainfall for the Lower Eel River is 59 inches (150 cm), 52 inches (132 cm) for the Upper Eel, 57 inches (145 cm) for the Middle Fork, and 71 inches (180 cm) for the South Fork. Snow sometimes occurs above 2,000 feet (610 meters) and the snow pack above 5,000 feet (1,524 meters) may persist into early summer.

2.4.1.3 Geologic Setting

The Eel River watershed lies completely within the Coast Range geologic province. The lithology of the Eel River watershed is dominated by the Franciscan formation, a complex assemblage of sedimentary sandstones, shales, and conglomerates interspersed with mafic marine volcanic material (Steiner 1998). The greywacke, greenstone, and sandstone rock of the Franciscan formation have been shattered and sheared by subduction, right lateral and thrust faulting, and regional uplift by the convergence of three crustal plates known as the Mendocino Triple Junction, fostering an abundance of landslides (Trush 1992).

2.4.1.4 Hydrology/Water Quality

High seasonal rainfall on semi-impermeable lithology and steep slopes contribute to the very flashy nature of the Eel River flow regime. In addition, the runoff rate has been increased by road systems and other land uses. High seasonal rainfall combined with a rapid runoff rate on unstable soils delivers large amounts of sediments to the river. As a result, the Eel River may transport more sediments than any other river of its size in the world. These sediments are deposited throughout the lower gradient reaches of the system.

Discharges between November and April comprise approximately 93 percent of the annual streamflow (Steiner 1998). During an episodic event in December of 1964, a peak flow of 752,000 cubic feet per second (cfs) was measured at the U.S. Geological Survey (USGS) stream gauge at Scotia (RM 20.5). A recent daily low flow of 54 cfs was recorded at the Scotia gauge in September 1994. Steiner (1998) reported mean monthly discharges at Scotia ranging from 145 cfs in September to 19,560 cfs in February for water years 1911 through 1993.

Mainstem Eel River flows have been regulated and managed for hydroelectric power and exported for agriculture since 1922. There are two dams associated with the Potter Valley Hydroelectric Project located on the upper mainstem Eel River. Scott Dam forms Lake Pillsbury, a 94,000 acre-feet storage reservoir. Twelve miles (19.3 kilometers) downstream, Cape Horn Dam forms the 700 acre-feet Van Arsdale diversion reservoir (Steiner 1998). A 5,835-feet diversion tunnel draws water from Van Arsdale reservoir through a mountain and delivers the water to the Potter Valley Powerhouse. Typically, the powerhouse produces 9.2 megawatts at a flow of 325 cfs (Steiner 1998). Some of the diverted water is used in Potter Valley. The remainder is stored in Lake Mendocino and released to the Russian River where it is used for frost protection and irrigation of crops and other purposes.

State and federal agencies, Pacific Gas and Electric Company, local Native American tribes, and interested parties are developing a water management strategy aimed at mimicking natural flow patterns of the upper Eel River. There has been a substantial voluntary interim increase in water releases from Scott and Cape Horn dams during the fall and spring seasons. The fall releases are needed for adult chinook salmon to gain access to the upper Eel River watershed during spawning migrations. Spring release flows are intended to mimic natural flow patterns which salmon and steelhead trout smolts use as a cue to initiate downstream migrations to the sea. Summer minimum bypass flows are currently set at five cfs.

The construction and closing of Scott Dam in 1921 had two significant adverse impacts on Eel River salmonid habitat. First, it blocked access to approximately 75 miles (121 kilometers) of spawning habitat in the Upper Eel and its tributaries. The reduction of habitat resulted in an estimated loss of 3,000 steelhead trout and 2,500 chinook salmon (Steiner 1998). In addition, regulated flow releases from Lake Pillsbury changed the temperature regime between Scott and Cape Horn dams. Water temperatures became cooler in summer and warmer in winter. The change in water temperature enhances summer rearing for steelhead trout, but can delay juvenile chinook salmon downstream, seaward migrations. The delay may result in juvenile chinook salmon encountering marginal or lethal water temperatures as they migrate through downstream reaches of the Eel River towards the ocean. Over half the mainstem and tributary channels can be considered thermally lethal during some portion of the summer (Kubicek 1977), however prior to cumulative human impacts, large populations of anadromous salmonids flourished in the Eel River.

There are two additional small hydroelectric facilities on the mainstem Eel River. One is located on Mud Creek (Dobbyns Creek tributary) and another on Kekawaka Creek (Department 1997).

Two other reservoirs, Centennial and Morris, are located on Davis Creek, a tributary to Outlet Creek. These reservoirs provide water supply to the city of Willits. Lake Emily and Lake

Adarose are located on Willits Creek, also a tributary to Outlet Creek. These reservoirs provide a water supply to the community of Brooktrails. Benbow Lake is located on the South Fork Eel and is a seasonal impoundment closed only during the summer months. It is currently under review by National Marine Fisheries Service (NMFS) for impact to salmonids.

There are approximately 260 licensed, permitted, or pending water rights within the Eel River watershed (depicted in Figure 2.4). This number does not include riparian users and other diversions that are not registered with the State Division of Water Rights (State Water Resources Control Board 2001).

2.4.1.5 Fish Resources

The three principal anadromous salmonid species in the Eel River watershed are fall-run chinook salmon, coho salmon, and steelhead trout. The steelhead trout population includes three races, fall, winter, and spring/summer. Other anadromous native fish of the Eel River include coastal cutthroat trout, green sturgeon, and Pacific lamprey.

The Eel River likely supports the largest remaining native coho salmon population in California (Department 1997). The South Fork Eel River has a significant, although remnant, population of coho salmon. Presently, an estimated 500 to 1,000 coho salmon adults spawn in the South Fork Eel River subbasin. Moyle and Morford (1991) estimated 1,000 coho salmon spawners in the South Fork Eel River system. The last count made at Benbow Dam Fishway, in 1975, consisted of only 509 coho salmon. These fish are what remain of peak coho salmon runs of approximately 25,000 adult coho salmon counted in 1946-47 at Benbow Dam. Coho salmon adult run-size estimates are not available for other Eel River sub-watersheds. However, they are at least present in some tributaries of the lower mainstem Eel River. Coho salmon have been reported twice at the Van Arsdale Fish Station, 47 fish in 1946/47 and one fish in 1984/85. Coho salmon have also been observed in tributaries to the upper Outlet Creek watershed.

In the early 1900's, the Eel River supported runs of salmon and steelhead trout that were estimated to exceed one-half million fish. In 1964, the Department estimated the annual spawning escapement in the entire Eel River system at approximately 82,000 steelhead trout, 23,000 coho salmon and 56,000 chinook salmon (Department 1997). Major flood events in 1955 and 1964 occurred during a period of intensive land use, primarily related to timber harvest. These activities had destabilized most subbasins in the Eel River system. The floods caused disturbed watershed soils to move into streams and bury fish habitat in sediment. The most recent estimate of the average annual salmon and steelhead trout spawning populations in the Eel River system was made in the late 1980's and indicated that steelhead trout had declined to 20,000 fish, chinook salmon to 10,000 fish, and coho salmon to 1,000 fish (Department 1997). Although these estimates are based on limited scientific data, they are supported by anecdotal accounts, and reflect at least an 80 percent decline in salmon and steelhead trout populations from early 1960's levels.

Table 2.4.1.5 presents a list of fish species currently present in the Eel River. There are six native anadromous fish species and seven native resident fish species. Several other fish species have been introduced. A wide variety of fish utilize the estuary for spawning and juvenile rearing habitat. Estuarine species are characterized as estuarine-dependant or estuarine-opportunists.

Table 2.4.1.5. Fish Species of the Eel River Watershed

Common Name	Scientific Name
Anadromous Species	
chinook salmon	*Oncorhynchus tschawytscha*
coho salmon	*Oncorhynchus kisutch*
steelhead trout	*Oncorhynchus mykiss*
coast cutthroat	*Oncorhynchus clarki*
Pacific lamprey	*Lampetra tridentata*
green sturgeon	*Acipenser medirostris*
American shad	*Alosa sapidissima*
Resident Species	
brook lamprey	*Lampetra richardsoni*
river lamprey	*Lampetra ayresi*
rainbow trout	*Oncorhynchus mykiss*
Sacramento sucker	*Catostomus occidentalis*
prickly sculpin	*Cottus asper*
Coast Range sculpin	*Cottus aleuticus*
three-spined stickleback	*Gasterosteus aculeatus*
California roach	*Hesperoleucus symmetricus*
golden shiner	*Notemigonus crysoleucus*
speckled dace	*Rhinichthys osculus*
Sacramento pikeminnow	*Ptychocherlus grandis*
brown bullhead	*Ictalurus nebulosus*
white catfish	*Ictalurus catus*
green sunfish	*Lepomis cyanellus*
bluegill	*Lepomis macrochirus*
largemouth bass	*Micropterus salmoides*
Estuarine Species	
Pacific sardine	*Sardinops caerulea*
northern anchovy	*Engraulis mordax*
surf smelt	*Hypomesus pretiosus*
longfin smelt	*Spirinchus thaleichthys*
Pacific tomcod	*Microgadus proximus*
bay pipefish	*Syngnathus leptorhynchus*
redtail surfperch	*Amphisticus rhodoterus*
shiner surfperch	*Cymatogaster aggregata*
pile surfperch	*Rhacochilus vacca*
kelp greenling	*Hexagrammos decagrammus*
cabezon	*Scorpaenichthys marmoratus*
staghorn sculpin	*Leptocottus armatus*
saddleback gunnel	*Pholis ornata*
topsmelt	*Atherinops affinis*
starry flounder	*Platichthys stellatus*
English sole	*Parophyrs vetulus*
speckled sanddab	*Citharichthys stigmaeus*
sand sole	*Psettichthys coenosus*
Pacific herring	*Clupea harengus*

2.4.1.6 Fish Facilities

The Van Arsdale Fish Station (VAFS) and fish ladder are located at Cape Horn Dam. Coho salmon have been reported twice at VAFS, 47 fish in 1946/47 and one fish in 1984/85. The Department has used the fish facility for collecting steelhead trout and chinook salmon eggs for augmenting natural stocks with hatchery programs. At present, all steelhead trout and most chinook salmon that enter the ladder are counted, and allowed to pass above Van Arsdale reservoir to spawn naturally between the two dams. Some chinook salmon are retained for spawning purposes. Chinook salmon are collected and spawned according to protocols described in the Upper Eel River Chinook Emergency Hatchery Program. The objective of this eight-year (two life cycle) program is to establish a self-sustaining population of chinook salmon in the upper mainstem Eel River above Cape Horn Dam. The goal is to rear 50,000 pre-smolts and 50,000 yearlings to produce 1,000 adults on an annual basis. Progeny from cultured fish are released as sub-yearlings during the fall. Recent counts of both Chinook salmon and steelhead trout far exceed the average of past years.

There are also three cooperative salmon hatchery projects operating in the Eel River watershed. One is located on Yager Creek, a tributary to the Van Duzen River. The other two are located on Hollow Tree Creek and Redwood Creek, tributaries to the South Fork Eel. These hatcheries primarily rear chinook salmon. Locations of fish rearing facilities are depicted in Figure 2.4.

2.4.1.7 Recreational/Commercial Fishing Interests

During the winter months, sport fishing for salmon and steelhead trout draws anglers from throughout California and other states to the Eel River. In addition, the Eel River is California's third largest contributor of salmon for the ocean sport and commercial fisheries. Due to declining populations, chinook salmon, and coho salmon, and steelhead trout are currently listed as threatened under the federal Endangered Species Act. The threatened status now restricts river sport fishing on Eel stocks. During the winter season, the Eel River is currently managed as a catch and release fishery. During trout season, there are special regulations that permit keeping two rainbow trout from the upper Van Duzen and five rainbow trout from the Middle Fork Eel above Black Butte River.

2.4.1.8 Land Use/Planning

Native Americans have inhabited the Eel River Watershed for thousands of years. Tribes include the Wiyot, Nongatl, Lassik, Wailaki, Sinkyone, Cahto, Huchnom, Yuki, and Pomo. The Tribes lived in small semi-sedentary villages, and moved throughout different areas of the watershed to procure subsistence resources as they became seasonally available.

The majority of the Eel River watershed is rural, with a number of small towns scattered throughout the watershed. Presently, the most significant land uses in the watershed are timber harvest, road construction (approximately 10,000 miles (16,093 kilometers) of roads in the watershed), hydroelectric power production, water diversions, grazing, agriculture, in-channel gravel mining, recreation, and most recently, subdivision and residential development. In-stream mining permits located on the Eel River are shown in Figure 2.4. Eighty-six percent of the Eel River watershed is held in private ownership.

The Eel River is part of the State's Wild and Scenic Rivers system. There are 16 segments of the Eel River that are designated “wild”, “scenic”, or “recreational” in accordance with the Wild and Scenic Rivers Act.

2.5 Cape Mendocino Rivers

The two main drainages included in this section are the Bear and Mattole Rivers (Figure 2.5). The Bear River supports a steelhead trout, and may still be suitable for coho salmon. In 1965, the Department estimated that the Bear River supported a run of 1,000 chinook salmon, 2,500 coho salmon, and 6,000 steelhead trout (Department 1965). The remainder of this discussion addresses the Mattole River watershed.

2.5.1 MATTOLE RIVER

2.5.1.1 Overview

The Mattole River watershed encompasses approximately 304 square miles (787 sq. km.) of the northern California Coast Range. A small portion of the Mattole's southern most headwaters originate in Mendocino County, but the vast majority of the watershed is within Humboldt County. The mainstem Mattole is approximately 62 miles (100 km) long, and receives water from over 74 tributary streams. There are approximately 545 perennial stream miles (877 kilometers) in the watershed. The Mattole River enters the Pacific Ocean approximately 10 miles (16 kilometers) south of Cape Mendocino (approximately 300 miles (482 kilometers) north of San Francisco). During the summer of most years, a sand spit forms across the river mouth creating a lagoon. Generally the lagoon remains until fall rains breech the sand spit; however, in some years high tides combined with large swells overtop the lagoon, creating a breech through the sand spit.

The Mattole River watershed is characterized by mostly steep mountainous topography, with half of the watershed with a slope greater than 15 percent. The upper half of the watershed is almost twice as steep as the lower half. The lowest section is characterized by broad flats, dominated by large gravel bars (Mattole Restoration Council 1989). Headwater elevations range from 1,350 feet (411 meters) at Four Corners to 4,087 feet (1,246 meters) at Kings Peak, located less than three miles (4.8 kilometers) from the ocean.

2.5.1.2 Climate

The Mattole River watershed has a Mediterranean climate characterized by cool wet winters with high runoff, and dry warm summers with greatly reduced flows. Most precipitation falls as rain. Along the coast, average air temperatures range from 46^o F (7.7^o C) to 56^o F (13.3^o C). Further inland, annual air temperatures are much more variable, ranging from below freezing in winter to over 100 degrees in summer. The Mattole watershed receives one of the highest annual amounts of rainfall in California. The annual watershed averaged rainfall is 81 inches (205 cm). Average rainfall near the coast in Petrolia is about 50 inches (127 cm) per year and well over 100 inches (254 cm) per year falls near the center of the watershed in Honeydew. Extreme rain events do occur, e.g. over 240 inches (610 cm) fell over parts of the watershed in 1982-83.

2.5.1.3 Geologic Setting

The Mattole watershed lies completely within the Coast Range geologic province. The Coast Range province is mainly composed of the Franciscan Complex. The Franciscan Complex is Jurassic in age and can be differentiated into 2 belts of rocks: the Central Franciscan Belt and the Coastal Franciscan Belt, of which the latter underlies the Mattole watershed. The unstable

Figure 2.5 Cape Mendocino Rivers

Coastal Franciscan Belt assemblage consists of young sedimentary rocks. Sedimentary rocks of the Franciscan formation have been accreted as a by-product of subduction in a process known as underplating: as the denser oceanic plate dives under the more buoyant continental plate (Mattole Restoration Council 1996). The King Range is thought to have been "obductively accreted", meaning that the material scraped off of the oceanic plate rode up and over the continental plate (Mattole Restoration Council 1995). Over geologic time, the rocks within the Mattole watershed have been severely folded, intensely fractured, and deeply weathered. Mattole rock breaks down very easily and is therefore susceptible to erosive forces (Mattole Restoration Council 1989). Erosion contributes large amounts of sediments to the river. The watershed is strongly influenced by the Mendocino Triple Junction, where the Gorda, Pacific, and North American plates come together creating a "geologically active" area. The area is known for damaging earthquakes recurring every three to five years.

2.5.1.4 Hydrology/Water Quality

High seasonal rainfall on semi-impermeable lithology and steep slopes contribute to the very flashy nature of the Mattole River's watersheds. In addition, the runoff rate has been increased by extensive road systems and other land uses. High seasonal rainfall combined with a rapid runoff rate on unstable soils delivers large amounts of sediment to the river. As a result, the Mattole River transports huge sediment loads. These sediments are deposited throughout the lower gradient reaches of the system.

Winter monthly stream flows in the Mattole River measured near Petrolia average between 1,710 and 4,170 cfs. However, peak flows measured on December 22, 1955 and December 22, 1964 were 90,400 and 78,500 respectively. Bank full discharge at Petrolia occurs at approximately 31,000 cfs (Mattole Restoration Council 1996). Summer and fall flows drop below 60 cfs, with a minimum measured flow of 20 cfs (Mattole Restoration Council 1989).

No major dams or power generating facilities are located within the Mattole River watershed. There are 28 licensed, permitted, or pending water rights within the Mattole River watershed (depicted in Figure 2.5). This number does not include riparian users and other diversions that are not registered with the State Division of Water Rights (State Water Resources Control Board 2001).

2.5.1.5 Fish Resources

Fishery resources of the Mattole River watershed include fall-run chinook salmon, coho salmon, and steelhead trout. Other fish species observed in the Mattole are presented in Table 2.5.1.5. A wide variety of fish utilize the estuary for spawning and juvenile rearing habitat.

The coho salmon population in the Mattole is currently thought to be less than 800 adult fish (Brown et al. 1994). This is a likely a small fraction of historic numbers. The Department estimates of chinook salmon escapement to the Mattole in the mid 1960's were 5,000 fish. A spawner survey in 1994-95 estimated 500 chinook salmon in the Mattole.

Table 2.5.1.5. Native Fish Species of the Mattole River

Common Name:	Scientific Name:
chinook salmon	*Oncorhynchus tshawytscha*
Coast Range sculpin	*Cottus aleuticus*
coho salmon	*Oncorhynchus kisutch*
Pacific lamprey	*Lampetra tridentata*
Pacific staghorn sculpin	*Leptocottus armatus*
prickly sculpin	*Cottus asper*
rainbow trout	*Oncorhynchus mykiss*
river lamprey	*Lampetra ayresi*
Sacramento sucker	*Catostomus occidentalis*
shiner perch	*Cymatogaster aggregata*
starry flounder	*Platichthys stellatus*
surf smelt	*Hypomesus pretiosus*
threespine stickleback	*Gasterosteus aculeatus*
topsmelt	*Atherinops affinis*
brook lamprey	*Lampetra richardsoni*

2.5.1.6 Fish Facilities

Beginning in 1981, the Mattole Salmon Support Group trapped and raised chinook salmon and coho salmon. Presently, the Mattole Salmon Support Group is part of the Department Cooperative Trapping and Rearing Program. In the upper reaches of the river system, the group has used hatch boxes placed instream to incubate fertilized eggs taken from locally-trapped chinook salmon and coho salmon broodstock. For the past several years in May and June, the group has also trapped chinook salmon out-migrants just upstream of the estuary/lagoon. Due to a combination of watershed factors, the estuary outlet closes in June or July in most years, preventing smolts from escaping very warm to lethal freshwater temperatures into the relative safety of the ocean. Project personnel and volunteers net up to 6,000 naturally spawned downstream migrants each year and hold them in rearing ponds at Mill Creek (RM 2). The fish are reared by the volunteers until released to the estuary when river stream temperatures drop, and/or the lagoon opens to the sea with fall rains. Between 1981 and 1995, more than 500,000 chinook salmon have been released from the upstream and estuarine operations. Locations of fish rearing facilities are depicted in Figure 2.5.

2.5.1.7 Recreational/Commercial Fishing Interests

Historically, sport fishing for salmon and steelhead trout has drawn anglers from throughout California and other states to the Mattole River, which has been an important contributor to both sport and commercial marine fisheries. Due to declining populations, chinook salmon, coho salmon, and steelhead trout are currently listed as threatened under the federal Endangered Species Act. The threatened status now restricts river sport fishing on Mattole stocks. The winter salmon and steelhead trout fishery of the Mattole River is managed as a catch and release fishery from January 1 to March 31. Only barbless artificial lures may be used. Additionally, the Mattole River mainstem from the confluence with Stansberry Creek to the confluence with Honeydew Creek is open from the fourth Saturday in May through August 31 for catch and release fishing with barbless artificial lures.

2.5.1.8 Land-Use/Planning

Athapaskan-speaking Mattole and Sinkyone peoples occupied the Mattole valley at the time of the first European settlers in the early 1850s. Little is known about them, for they were quickly obliterated by settlers, culminating in the massacre at Squaw Creek (RM 12) in early 1864.

More recently, most of the land use in the Mattole watershed is centered on timber harvest, cattle and sheep grazing, pasture and field crops, and recreation in the King Range National Conservation Area. There are three small towns in the Mattole watershed: Whitethorn in the headwaters region, Honeydew near the center of the watershed, and Petrolia near the mouth. The resident population in the watershed in 1989 was estimated at about 2,000 people.

Many roads were built to gain residential and land use access throughout the watershed. By the late 1980s, geologists estimated that 76% of the Mattole's most serious erosional disturbances had some connection to road construction and maintenance. Roads have contributed untold tons of sediment to the river and its tributaries (Mattole Restoration Council 1989). Most land in the Mattole River watershed is in private ownership (79%). A small proportion is under public protected management (18%); the remainder of the watershed is public land managed for multiple use (2%). One in-stream mining permit is located on the Mattole River (Figure 2.5).

2.6 Mendocino Coast Watershed

Virtually the entire Mendocino County is mountainous and is part of the Coastal Range. Major habitat types include redwood forest, coastal forest, grassland, woodland-grass, pine-fir-chaparral, chaparral, and hardwood. The prominent coastal streams in this area include the Ten Mile River, Noyo River, Albion River, Big River, Navarro River, Garcia River, and the Gualala River (Figure 2.6). Smaller streams tributary to the Pacific Ocean include Cottoneva Creek, Wages Creek, Howard Creek, DeHaven Creek, Hare Creek, Casper Creek, Little River, Big Salmon Creek, Elk Creek, Brush Creek, and others.

The coastal climate is temperate, and heavy fog is a common occurrence. Most of the area lies in the 30 to 50 inch rainfall bracket, with an average annual precipitation of 27 inches (68 cm). Precipitation is virtually all rain, which occurs mainly from November to May. Inland, the summers are warm with temperatures often exceeding 100^{o}F. Freezing temperatures and infrequent snows occur at the higher altitudes in the winter. The estimated mean annual runoff is 180,000 acre-feet.

The Mendocino Coast watershed lies completely within the Coast Range geologic province. The Coast Range province is mainly composed of the Franciscan Complex. The Franciscan Complex is Jurassic in age and can be differentiated into 3 belts of rocks: the Eastern Franciscan Belt, the Central Franciscan Belt and the Coastal Franciscan Belt. These belts consists of isolated blocks of exotic serpentine, greenstone, blueschist, eclogite, chert, shale, ultramafic rocks, and greywacke in a highly sheared mudstone matrix. The San Andreas Fault Zone, which crosses along the western edge of the watershed, delineates the Franciscan Complex to the west and the Salinian Block to the east. The Fault's extent in this watershed is approximately 44 miles (70.8 kilometers) and forms the contact between the Salinian Block and the Franciscan Complex. The fault is a left lateral strike slip fault and generally trends northwest.

Figure 2.6 Mendocino Coast

The Salinian Block is Cretaceous in age and is composed of granitic rocks, predominately granodiorite, and minor amounts of metamorphic rocks including marble, quartzite, gneiss and schist. Isolated Cenozoic sedimentary basin deposits, composed of mainly sandstones and shales, overlie both the Franciscan Complex and the Salinian Block. The youngest material in the watershed is recent, mainly Holocene, alluvial, coastal and aeolean deposits. These deposits are located along the coast and in isolated areas of the southern half of the watershed.

2.6.1 TEN MILE RIVER

2.6.1.1 Overview

The Ten Mile River originates in the Coast Range of Mendocino County. Its main tributaries are the North and South Forks. It enters the ocean about nine miles (14.5 kilometers) north of Fort Bragg. The Ten Mile River flows through coastal forests primarily owned by private logging companies, and there is no public access. In years prior to the present Forestry Practice Rules, the habitat was severely degraded by logging activity, caused by poor logging practices (Department 1965).

2.6.1.2 Hydrology/Water Quality

There are no dams in the drainage and none are proposed. Licensed, permitted or pending water rights are depicted in Figure 2.6.

2.6.1.3 Fish Resources

There was an estimated 103 stream miles (166 kilometers) of coho salmon and steelhead trout habitat in the drainage in 1963. The estimated coho spawning population was 6,000 fish per year, and steelhead trout about 9,000 fish per year (Department 1965).

The stream was surveyed 12 times between November 1989 and February 1990, and coho salmon were observed during these surveys. Calculations based on carcass and skeleton counts indicated anywhere from 31 – 55 coho salmon in Ten Mile River (Moyle and Brown 1991).

2.6.1.4 Fish Facilities

The Ten Mile River Hatchery, located on Georgia Pacific Corporation property on the Ten Mile River near Fort Bragg, is operated by the Salmon Restoration Association. This site began operation as a rearing facility for steelhead trout, which continued to be the primary focus until the actual hatchery facility was constructed in 1990. Coho salmon were first spawned at this facility during the 1986-1987 season when two native females were used to produce about 6,000 fingerlings, all of which were planted into the mainstem Ten Mile River. Coho salmon were not spawned again until the 1992-1993 spawning season, when the first source of native coho salmon eggs were obtained for the new hatchery. Locations of fish rearing facilities are depicted in Figure 2.6.

2.6.1.5 Recreational/Commercial Fishing Interests

Only artificial lures with barbless hooks may be used for fishing on the Ten Mile River. Certain sections of the river have catch and release restrictions while other sections allow keeping one “hatchery” trout or steelhead trout.

2.6.1.6 Land-Use/Planning

The Ten Mile River is primarily owned by private logging companies, with land-use devoted to timber products.

2.6.2 NOYO RIVER

2.6.2.1 Overview

The Noyo River watershed is located in northern Mendocino County. The drainage includes approximately 80 miles (129 kilometers) of stream, of which 70 (113 kilometers) miles can be considered of present or potential fisheries value. The drainage is divided into three main units: the Main, South, and North Forks. Vegetation of the headwaters area is comprised primarily of oak woodland-shrubland-grassland complexes. Farther downstream, the river becomes more gradual in gradient and enters broad V-shaped canyons densely covered with second growth redwood and Douglas-fir forests.

2.6.2.2 Hydrology/Water Quality

The City of Fort Bragg operates a diversion just above tidewater influence. The Noyo pump station is a series of perforated collector pipes buried eight feet (2.4 meters) below streambed level. Diversion from 1970-1985 ranged from 38 acre-feet per year to 1,168 acre-feet per year. Required bypass terms for the October 1 through May 31 period are 10 cfs or the natural flow, whichever is less, and from June 1 through September 30 are 3 cfs or the natural flow, whichever is less (John Corollo Engineers 1986). Licensed, permitted or pending water rights are depicted in Figure 2.6.

2.6.2.3 Fish Resources

This river is known for its winter chinook salmon and steelhead trout fishing in the lower part of the river.

2.6.2.4 Fish Facilities

The Department operates the Noyo River Salmon Egg Collecting Station on the Noyo River. Adult coho salmon are trapped and spawned and the resulting eggs and young fish are reared at Mad River Hatchery in Humboldt County. Yearlings are stocked in the Noyo River and in other selected streams to maintain and restore coho salmon runs. Locations of fish rearing facilities are depicted in Figure 2.6. Records of returning coho salmon from the Noyo River Salmon Egg Collecting Station are shown in Table 2.6.2.4.

2.6.2.5 Recreational/Commercial Fishing Interests

Recreational use is limited to steelhead trout fishing in the lower part of the river, and hunting and camping within Jackson State Forest (Holman and Evans 1964). Only artificial lures with barbless hooks may be used for fishing on the Noyo River. Certain sections of the river have catch and release restrictions while other sections allow keeping one “hatchery” trout or steelhead trout.

Table 2.6.2.4. Counts of Returning Coho Salmon on the Noyo River

Season	Males	Females	Grilse	Total
1962--63	775	416	2,501	3,692
1963--64	1,054	2,403	1,483	4,940
1964--65	326	745	1,006	2,077
1965--66	262	291	1,199	1,752
1966--67	951	1,124	925	3,000
1967--68	248	611	1,663	2,522
1968--69	1,120	1,796	166	3,082
1969--70	308	557	473	1,338
1970--71	278	440	1,193	1,911
1971--72	1,245	1,618	170	3,033
1972--73	184	221	1,872	2,277
1973--74	532	871	1,489	2,892
1974--75	888	1,152	496	2,536
1975--76	257	424	1,108	1,789
1976--77	457	620	183	1,260
1977--78*	204	187	120	511
1978--79*	190	200	49	439
1979--80*	103	155	334	592
1980--81*	123	90	125	338
1981--82	431	891	506	1,828
1982--83	214	327	54	595
1983--84	10	17	72	99
1984--85	365	429	230	1,024
1985--86	13	7	26	46
1986--87	227	169	634	1,030
1987--88	1,146	1,424	98	2,668
1988--89	69	85	554	708
1989--90	419	299	294	1,012
1990--91*	57	32	56	145
1991--92	173	179	157	509
1992--93*	74	66	24	164
1993--94[1]	26	20	81	127
1994--95[2]	293	316	326	935
1995--96[2]	137	149	10	296
1996--97[2]	101	253	1,254	1,878
1997--98	374	753	123	1,250
1998--99	5	11	355	371
1999--00	46	39	105	190
2000--01	168	190	71	429

* Drought years
[1] No fish spawned this year--not a complete count.
[2] Not a complete count

2.6.2.6 Land Use/Planning

The land use history of the Noyo River watershed is dominated by logging and railroads. The Railroad's original purpose was to allow economical timber harvest, but has since evolved into a significant passenger line enterprise. Beginning in the 1940s, most of the railroad grades were converted to roads. Several minor areas adjacent to streams have been cleared of trees and are used for cattle and sheep grazing (Holman and Evans 1964).

Overall, 80.6% of the watershed is in private ownership, and 19.4% is in public ownership. Essentially all of the public ownership is concentrated in the South Fork Noyo Planning Area, where 78.4% is publicly owned, while the remaining 21.6% is privately held. Nearly 90% of the South Fork Noyo drainage is located within the Jackson State Forest (Holman and Evans 1964).

2.6.3 BIG RIVER

2.6.3.1 Overview

The Big River drainage is entirely within Mendocino County and is located about 120 miles (193 kilometers) northwest of San Francisco. The drainage area covers approximately 182 square miles, with elevations ranging from mean sea level to 2,300 feet (701 meters). Watershed topography is hilly to mountainous, and the river flows through deep narrow gorges (U. S. Fish and Wildlife Service 1974). Vegetation in Big River Watershed is predominantly conifers with redwoods near the coast and in the stream bottoms, with Douglas-fir and ponderosa pine in the interior and along the ridges. Broadleaf trees typical of the area include tan oak, live oak, alder, bay, and madrone. They are interspersed throughout the conifer stands. On the drier slopes in the headwaters, there is considerable oak-grassland and brush. California black oak, Oregon oak, ceanothus, currant, raspberry, and manzanita dominate in these areas. Herbaceous species consist of oat grasses, bromes, fescues, and filaree (U. S. Fish and Wildlife Service 1974).

2.6.3.2 Hydrology/Water Quality

In the Big River watershed, the annual precipitation is 27 inches (68 cm) and the mean annual runoff is 180,000 acre-feet. During a study in 1973, water temperatures exceeding 65 F (18.3^{o} C) were recorded in some areas. Additionally, extreme temperatures ranging in the low-80s were recorded in May-August period where riparian cover was absent. Licensed, permitted, or pending water rights are depicted in Figure 2.6.

2.6.3.3 Fish Resources

Principal fish species of importance in watershed streams are coho salmon and steelhead trout. Chinook salmon have been observed but infrequently. In 1963, there were approximately 101 stream miles (162.5 kilometers) of coho salmon and 137 miles (220 kilometers) of steelhead trout habitat in the drainage. The estimated annual spawning run was 6,000 coho salmon and 12,000 steelhead trout (Department 1965). Other species found are threespine stickleback, prickly sculpin, coast range sculpin, Sacramento sucker, and lamprey (Barber 2000).

2.6.3.4 Fish Facilities

There are no hatcheries or fish facilities on Big River.

2.6.3.5 Recreational/Commercial Fishing Interests

Only artificial lures with barbless hooks may be used for fishing on the Big River. Certain sections of the river have catch and release restrictions while other sections allow keeping one "hatchery" trout or steelhead trout.

2.6.3.6 Land-Use/Planning

Big River flows through coastal forests primarily owned by private logging companies, with the exception of the Jackson State Forest. Big River is a central attraction of the Mendocino Coast. Its beach adjoins the town of Mendocino, and the river supports recreational activities such as fishing, bird watching, and canoeing. The existing haul road along the river is the only river access for joggers, hikers, and bike riders. More than 10,000 canoers and kayakers each year use Big River for on-water recreation.

2.6.4 ALBION RIVER

2.6.4.1 Overview

The Albion River is a 43 square mile (111 square kilometer) system with two miles (3.2 kilometers) of estuary, before draining into the Pacific Ocean. Albion River is in Mendocino County, between the Navarro River on the south, Little River and Big River on the north. The Albion River initiates inland about 13 miles (21 kilometers), with headwaters on lands around the small town of Comptche.

2.6.4.2 Hydrology/Water Quality

There are no major dams in the watershed and none are proposed. Licensed, permitted, or pending water rights are depicted in Figure 2.6.

2.6.4.3 Fish Resources

Remnant runs of native coho salmon and steelhead trout inhabit Albion River. Spawning adult coho salmon may number fewer than 200 individuals in the Albion River. Louisiana Pacific Corporation counted some coho salmon adults in the Albion River in 2000-2001.

2.6.4.4 Fish Facilities

There are no hatcheries on the Albion River.

2.6.4.5 Recreational/Commercial Fishing Interests

Only artificial lures with barbless hooks may be used for fishing on the Albion River. Certain sections of the river have catch and release restrictions while other sections allow keeping one “hatchery” trout or steelhead trout.

2.6.4.6 Land-Use/Planning

Land uses include industrial timber management and rural residential areas, with a 5-acre minimum on the ridge tops. Near the headwaters, larger 40+ acre ranches occur. There has been an increase in recent years of timber harvest in the area. There are two campground marinas on the estuary, which in the past served the small-boat commercial salmon fleet and commercial urchin harvest, as well as sport fishing and diving for abalone. They now serve mainly recreational fisheries. Year-round mobile homes on Albion Flats Campground have been replaced by year-round camping.

A 90-acre conservation easement has been purchased by the Coastal Conservancy in Albion headwaters, and a State Park or State Forest is proposed for the headlands between the Albion River mouth, to approximately Salmon Creek, on former ranch lands.

2.6.5 NAVARRO RIVER

2.6.5.1 Overview

The Navarro River flows through the coastal range of mountains west of Hopland and drains into the Pacific Ocean about 17 miles (27 kilometers) south of Fort Bragg. It drains an area of about 300 square miles (777 square kilometers). The main tributaries are the North Fork, Rancheria, Anderson, and Indian Creeks.

2.6.5.2 Hydrology/Water Quality

In October 1993, the U.S. Environmental Protection Agency included the Navarro River on the State Water Resources Control Boards' (SWRCB) Clean Water Act (CWA) section 303(d) list of water bodies that do not meet water quality standards. The designation was due to sedimentation. The SWRCB considers the beneficial uses of water in the Navarro, including aquatic and recreation resources, to be threatened. Likely threats include roads and logging activities, as well as agriculture and grazing. Concern exists as well regarding threats to domestic and agricultural water supplies due to significantly increased development in Anderson Valley over the last decade (Anderson Valley Land Trust 1994). Licensed, permitted, or pending water rights are depicted in Figure 2.6.

The Navarro River, and its varied beneficial uses, is the focus of the local economy. The commercial fishing industry of Mendocino County in general, has declined due to the loss of salmon populations. The decline of the anadromous fish resource in the watershed can also be directly translated into an economic loss of tourism dollars and the loss of an important recreational amenity for local citizens.

2.6.5.3 Fish Resources

There are 130 stream miles (209 kilometers) of coho salmon habitat and 185 miles (298 kilometers) of steelhead trout habitat in the Navarro River drainage. The quality of spawning areas is classified as poor to good. The better areas are located in the undisturbed headwater tributary streams other than those of the Soda Creek drainage. In 1963, the coho salmon resource was estimated at 7,000 fish per year, and steelhead trout at 16,000 per year (Department 1965).

The Navarro was famous for its coho salmon runs, but today they have been virtually extirpated from the watershed. The steelhead trout, although faring somewhat better than salmon due to a higher tolerance for elevated water temperature, have also been severely reduced.

2.6.5.4 Fish Facilities

There are no hatcheries on the Navarro River.

2.6.5.5 Recreational/Commercial Fishing Interests

Only artificial lures with barbless hooks may be used for fishing on the Navarro River. Certain sections of the river have catch and release restrictions while other sections allow keeping one "hatchery" trout or steelhead trout

2.6.5.6 Land-Use/Planning

The open, agricultural and forested nature of this area, in which two very popular State parks are situated (Hendy Woods and Navarro River State Parks), draws over 100,000 visitors annually. The *Overall Economic Development Plan of Mendocino County* cites "green tourism" and public recreation as a significant source of economic expansion for the county. The restoration and preservation of the resource base is necessary to the continued viability and growth of tourism here (Anderson Valley Land Trust 1994).

The Navarro River Watershed supports a significant base of agriculture, livestock, and timber (and, formerly, fishery) production. Sheep and cattle graze the open grassland areas, especially in the headwaters. Anderson Valley, the most settled part of the watershed, supports significant orchard and viticulture enterprises. Portions of the watershed support mixed redwood-Douglas-fir forest, which has been heavily logged. While use of these resources has been in part responsible for the damage to the salmon and steelhead trout resource, they continue to play an important role in the local economy (Anderson Valley Land Trust 1994).

2.6.6 GARCIA RIVER

2.6.6.1 Overview

The Garcia River drains an area of about 100 square-miles (259 square kilometers) in Mendocino County and follows a winding course before entering the Pacific just north of Point Arena. The watershed drains approximately 72,000 acres (114 square miles or 186,479 square kilometers). The mainstem is approximately 44 miles (71 kilometers) long from the mouth at the Pacific Ocean to its source at Pardabe Peak. The Garcia River is a small, cold streams, which is deeply shaded, with frequent deep pools (>30 in.) that are used by coho salmon and steelhead trout for spawning and rearing. The elevation of the river ranges from 2,470 feet (753 meters) at the headwaters to sea level. The watershed is characterized by partially harvested forestland in the steep and rugged upper portions and agriculture and grazing lands on the more gently sloping, lower portions. The Garcia River estuary, which extends from the ocean to the confluence of Hathaway Creek, is an environmentally sensitive portion of the river. The estuary is an important habitat for anadromous fish, shorebirds, waterfowl, and other wildlife.

2.6.6.2 Hydrology/Water Quality

Flows on the Garcia River were measured continuously by the USGS between 1963 and 1983 at a stream gage located at RM 8.2 in Connor Hole, 0.3 miles (0.5 kilometers) downstream of the confluence with the North Fork. The gauge (Garcia River near Point Arena, No. 11467600) was re-established in fall of 1992. According to the USGS, the record flood on the Garcia occurred in January 1974, with an estimated peak of 30,300 cfs. A flow of 14,500 cfs equates to the 2-year flood, and along most of the river 3,000 - 5,000 cfs inundates the gravel bars. A flow of approximately 20,000 cfs begins to inundate the flood plain areas, and a 30,000 cfs flood inundates the flood plain areas to a depth of several feet, depending upon location. The 100-year flood is estimated to be 53,000 cfs. Recent floods were measured on December 31, 1992 through January 4, 1993 and January 10 through 23, 1993. Licensed, permitted, or pending water rights are depicted in Figure 2.6.

2.6.6.3 Fish Resources

The Garcia River supports approximately 38 miles (61 kilometers) of coho salmon habitat and 41 miles (66 kilometers) of steelhead trout habitat. Mendocino County (1991c) estimates that 2,000 coho salmon and 4,000 steelhead trout spawned in the Garcia River annually during the 1960's. Because of its status as an anadromous fish stream, it is recognized as an Environmental Sensitive Habitat Area (ESHA) by Mendocino County (1991a). Under the provisions of the Management, Control and Protection of Certain Spawning Areas regulation (California Fish and Game Code, section 1505), state-owned portions of the Garcia River are under the management of the Department for protection of spawning areas.

2.6.6.4 Fish Facilities

There are no fish hatcheries on the Garcia River.

2.6.6.5 Recreational/Commercial Fishing Interests

Of the coastal river systems, the Garcia is one of the most accessible. The Garcia River has 84 percent of its salmon and 80 percent of its steelhead trout habitat accessible to angling. Only artificial lures with barbless hooks may be used for fishing on the Garcia River. Certain sections of the river have catch and release restrictions while other sections allow keeping one “hatchery” trout or steelhead trout.

2.6.6.6 Land-Use/Planning

The Garcia River flows through private lands utilized primarily for timber production (Department 1965). The land is used for timber harvest, cattle ranching, dairy production, gravel mining, and private residency. A few in-stream mining permits are located on the Garcia River (Figure 2.6). Landowners include timber companies, independent ranchers, an Air Force Base, a Rancheria, and residential and non-industrial holdings.

2.6.7 GUALALA RIVER

2.6.7.1 Overview

The Gualala River begins on the western slope of the heavily wooded coastal ranges of Mendocino and Sonoma counties, the lower 3.5 miles (5.6 kilometers) of the mainstem forming the common boundary of these counties. The main tributaries are the North and Wheatfield Forks, and Buckeye Creek. Since it rises in an area that receives about 30 inches (76 cm) of rain annually, the stream usually has a good winter flow. Consequently, the sand bar at the mouth of the river breaks through with the first good winter rain, which generally occurs in November or December. The mouth then closes temporarily until the impounded head, high tides and additional rainstorms periodically open it. The first run of spawners ascends when the bar initially breaks, and additional runs ascend during prolonged periods of good flows after the rainy season is underway (Fisher 1954).

The Gualala River is somewhat unique in that the principal drainage, both north and south forks, closely parallels the coast of Mendocino and Sonoma counties, respectively. The South Fork Gualala River flows northwest along a rift valley formed by the San Andreas Fault, which parallels the coast for about 25 miles (40 kilometers). The surrounding topography is generally steep ridges and hills, covered with dense stands of redwood and Douglas-fir forest. Scattered along both forks of the river are sand and gravel bars, as well as stands of willow and alder. Four miles (6.4 kilometers) upriver along the south fork are a few marsh areas among the redwoods.

The river valley broadens at its mouth, south of the Highway 1 Bridge. In the vicinity of the bridge on both sides of the river are a few scattered freshwater marshes. The lower mile of the river is bordered by a broad grassland-covered bluff to the south and bluffs to the north (Gayle 1978).

2.6.7.2 Hydrology/Water Quality

The Sea Ranch Gas and Water Company, a public utility serving Sea Ranch, purchased 46 acres of land fronting the south fork of the Gualala River in the 1960s. A well and chlorination station were developed on this property to divert and utilize the subsurface flows of the river as a source of domestic water. Sufficient diversion of this water occurs during the summer to significantly impact surface flows in the river's south fork and, ultimately, the amount of freshwater entering the estuary. The reductions in surface flows adversely affect steelhead trout and silver salmon spawning and nursery habitat (Gayle 1978). Licensed, permitted or pending water rights are depicted in Figure 2.6.

At the Company's point of diversion, the South Fork Gualala River drainage encompasses approximately 161 square-miles (417 square kilometers) of mountainous coastal terrain in northern Sonoma County. The mean annual runoff is approximately 312,000 acre-feet per year with a recorded maximum discharge of 55,000 cfs and a minimum discharge of 0.4 cfs. Typically, the river is characterized by high runoff during the winter and spring and low surface flow during the summer and fall. Approximately 6.5 miles (10.5 kilometers) downstream from the Company's diversion, the river joins the North Fork Gualala River and turns southwest for approximately five miles (8 kilometers) to the ocean (State Water Resources Control Board 1990).

2.6.7.3 Fish Resources

There are 75 miles (120 kilometers) of coho salmon and 178 miles (286 kilometers) of steelhead trout habitat in the drainage. Estimated spawners numbered 4,000 coho salmon and 16,000 steelhead trout per year in 1963. Fish species found in the Gualala River included salmon, steelhead trout, roach, stickleback, sculpin, and starry flounder (Brown 1986).

2.6.7.4 Fish Facilities

The Gualala River Steelhead Project has operated a cooperative rearing facility on the Doty Creek tributary, raising up to 15,000 steelhead trout annually. The fish are rescued from drying tributaries of the Gualala, maintained in circular rearing pools, and released into the North Fork of the Gualala when habitat conditions are suitable.

2.6.7.5 Recreational/Commercial Fishing Interests

The lower 3.5 miles (5.6 kilometers) of river are open to fishing and contain seven good-sized holes separated by fast glider and riffles. During average water stages the stream can be waded from shore to shore at several riffles, thereby making the south bank of the stream accessible. Fish caught in the lower Gualala River during a study from 1984 through 1986 included steelhead trout, roach, stickleback, sculpin, and starry flounder (Brown 1986).

Only artificial lures with barbless hooks may be used for fishing on the Gualala River. Certain sections of the river have catch and release restrictions while other sections allow keeping one "hatchery" trout or steelhead trout. Use was about 700 angler-days per year for salmon fishing and 3,000 for steelhead trout. Yield was about 300 salmon and 1,200 steelhead trout per year (Department 1965).

2.6.7.6 Land-Use/Planning

Various recreational activities, such as swimming, camping, and nature study, are provided in the county parks. There is an education/information center located on the bluff top to the south overlooking the estuary and brackish marsh. Hiking trails lead down to the beaches past the marsh. In spite of moderate to heavy public use of these trails, the marsh appears to be relatively undisturbed. The county has owned the property since 1972. Previously, cattle were grazed on the bluffs and probably in the marsh. The cattail marsh area was formerly the site of a mill pond with a railroad running along its edge. The land currently used for logging is owned by Gualala Redwoods (Gayle 1978). A few in-stream mining permits are located on the Gualala River (Figure 2.6).

2.7 Russian River Watershed

2.7.1 RUSSIAN RIVER

2.7.1.1 Overview

The Russian River watershed contains 1,485 square miles (3,846 square kilometers) of drainage area in Mendocino and Sonoma counties, with a small portion of the watershed extending into Lake County (Figure 2.7). The mainstem, bordered to the west by the Coast Range, is approximately 110 miles (177 kilometers) long. From its headwaters in Redwood and Potter valleys north of Ukiah, the river flows 69 (111 kilometers) miles in a south-eastward direction, makes a sharp turn to the west south of Healdsburg and flows another 41 miles (66 kilometers) before entering into the Pacific Ocean at Jenner. The Russian River watershed varies from 10 to 30 miles (16 to 30 kilometers) in width. Major tributaries to the Russian River include the East and West forks of the mainstem, Robinson Creek, Feliz Creek, Pieta Creek, Big Sulphur Creek, Dry Creek, Maacama Creek, Mark West Creek, and Austin Creek. There are approximately 240 named tributaries within the watershed and a multitude of small unnamed streams both perennial and ephemeral. All were once home to the anadromous and warm water fish species native to the watershed (Coey 2001).

2.7.1.2 Climate

The Russian River region has a Mediterranean climate, characterized by warm summers and mild winters. The watershed's fog-influenced coastal region, which extends 10 miles (16 kilometers) inland, typically has cool summers and abundant summer fog moisture. The drier interior region, on the other hand, experiences hot, dry summers with temperatures increasing to upwards of 100^{o}F in the northeastern valleys most isolated from coastal influence. Winter temperatures fall as low as the low 20^{o}s F, though snowfall is uncommon. Rainfall in the watershed ranges from 22-80 inches (56-203 cm), with a watershed-wide average of 41 inches

Figure 2.7 Russian River Watersheds

(104 cm) (SEC 1996). According to the National Climate Data Center Cooperative Weather Stations, the greatest average annual precipitation occurs at high elevations near Mt. St. Helena and in the coastal mountains near Cazadero, while the least amount occurs in the southern Santa Rosa Plain (29.5 inches or 75 cm). From 1939 to 1971, the average precipitation in the Cazadero area was 75.8 inches (192.5 cm) and from 1971 to 1995 it was 67.5 inches (171.5 cm). About 80 percent of the annual precipitation occurs as a result of Pacific frontal storms from November through March, with maximum precipitation occurring in December and January (Swanson 1992). Approximately 95 percent of the watershed's natural runoff occurs between November and April. Runoff is negligible between July and October with many tributaries running dry in the lower reaches (Coey 2001).

2.7.1.3 Geologic Setting

Elevations within the watershed range from sea level at the mouth to 4,344 feet (1,324 meters) at the summit of Mt. St. Helena in the Mayacamas Mountains to the east. Historic lava flow associated with Sonoma Mountain may have contributed to the isolation of the Russian River from the Petaluma and Sonoma rivers (Hopkirk 1974).

The Russian River watershed lies completely within the Coast Range geologic province. The Coast Range province is mainly composed of the Franciscan Complex. The Franciscan Complex is Jurassic in age and can be differentiated into 3 belts of rocks: the Eastern Franciscan Belt, the Central Franciscan Belt and the Coastal Franciscan Belt. These belts consist of exotic serpentine, greenstone, blueschist, eclogite, chert, shale, sandstones, basalt, thyolite, ultramafic rocks, and greywacke in a highly sheared mudstone matrix. The Healdsburg Roger Fault Zone is located in the southern half of the watershed. The fault's extent in this watershed is approximately 33 miles (53 kilometers). The fault is a left lateral strike slip fault and generally trends northwest. The Maacama Fault Zone is located in the northern half of the watershed and trends generally northwest. The fault's extent is approximately 28 miles (kilometers). The fault is a left lateral strike slip fault and generally trends to the northwest.

The river passes through a series of broad alluvial valleys and narrow bedrock constrictions along its course. Alluvial regions bordering the mainstem include the Ukiah and Hopland valleys in Mendocino County, and Alexander Valley and the Santa Rosa Plain in Sonoma County. The area within the watershed consists of 85 percent hills and mountains and a mere 15 percent alluvial valleys (SEC 1996). Present drainage patterns in the Russian River region are similar to drainage patterns for the North Coast Ranges and are the result of Pleistocene downfaulting (Hopkirk 1974). Faulting in the North Coast Ranges follows northwest to southeast orientation, generally, and thus many streams (including the upper run of the Russian River) follow this orientation. With the onset of the Wisconsin glacial epoch, sea level changes combined with downwarping along the coast contributed to flow pattern changes as southeasterly flowing rivers of the area were redirected westward (Hopkirk 1974). Eventually the headwaters of the upper Russian River became the headwaters of the Eel, Navarro, and Gualala river systems (Coey 2001).

Perhaps the most striking character of the Russian River drainage is the sharp turn to the west that the mainstem takes near its confluence with Mark West Creek, where "After following for fifty miles its regular southeasterly course to Santa Rosa Valley, it turns away from this flat and uninterrupted alluvial plain which opens directly to San Francisco Bay, and flows westward to the ocean through twenty miles of rugged canyon, winding through a highland that varies from eight hundred to twelve hundred feet in elevation" (Holway 1913). Holway, in his 1913 paper, hypothesizes that a likely explanation for this is "that the transverse portion of the river from the open valley through the highland was antecedent to, and persisted through, the uplift which made the highland." (Coey 2001)

2.7.1.4 Hydrology/Water Quality

Before 1908, the Russian River flows mirrored precipitation patterns. High winter flows occurred with storm events, and summer flows were low or intermittent (SEC 1996). Today, summer low flows are regulated by releases from Coyote Dam and Warm Springs Dam. Minimum instream flow releases vary depending upon annual precipitation. Augmentation from the Potter Valley Project, which began in 1908 with completion in 1922, contributes 300 cubic-feet per second (cfs) to the Russian from the Eel River. Regulated flows from the two large reservoirs have altered river discharge characteristics. Summer flows, once extremely low to intermittent, are greatly augmented and peak winter flows are artificially low under all but the highest flows. Licensed, permitted or pending water rights are depicted in Figure 2.7. The average annual runoff for the entire Russian River watershed is approximately 1,600,000 acre feet at Guerneville, on the lower river (Coey 2001).

A combination of soil types and steep topography within the Russian River watershed leads to low water intake rates, or retention capacity, which leads to high rates of runoff and serious erosion under major storm conditions. The result of these factors is a frequent occurrence of flooding. Flow frequency analysis indicates that major floods, ranging from approximately 89,000 to 100,000+ cfs will likely recur on 20 to 50+ year intervals, respectively. Historical evidence and flow records show that floods of this magnitude have occurred eight times since 1862. Floods with a range of 75,000 to 90,000 cfs can be expected to recur at approximately 10 to 20 year intervals, and floods equal to 60,000 cfs can be expected to recur on an average interval of 2.5 to 3 years (Trinity 1993). The largest flood on the Russian River occurred in 1862, as a result of precipitation at approximately 154 percent of normal. This was not only the largest flood recorded within the watershed, but also the largest flood on record in all of California, with flows estimated at over 100,000 cfs (Trinity 1993).

2.7.1.5 Fish Resources

The Russian River supports an assortment of species and includes both freshwater and anadromous forms as well as native and introduced species. A total of 48 species of fish have been identified in the Russian River watershed, including 27 native species. One subspecies of fish, the Russian River Tule perch, is endemic, occurring in no other California river system (Hopkirk 1980). Additionally, one species of invertebrate, the California freshwater shrimp (*Syncaris pacifica*), which is present in some tributaries of the Russian River, has been state listed as endangered (Coey 2001).

Anadromous native species identified (historical or present) in the Russian River system include: chinook salmon, coho salmon, steelhead trout, pink salmon, Pacific lamprey, river lamprey, white sturgeon and green sturgeon. Introduced anadromous species include striped bass and American shad. The Fish and Wildlife Plan estimated 133 miles (214 kilometers) of coho salmon habitat in 1963 (Department 1965).

Introductions of non-native fish to the Russian River include all of the catfishes (two species) and bullheads (two species); all of the centrarchids (except the Sacramento perch); all of the basses; all of the mosquito fishes, and some of the minnows (Coey 2001).

2.7.1.6 Fish Facilities

The major fish rearing facilities operated by the Department on the Russian River are the Warm Springs Salmon and Steelhead Hatchery on Dry Creek below Warm Springs Dam, and Coyote Valley Fish Facility on the East Branch Russian River below Coyote Dam. These facilities have consistently met the goal of producing 500,000 yearling steelhead trout for the Russian River watershed. These fish are mitigation for rearing and spawning areas made inaccessible by construction of Warm Springs and Coyote dams. Records of fish counted and production are shown (Tables 2.7.1.6a, b). The Warm Springs Hatchery is working with NMFS to obtain permits to collect juvenile coho salmon in the future to reestablish the runs in the Russian River drainage.

2.7.1.7 Recreational/Commercial Fishing Interests

Fishery resources of the Russian River system are very important for both recreational and commercial fishing. They also generate considerable economic benefits in Sonoma and Mendocino counties. The Russian River system, for fishery purposes, includes six segments: (1) the upper reach above Cloverdale, with cool water and a narrow channel, which has the best habitat for steelhead trout; (2) the upper middle reach from Healdsburg to Cloverdale, which is the primary reproductive habitat for American shad, and is also occupied by other warm water species during the summer; (3) the reach below Healdsburg which provides habitat for warm water species and striped bass; (4) the reach of Dry Creek from Warm Springs Dam to the confluence with the Russian River; and (5) Lake Mendocino and Lake Sonoma, which provide or will provide habitat for trout and warm water species. The Russian River is an exception to the coastal stream closures in the Department supplemental fishing regulations.

2.7.1.8 Land-Use/Planning

At the present time, the Russian River watershed is primarily an agricultural area with the greatest emphasis placed on orchard crops and vineyards. Besides agricultural pursuits, there is a growing trend toward light industry and commercial development, with the major urban center being Santa Rosa and its vicinity. A few in-stream mining permits are located on the Russian River (Figure 2.7), some of these have historically extracted very large volumes of aggregate.

Also, there is considerable activity in cattle and sheep raising in the hilly areas surrounding the valleys. There are a significant number of summer homes and resorts along the river reaches adjacent to Healdsburg and between Mirabel Park and Duncan Mills. Major orchard crops consist of prunes, pears and apples, with some production of other crops such as cherries and walnuts. The Russian River watershed is one of the most important wine- grape producing centers of the United States, with vineyards located along all of the river valleys and some of the major tributaries. Over the past several years' wine-grape prices have been high, encouraging the planting of new vineyards in Sonoma and Mendocino counties, as well as in other places in the State. Many prune orchards and some pear orchards have been taken out to make room for the new vineyards. A large percentage of the new vineyard plantings are on what previously was referred to as low-density agricultural land; generally defined as native pasture, wood- and brushland, and improved pastureland.

The watershed was once important in the production of hops, but this crop has virtually disappeared and the hopyards have been converted to orchards, vineyards, or truck crops. The watershed contains both dry and irrigated pasture, and both hay and grains are grown. Industrial activities in the watershed include lumber production and the processing of timber products, wine production, and facilities for the processing of agricultural and animal products, gravel removal and processing, a minor amount of mining and miscellaneous light manufacturing operations. Commercial activities are largely in the fields of distribution and services to supply the needs of those engaged in the agricultural, industrial, and recreational activities mentioned above.

From Ukiah to the county line, there are no developed public access facilities and only one private recreation facility along the river. Some canoeing occurs in the lower part of this area but this activity drops significantly north of Squaw Rock. From the county line to Healdsburg, canoeing is the primary recreational activity except in the Healdsburg area. Bridge crossings in this reach provide the primary access. There are no major public recreation facilities along this reach north of the Healdsburg area. Privately owned land along West Soda Rock Road is a major use area.

The area from Jenner to Healdsburg is much more orientated to tourism and recreation. Along this reach there are substantial numbers of public and private recreational facilities and tourism is actively promoted. The proximity of this area to the ocean is an additional draw to tourists.

2.8 Bodega and Marin Coastal Watersheds

The Bodega and Marin Coastal Watersheds possess many interesting physical features including Mt. Tamalpais, Bolinas Bay, Drakes Bay and Estero, Tomales Bay, and Point Reyes Peninsula (Figure 2.8). Habitat is largely grassland, with some chaparral, woodland-grass, coastal forest, and hardwood forest. Notable redwood groves are in the Muir Woods National Monument and at Samuel Taylor State Park, but these are not extensive (California Department of Fish and Game 1965).

Elevation is from sea level to 2,604 feet (794 meters) on Mt. Tamalpais. Precipitation increases with elevation, annually averaging 28-30 inches (71-76 cm) at sea level and 48-50 inches (122-127 cm) near 2,000 feet (610 meters). Most precipitation occurs between November 1 and April 30 (85-90 percent), peaking in December and January. The cool summers are due to the cooling influence of the ocean and summer fog. Summer temperatures increase with distance from the coast and from the influence of coastal fog; the mean summer temperature is 60-66^{o}F at sea level, but it is 15-20^{o}F warmer in the inland, fog free areas. Mean winter temperature is 47-50^{o}F at sea-level, but is generally cooler on the upper slopes of Mt. Tamalpias and in the low, narrow valleys (Snider 1984).

Over 90 percent of the annual runoff occurs between November 1 and April 30, mainly during and immediately following precipitation (Lehre 1974). A graph of flow duration and intensity would closely parallel a graph of precipitation. This is due to 1) steep upper watersheds promoting rapid runoff, 2) shallow soil and poor permeability resisting recharge and severely limiting storage capacity, and 3) most precipitation falling upon previously saturated ground. Base flow is maintained by slow drainage of water through the soil yielding a low, yet perennial flow in the lower drainage (below 1,900-foot (579 meters) elevation). Summer flow has not been gauged in the drainage. However, based upon Lehre’s (1974) evaluation of hydrology in the region, a summer flow of about 0.05 cfs is estimated to occur along the bedrock courses of the drainage, from near Panoramic Highway to near Spike Buck Creek. Summer flow gradually disappears into the shallow alluvium below Kent Canyon, becoming intermittent, disappearing and reappearing as pools and short flowing sections where bedrock encroaches the surface (Snider 1984).

Figure 2.8 Bodega and Marin Coastal Watersheds

There was an estimated 92 miles (148 kilometers) of coho salmon habitat in Marin County streams in 1963 (California Department of Fish and Game 1965). The Lagunitas Creek Watershed is the largest in the County. Other large streams include Walker Creek, also tributary to Tamales Bay, and Redwood Creek, a tributary to the Pacific Ocean. San Geronimo Creek originates in the northern foothills of Mt. Tamalpais, and flows through a small, linear valley before joining with Lagunitas Creek just below Peters Dam. Willow, alder, bay, and oak are the major riparian species, and the upland areas range from grassland and chaparral on the south facing slopes to mixed evergreen forest on the north facing slopes. Several small towns (Woodacre, San Geronimo, and Lagunitas) are located in the valley and urban development has spread into wooded uplands. A major bedrock outcrop occurs on San Geronimo Creek just above its junction with Lagunitas Creek. Although the stream has formed several large pools in the rock (locally called the "Inkwells"), and salmonids are able to migrate past this obstruction at most flows, migration has been inhibited in past years. Roy's Dam in San Geronimo has been a barrier, but a fishway has been constructed to pass salmon and steelhead trout during spawning migrations. Several other minor migration barriers are caused by road crossings between San Geronimo and Woodacre.

Olema Creek is fed by many small tributaries from canyons on Bolinas Ridge. The stream flows in a northwesterly direction through a narrow valley formed by the San Andreas Rift Zone. The upper watershed is a steep and narrow canyon. The valley and southwest facing slopes are primarily grazing pasture. Northeast slopes are within the Point Reyes National Seashore, and are vegetated by an extensive conifer forest. Vegetation growth along the stream is dense in areas and consists of willow, alder, blackberries, and other typical riparian species. Reported fish species include Pacific lamprey, coho salmon, steelhead trout, goldfish, carp, California roach, Sacramento sucker, threespine stickleback, bluegill, largemouth bass, and sculpin. Public highways are found along San Geronimo, Lagunitas, and Olema creeks, permitting ready access to the streams (Emig 1985).

The Bodega and Marin Coastal Watershed lies completely within the Coast Range geologic province. The Coast Range province is mainly composed of the Franciscan Complex. The Franciscan Complex is Jurassic in age and can be differentiated into 2 belts of rocks: the Eastern Franciscan Belt and the Central Franciscan Belt. These belts consist of isolated blocks of exotic serpentine, greenstone, blueschist, eclogite, chert, ultramafic rocks and greywacke in a highly sheared mudstone matrix. This belt of rocks is very deformed with many folds and small-scale faults. The San Andreas Fault Zone, which crosses along the western edge of the watersheds, delineates the Franciscan Complex to the west and the Salinian Block to the east. The Salinian Block is Cretaceous in age and is composed of granitic rocks, predominately granodiorite, and minor amounts of metamorphic rocks including marble, quartzite, gneiss and schist. Widespread Cenozoic sedimentary watershed deposits, composed of mainly sandstones and shales, overlie both the Franciscan Complex and the Salinian Block. The youngest material in the watershed is recent, mainly Holocene, alluvial, coastal and aeolean deposits. These deposits are located along the coast.

2.8.1 WALKER CREEK

2.8.1.1 Overview

Walker Creek is a small stream originating in the rolling hills of Marin County, California, and meandering northwest 18 miles (29 kilometers) to enter the north end of Tomales Bay.

2.8.1.2 Hydrology/Water Quality

Releases from Soulajoule Reservoir, a 10,000 acre-feet capacity impoundment on Arroyo Sausal, a major tributary of Walker Creek, are designed to improve salmon and steelhead trout habitat in most years. Natural surface flows often cease by midsummer of each year. According to an agreement between Department and the Marin Municipal Water District, approved on July 30, 1985, winter releases of 10 to 20 cfs, and summer releases of 2-5 cfs are made, depending on reservoir storage. In exceptionally dry years, a release of 0.5 cfs is made. Licensed, permitted or pending water rights are depicted in Figure 2.8.

Gambonini Mercury Mine contributed large quantities of mercury to the Walker Creek Watershed for over 50 years. This abandoned mine site was clean-up in 1998 through an Emergency Action by US EPA; however, the mercury that previously escaped the site continues to degrade water quality in this drainage.

2.8.1.3 Fish Resources

The current fish population of Walker Creek is mostly dominated by western roach. A few coho salmon have been found in the canyon area near the confluence of Chileno Creek and just downstream of the confluence of Salmon Creek and Arroyo Sausal (Emig 1984). Long ago, large numbers of coho salmon and steelhead trout migrated into Walker Creek each year to spawn, but for the past several decades only a few have done so. Their numbers have not been enough to sustain any significant fishing. Many long-term residents of Marin County remember when Walker Creek supported salmon and steelhead trout runs. They reported adult steelhead trout migrating nearly 25 miles (40 kilometers) upstream to spawn in the headwaters of a tributary, Arroyo Sausal. In 1981, a survey reported Pacific lamprey, coho salmon, steelhead trout, California roach, mosquito fish, threespine stickleback, bluegill, and sculpin in Walker Creek (Emig 1984).

Peter F. Worsely (1972), in a report to the Conservation Foundation, wrote, “Walker Creek itself at one time had a good return of spawning silver salmon and steelhead trout. It is said that 40 to 50 years ago it was difficult to drive a horse and buggy across the stream at the height of the winter run because of the numbers of fish in the shallow water.” Small numbers of steelhead trout are reported by local fishermen to swim upstream each year.

2.8.1.4 Fish Facilities

There are no fish hatcheries or facilities on Walker Creek.

2.8.1.5 Recreational/Commercial Fishing Interests

Walker Creek mainstem above Highway 1 and all Walker Creek tributaries are closed to fishing all year. Walker Creek below Highway 1 has the following regulations. Only artificial lures with barbless hooks may be used from the fourth Saturday in May through Oct. 31. Only barbless hooks may be used from Nov. 1 through Mar. 31.

2.8.1.6 Land-Use/Planning

Major land uses in the Walker Creek watershed include sheep and cattle grazing.

2.8.2 LAGUNITAS CREEK

2.8.2.1 Overview

Lagunitas Creek originates on the north slopes of Mt. Tamalpais, Marin County. It flows some 25 miles (40 kilometers) to discharge into the southern end of Tomales Bay near Pt. Reyes Station. The major tributaries are Olema creek, Nicasio Creek, Devil's Gulch Creek, and San Geronimo Creek. The entire watershed covers approximately 83,239 acres. A coast redwood and Douglas-fir forest is the primary vegetation type in this area. The riparian zone contains willow, red alder, bigleaf maple, Oregon ash, and California bay. Grassland and chaparral are found in upland areas, particularly on ridges and the drier southwest facing slopes.

Below the northern State Park boundary, the gradient of Lagunitas Creek declines, and the stream flows through a narrow valley, which broadens as it approaches Tomales Bay. Riparian growth is dense except for areas heavily grazed by cattle. A mixed evergreen forest replaces the redwood and fir found in the State Park area. Extensive tracts of grassland are found on ridges and drier upland slopes.

Lagunitas Creek once supported large numbers of coho salmon and steelhead trout, but populations have been significantly reduced by inadequate instream flows, prolonged drought, and habitat loss. The coho salmon decline may also be related to other factors in that this species has declined in most streams along the West Coast of the United States. Another notable resource is the endangered California freshwater shrimp. Fresh water outflow from the creek also plays a significant role in the maintenance of the Tomales Bay Estuary.

2.8.2.2 Hydrology/Water Quality

The maximum mean daily discharge in winter has ranged from 29 cfs during the 1976 drought to 10,600 cfs in January 1982. Usually, the winter flow maximum has been between 1,200 and 3,800 cfs. Summer flows have been approximately three cfs, with flow less than one cfs during the drought of 1976-77 and in October of some years. Below Peters Dam, Lagunitas Creek flows north through a narrow canyon, which is part of Samuel Taylor State Park.

Lagunitas Creek is a good example of the difficulty in satisfying competing water demands in a small, coastal watershed. The system is one of the major watercourses in Marin County, draining from the northern slopes of Mount Tamalpais to Tomales Bay. Marin Municipal Water District is the largest user of Lagunitas Creek water and operates Lagunitas, Bon Tempe, Kent, and Alpine reservoirs on the main stream and Nicasio Reservoir on a tributary. The system provides basic water supplies to approximately 170,000 people in Marin County. Lagunitas Creek is also used by North Marin Water District, which serves approximately 1,000 to 1,500 residents in the Point Reyes Station area. Municipal demand is expected to increase as a result of continuing population growth. There are also two substantial agricultural users, one of who operates Giacomini Dam at the mouth of the creek. Licensed, permitted or pending water rights are depicted in Figure 2.8.

The environmental needs of the system were recognized by the SWRCB in 1982, when a minimum flow of 1 cfs was established at the Giacomini Dam fish ladder. However, recent drought conditions and rapid population growth have made it clear that there is significant potential for demand to habitually exceed the available supply. In 1990, MMWD, the Department, and several other concerned parties requested new SWRCB hearings to resolve these conflicts. Hearings were held in spring 1992; the SWRCB heard testimony on the instream flow and water quality needs for fisheries, freshwater requirements of Tomales Bay, and the present and anticipated future status of agricultural and municipal water needs. (Bulletin 160-93, The California Water Plan Update, October 1994)

2.8.2.3 Fish Resources

Lagunitas Creek once supported a substantial run of steelhead trout and an annual escapement of 3,000 to 5,000 coho salmon. The Creek now supports significantly reduced numbers of these species. Roach (*Hesperoleucus symmetricus*), sculpin (*Cottus asper* and/or *C. aleuticus*), threespine stickleback (*Gasterosteus aculeatus*), pacific lamprey (*Entosphenus tridentatus*), Sacramento sucker (*Catostomus occidentalis*), bluegill (*Lepomis macrochirus*), and the endangered California freshwater shrimp (*Syncaris pacifica*) are found in the stream.

2.8.2.4 Fish Facilities

There are no fish hatcheries or facilities on Lagunitas Creek.

2.8.2.5 Recreational/Commercial Fishing Interests

Before 1982, fishing was permitted during the summer months, but present regulations prohibit all angling in Lagunitas Creek and tributaries.

2.8.2.6 Land-Use/Planning

Although largely in private ownership, some sections of Lagunitas Creek are within lands of the Golden Gate National Recreation Area. Private lands are used primarily for cattle grazing. The State Park has high recreational use, because of its pleasant environment and its proximity to the San Francisco metropolitan area. Picnicking, camping, hiking, swimming, biking, and jogging are the major outdoor activities.

2.8.3 REDWOOD CREEK

2.8.3.1 Overview

The Redwood Creek drainage is situated in the coastal mountains of southwestern Marin County about 10 miles (16 kilometers) north of San Francisco. The drainage encompasses about 9 square miles (23 square kilometers), originating on the southern slopes of Mt. Tamalpias (2,600-foot (792 meters) elevation) and entering the Pacific Ocean at Muir Beach about 9 miles (14.5 kilometers) downstream. Redwood Creek begins at the confluence of Bootjack and Rattlesnake creeks (640-foot (195 meters) elevation), 6 miles (9.6 kilometers) above the mouth. Fern Creek (180-foot (55 meters) elevation, 4.2 miles (6.7 kilometers) above the mouth), Kent Canyon (60-foot (18.3 meters) elevation, 2.1 miles (3.4 kilometers) above the mouth) and Green Gulch (20-foot (6 meters) elevation, 0.3 miles (0.5 kilometers) above the mouth) are the major tributaries to Redwood Creek. Bootjack, Rattlesnake, Fern, Spike Buck creeks and upper Redwood Creek flow through deep, V-shaped canyons formed by the rapid runoff down the steep, rocky slopes of Mt. Tamalpias. The canyon widens and deposition begins to increase as the gradient lessens near Fern Creek. Above Fern Creek, Redwood Creek flows through a fairly narrow canyon bordered by a redwood and evergreen forest. Below Fern Creek, the canyon widens into a flat, alluvial valley (Frank Valley), which is wide and bordered by rolling, grass and shrub covered slopes, interspersed with cultivated crops and eucalyptus groves. Streamside vegetation below

Fern Creek is predominantly red alder, providing a dense continuous canopy nearly all the way to the mouth. The final 600 to 1,000-foot (183-305 meters) of stream passes through an intertidal area and across beach sand into the ocean (Snider 1984).

2.8.3.2 Hydrology/Water Quality

Four wells currently divert water from the Redwood Creek alluvium. One provides domestic water to two Park residences (about 150 gallons per day), one provides irrigation water to a commercial flower farm located adjacent to Redwood Creek near the mouth, and two provide water to Muir Beach area residents (Vollintine 1973). The diversions significantly reduce surface water flow within the last mile of stream (Arnold 1971). Licensed, permitted or pending water rights are depicted in Figure 2.8.

Wastewater disposal includes domestic waste disposal to septic systems, and agriculture waste water runoff from the commercial flower farm. Effluent from septic systems close to the shallow ground water, and the runoff of pesticides, have reportedly degraded water quality during low summer flow conditions, by entering pools and creating noxious conditions (Vollintine 1973).

Identified erosion sources in the drainage include the cultivated flower fields, logging activities in upper Kent Canyon (Arnold 1971) and trail development (Vollintine 1973). None of these sources have caused recent damage to stream habitat. The logging occurred in the 1960's and apparently caused severe damage at that time.

Streambed alteration has been most severe in the lower drainage. Historically, a large, deep lagoon (Big Lagoon) persisted in the lower 900 to 1,500 feet (274-457 meters) of the stream. Today, the upper part of the lagoon area is composed of a large, curved pool, the result of years of dredging and building levees and summer dams. The pool annually fills with the winter runoff, and is cleaned out by bulldozers in the summer. Apparently, the pool is used to collect water for irrigating the adjacent fields, and to prevent salt water from reaching upstream to the vicinity of the diversion. A tidal gate is built into the dam preventing upstream movement of tidal flow. The result has been loss of the lagoon (Snider 1984). Arnold (1971) also reported that grading within the streambed in the vicinity of the well diversion, associated with the pool, completely destroyed fish habitat in 1968.

2.8.3.3 Fish Resources

Fishes native to Redwood Creek include steelhead trout, coho salmon, threespine stickleback, prickly sculpin, and riffle sculpin (Snider 1984). Other species have been occasionally found in the tidal area of lower Redwood Creek, including striped bass, staghorn sculpin, and starry flounder (Arnold 1971).

2.8.3.4 Fish Facilities

There are no fish hatcheries or facilities on Redwood Creek.

2.8.3.5 Recreational/Commercial Fishing Interests

Redwood Creek is closed to fishing all year.

2.8.3.6 Land-Use/Planning

Land use and development in the Redwood Creek drainage ranges from open space recreation within Mt. Tamalpias State Park and Muir Woods National Monument to moderately dense residential development at Muir Beach. Associated impacts affecting the fishery resource include water division, wastewater disposal, and streambed alteration (Snider 1984).

2.9 San Francisco Bay Region

San Francisco Bay, which includes North (San Pablo), Suisun, Central, and South bays, extends about 85 miles (137 kilometers) from the east end of Chipps Island (in Suisun Bay near the City of Antioch) westward and southward to the mouth of Coyote Creek (tributary to South Bay near the City of San Jose) (Figure 2.9). The surface area of San Francisco Bay is about 400 square miles (1036 square kilometers) at mean tide. This is about a 40 percent reduction, due to fill, from its original size. Most of the Bay's shoreline has a flat slope, which causes the intertidal zone to be relatively large. San Francisco Bay is surrounded by about 130 square miles (337 square kilometers) of tidal flats and marshes.

The region has a Mediterranean climate, with a wet season from approximately November through April and minimal rainfall during May through October. Average rainfall varies greatly due to topography: parts of the Santa Cruz Mountains receive 40 to 60 inches (101-152 cm) per year, while central Santa Clara Valley averages 13 to 14 inches (33-35.5 cm). Temperatures in the region tend to be mild, rarely far below freezing, while average summer temperatures seldom go above 90^{o} F.

The San Francisco Bay estuary is composed of six natural vegetation communities, including riparian, grassland, freshwater emergent wetland, saline emergent wetland, foothill woodland, and mixed chaparral. The complex interface between land and water in the San Francisco Bay estuary provides a variety of habitats for wildlife. Large numbers of migratory waterfowl dominate the landscape, especially in Suisun Marsh. Habitats at low elevations include open water, tidal mudflats, diked and undiked marshland, and riparian vegetation; grasslands, agricultural land, woodland, and chaparral can be found in upland areas.

The San Francisco Bay complex supports a wide variety of fish - more than 100 fish species. Habitat types in the Bay include open water, tidal mudflats, and marshland. The anadromous species of fish that occur in San Francisco Bay system include chinook salmon, striped bass, sturgeon, American shad, and steelhead trout. Coho salmon occurred in the bay historically and as recently as the 1980's (Leidy 1984), but more recent reports have been few. Marine fish, found mainly in the lower bays, include flatfish, sharks, Pacific herring, jacksmelt, topsmelt, and surf perch. Other fish in the estuary include catfish, black bass, crappie, bluegill. Shellfish include mussels, oysters, clams, crabs, and shrimp.

Some of the region's streams either known to have had coho salmon runs, or thought to have had historical runs of coho salmon include: Arroyo Corte Madera Creek, Corte Madera Creek, San Rafael Creek, Walnut Creek, San Pablo Creek, Strawberry Creek, San Leandro Creek, Alameda Creek, and Coyote Creek.

Water quality in the San Francisco Bay system is impacted by several factors. For example, the presence of elevated concentrations of toxic pollutants in the bays, from both point and nonpoint sources, has caused them to be listed as impaired water bodies. The State Department of Health

Figure 2.9 San Francisco Bay

Services has issued health advisories on the consumption of the Bay's fish and certain waterfowl due to their elevated levels of selenium and other metals.

The San Francisco Bay Region lies completely within the Coast Range geologic province, which is mainly composed of the Franciscan Complex. The Franciscan Complex is Jurassic in age and can be differentiated into 2 belts of rocks: the Eastern Franciscan Belt and the Central Franciscan Belt. These belts consist of isolated blocks of exotic serpentine, greenstone, blueschist, eclogite, chert, ultramafic rocks and greywacke in a highly sheared mudstone matrix. Cenozoic volcanic rocks occur in the watershed; these volcanics, called the Sonoma-Tolay Volcanics, range in composition from mainly basalt to rhyolite. The youngest material in the watershed is recent, mainly Holocene, alluvial, coastal and aeolean deposits. These deposits are located in the southern half of the watershed. Mineral deposits, mines, and quarries have played a important role in the water quality of the region; of particular note are the inactive mercury mines in the Napa River Watershed and in the South Bay (New Almaden area), and the inactive sulphur mines in the East Bay.

The San Francisco Bay Region is one of the most seismically active areas in the world. The San Andreas Fault Zone delineates the Franciscan Complex to the west and the Salinian Block to the east. This well-known fault is a left lateral strike slip fault and generally trends northwest. The Hayward Fault Zone parallels the length of the south bay. This fault is a left lateral strike slip fault and generally trends northwest. The Calaveras Fault Zone parallels the length Hayward Fault Zone and lies to the east. The fault is a left lateral strike slip fault and generally trends northwest. The Green Valley Fault parallels the Calaveras Fault Zone to the east. The fault is a left lateral strike slip and generally trends northwest. The Healdsburg Roger Fault Zone cuts across the San Pablo Watershed, which is located in the north of the San Francisco Bay Region. The fault's extent in this watershed is approximately 17 miles (27.4 kilometers). The fault is a left lateral strike slip fault and generally trends northwest.

2.9.1 NORTH (SAN PABLO) BAY

2.9.1.1 Overview

The North Bay includes may urban creeks, such as Corte Madera Creek, San Anselmo Creek, lower Cascade Creek, Arroyo Corte Madera del Presidio, Old Mill Creek, Reed Creek, Widow Creek, Warner Creek, Warner Creek, Bowman Creek, Leveroni Creek, Novoto Creek, Sonoma Creek, and two rivers, Napa and Petaluma Rivers.

These creeks and rivers flow into San Francisco Bay, draining areas that are intensely developed. Most of the watershed is a relatively hot and dry oak savanna or oak woodland. The Arroyo Corte Madera del Presidio watershed drains the east side of Mount Tamalpais and an approximately eight square mile urbanized area, which includes the City of Mill Valley, and other unincorporated areas. Arroyo Corte Madera del Presidio and its tributaries, Old Mill Creek, Reed Creek, Widow Creek and Warner Creek flows into San Francisco Bay, in Richardson Bay. Novato Creek drains eastward to San Pablo Bay, and Sonoma Creek, Napa River and Petaluma River drain southward into San Pablo Bay.

The Sonoma Creek watershed covers an area of approximately 170 square miles (440 square kilometers). Sonoma Creek flows from Sugarloaf Ridge State Park, at about 2,790 feet (850 meters). It is bounded in the west by the Petaluma River watershed (Santa Rosa Creek), and in the south, Sonoma Creek flows to San Pablo Bay via several sloughs at or below mean sea level, that have been highly modified by dredging, levees, and realignment over the last 150 years. Much of the original wetland vegetation has been changed (McKee et al. 2000).

The Napa River watershed contains 426 square miles (1,103 square kilometers) of land located within Napa County. It drains an area approximately 40 miles (64 kilometers) long and 10 miles (16 kilometers) wide. Numerous tributary streams join the river from both sides of the Napa Valley. The larger tributaries are Redwood Creek, Dry Creek, Sulphur Creek, Conn Creek, Soda Creek, and Milliken Creek. There are an estimated 270 miles (434 kilometers) of streams in the Napa River drainage. Approximately 190 miles (306 kilometers) are accessible to steelhead trout. Only 70 miles (112 kilometers) of streams maintain a permanent flow of water. The remainder are dry or intermittent during the summer months (Anderson 1972). The watershed rises at the northwest boundary of the County and drains southeasterly into San Pablo Bay through Mare Island Strait at Vallejo. Elevations range from sea level to 4,344 feet (1,324 meters). The prominent geographical feature of the drainage is the Napa Valley, approximately 1 to 3 miles (1.6-4.8 kilometers) wide and 35 miles (56 kilometers) long (Anderson 1972). The primary habitat types are woodland-grass and chaparral, with lesser amounts of hardwood, woodland-chaparral, and grassland. Riparian vegetation consists of alder, oak, willow, elderberry, cottonwood, snowberry, wild grape and wild berry vines (Anderson 1972).

2.9.1.2 Hydrology/Water Quality

North Bay watersheds are currently listed as impaired for sediment, nutrients, and pathogens, with an increasing downstream trend in both total phosphorus and phosphate. Concentrations in the downstream waters exceed recommendations for a healthy aquatic ecosystem. These North Bay creeks, such as Sonoma Creek, can have very low flows during the dry season and can be completely dry during July, August or September. The lower reaches boarding the Bay are tidal; for example tidal influence in the Napa River extends upstream from San Pablo Bay through the City of Napa to Trancas Street Bridge. The freshwater reach of Napa River varies in width from three feet (0.9 meters) in the headwaters to about 50 feet (15 meters) at the Trancas Street Bridge.

There are a number of obstructions in the form of summer dams, and some other small water impoundments as well as small diversions for agricultural purposes. Licensed, permitted or pending water rights are depicted in Figure 2.9. Stafford Dam, which was completed in 1951, captures water from the upper 8.4 square-miles (21.8 square kilometers) of the Novato Creek Watershed.

2.9.1.3 Fish Resources

In the North Bay, the most important fishery value lies in the freshwater reaches of the creeks and rivers. For example, the Napa River and its tributaries provide spawning areas, nursery areas, and migration routes for steelhead trout. The Napa River historically supported an annual run of 6,000 adult steelhead trout. Steelhead trout inventory studies in 1972 indicated that the river supported an average annual run of only 1,200 to 1,900 fish. Coho salmon once utilized the Napa River as spawning and nursery habitat. Historically, the salmon run averaged 1,000 to 2,000 fish annually. This species, however, is no longer found in the drainage (Anderson 1972). Leidy (1984) reported observing coho salmon in Corte Madera Creek, San Anselmo Creek, and in Arroyo Corte Madera del Presidio. However, later studies (1995 and 1999) found steelhead trout in these creeks, but no coho salmon.

In addition to steelhead trout, these creeks and rivers support a population of introduced warm-water game fishes, including smallmouth bass, white catfish, brown bullhead, and green sunfish. These warm water game fishes support a minor, local sport fishery. The river is also habitat for a variety of non-game fishes. The principal non-game species are carp, California roach, Sacramento squawfish, Sacramento sucker, riffle sculpin, California roach, prickly sculpin, tule perch, Pacific lamprey, and longjaw mudsucker. These warm water game and non-game fishes use the river for spawning, as well as for habitat for other lifestages (Anderson 1972). The pools and riffles provide habitat for a variety of frogs, salamanders, water snakes, crayfish, shrimp, and a host of aquatic insects. These organisms serve as food for organisms higher in the food chain (Anderson 1972).

2.9.1.6 Land Use/Planning

These watersheds are largely urbanized, with some areas of agriculture. The Novato Creek Watershed is heavily impacted by development. In the watershed upstream of Stafford reservoir and on the south-facing slopes of Burdell Mountain ridge below the dam where grassland predominate, dairy ranching is the principal land use. The alluvial valley below Stafford Dam has been almost entirely altered by residential and commercial development. The Sonoma Watershed is highly developed, with a mix of agricultural, commercial, park/open space, residential and urban uses. Some portions of the diked Baylands have been converted to vineyards and several new commercial real estate ventures are being proposed. Agriculture, primarily viticulture and grazing, is a major economic activity in the Napa and Petaluma River watersheds (California Department of Fish and Game 1965).

2.9.2 SUISUN BAY

2.9.2.1 Overview

The most prominent feature of Suisun Bay is the marshlands. Suisun Marsh is one of the few major marshes remaining in California and the largest remaining brackish wetland in Western North America. Located at the northern edge of Suisun Bay, just west of the confluence of the Sacramento and San Joaquin rivers and south of the City of Fairfield, the Marsh consists of a unique diversity of habitats, including tidal wetlands, sloughs, managed diked wetlands, unmanaged seasonal wetlands, and upland grasslands. Numerous studies have established that tidal marshlands can have significant geomorphic and ecological values, including flood control, shoreline stabilization, sediment entrapment, water quality improvement, and food chain support for aquatic, semi-aquatic and terrestrial plants and animals.

The primary managed area of Suisun Marsh contains 58,600 acres of marsh, managed wetlands, and adjacent grasslands, plus 29,500 acres of bays and waterways. An additional 27,900 acres of varying land types act as a buffer zone. Most of the managed wetlands are enclosed within levee systems.

2.9.2.2 Hydrology/Water Quality

Bay watersheds are currently listed as impaired for sediment, nutrients, and pathogens, with an increasing downstream trend in both total phosphorus and phosphate. Unscreened diversions used to flood managed wetlands in the Marsh represent potential adverse impacts to fishery resources including coho salmon. A screening program currently being implemented is gradually working on screening those diversions in locations that represent the greatest risks. Licensed, permitted or pending water rights are depicted in Figure 2.9.

2.9.2.3 Fish Resources

Introduced striped bass, for which the marsh is an important nursery area, are the most common fish found in the marsh channels. Other anadromous species sometimes found in the marsh include chinook salmon, sturgeon, American shad, and steelhead trout. Catfish are a common resident species in Suisun Marsh and provide a popular sport fishery. Coho salmon may have used this area as a migration corridor and, under conditions of higher outflow, use the tidal submergent and emergent wetlands as rearing habitat.

2.9.2.4 Fish Facilities

There are no fish rearing facilities in Suisun Bay.

2.9.2.5 Recreational/Commercial Fishing Interests

About 70 percent of the managed wetlands are privately owned by more than 150 duck clubs. The Department owns and manages 14,000 acres, while another 1,400 acres on the channel islands is owned by the federal government. This area is heavily used for fish and wildlife hunting and viewing.

2.9.2.6 Land-Use/Planning

Under the 1984 Plan of Protection for the Marsh and the 1987 Suisun Marsh Preservation Agreement to mitigate the effects of upstream water projects on the marsh, the staged construction of extensive marsh water control facilities was planned. To date, the salinity control structure on Montezuma Slough, a major waterway in the Marsh, has been constructed. This facility helps to ensure that a dependable supply of water of suitable salinity is available to preserve marsh habitat, including food plants for waterfowl.

2.9.3 CENTRAL (EAST) BAY

2.9.3.1 Overview

The watersheds in the Central Bay are largely urbanized. Strawberry Creek is representative of watersheds of this area. The Strawberry Creek watershed lies east of Oxford Street in Berkeley. The entire runoff from the 1,163 acre (1.8 square miles or 4.6 square kilometers) watershed is delivered to the entrance of the city culvert at Oxford Street, which runs underground in a westerly direction, eventually emptying into San Francisco Bay near University Avenue. Elevation ranges from about 1,760 feet (536 meters) at the crest of the Berkeley Hills down to 200 feet (61 meters) at the west end of the central campus (Oxford Street), constituting a drop of over 1,500 feet (457 meters) in elevation in the upper watershed (Charbonneau 1987).

2.9.3.2 Hydrology/Water Quality

Bay watersheds are currently listed as impaired for sediment, nutrients, and pathogens, with an increasing downstream trend in both total phosphorus and phosphate. Various newspaper articles in the 1970's and 1980's relate the continuing water quality problems in Strawberry Creek. A 1981 article states that the creek is treated as a sewer contaminated by urban runoff, chemicals, drains, and sewage. Berkeley Health Department officials advised citizens not to enter the creek at that time.

Water quantity is also an issue. Waterworks were constructed in Strawberry Canyon in the 1860's to supply water to farms and speculators. Springs were developed, pipes laid, and wooden flumes constructed to carry the water. In 1867, a brick reservoir was constructed in the canyon and waterworks placed to deliver more water. In October of 1882 the University built five check dams along Strawberry Creek in an attempt to stop streambed incision and subsequent bank erosion on the central campus. Licensed, permitted or pending water rights are depicted in Figure 2.9.

2.9.3.3 Fish Resources

It is believed the native fish of Strawberry Creek disappeared in the late 1800's, partly due to excessive water removal to provide water supply for the UC Berkeley Campus and flows being replaced with raw sewage. Anecdotal evidence of coho salmon in Strawberry Creek has not been verified (Leidy, pers. comm.). The following native fish species have been reintroduced to Strawberry Creek since 1989: threespine stickleback, California roach, hitch, Sacramento suckers, prickly sculpin (Charbonneau, pers. comm.).

2.9.3.4 Fish Facilities

A fish hatchery owned and operated by the State was situated on Strawberry Creek, on the grounds of the University of California, Berkeley. Through 1873, the California Acclimatization Society actually operated this hatchery and was paid by the Commission for the trout reared. Because the building was too small for the quantities of fish to be reared and lacked a reliable water supply, its operations were replaced by the larger San Leandro Hatchery in 1878.

2.9.3.5 Recreational/Commercial Fishing Interests

There is little opportunity for fishing in the freshwater reaches of creeks of the Central Bay; however, the tidal reaches do provide some recreational fishing.

2.9.3.6 Land use

The Gold Rush of 1849 opened the East Bay to land development booms. The Berkeley area bore the brunt of the influx of American settlers as development spread across the Bay from San Francisco. In 1860, the College of California moved to its present site from Oakland. Cattle were introduced into the hill area in the 1850's and grazed on imported annual grasses that quickly established themselves. Eventually these grasses out-competed the native perennial bunch grasses that could not survive the impacts of heavy grazing. Dairy farms were located in Strawberry Canyon before the land became part of UC holdings in 1909 and cattle continued grazing in the hills until the 1930's. Grass-oak savannah was the vegetative cover in the canyon as shown in photographs taken in 1870 and 1901. The East Bay creeks supported a growing timber trade that significantly depleted the tree cover of the upper creeks. This was especially true during the rebuilding period, which followed the 1906 San Francisco earthquake and fire. Eucalyptus was often planted throughout the East Bay hills in the early 1900's by small private water companies as a means of profiting from the shortage of California hardwood lumber at the time (Charbonneau, 1987).

The Strawberry Watershed represents the picture of the Central Bay. Today, the upper 1,163 acres of the watershed upstream from downtown Berkeley are 22% institutional (UC Berkeley campus), 9% single family residential, 3% multi-family residential, 2% recreational (athletic fields), 1% commercial, 2% open space (undeveloped), 30 % north coastal scrub, 22% woodland, and 9% coniferous (Monterey cypress) (Charbonneau, 1987).

2.9.4 SOUTH BAY

2.9.4.1 Overview

Principal watersheds in the South Bay include Alameda Creek, San Francisquito Creek, Stevens Creek, Guadalupe River, and Coyote Creek and their tributaries. The physical environment encompasses a number of different landform types, most notably the flatlands and rolling hills of the Livermore Valley, the increasingly rugged terrain associated with the Niles Canyon and Sunol-Ohlone Regional Wilderness areas, and the lowlands of the Bay coastal plain (Figure 1).

San Francisquito Creek watershed drains approximately 45 square miles (116 square kilometers) of northwestern Santa Clara and southeastern San Mateo counties. The creek itself flows 12.5 miles (20 kilometers) from Searsville Dam to the Bay. Stevens Creek watershed is bounded on the northwest by the Permanente Creek watershed and on the southeast by the Calabazas Creek watershed. The creek originates at about the 2,500-foot (762 meters) elevation on the northeast-facing slopes of the Santa Cruz Mountains just to the east of Skyline Boulevard. From here it flows southeasterly for 5.5 miles (8.8 kilometers) before heading northeast and then north to Stevens Creek Reservoir. From Stevens Creek Dam, the creek flows northward about 13 miles (21 kilometers) to the Bay. The watershed drains approximately 38 square miles (98 square kilometers), including almost 9 square miles (23 square kilometers) of the Permanente Creek Watershed, whose peak flows were diverted to Stevens Creek in 1959. Guadalupe River watershed headwaters are in the eastern Santa Cruz Mountains near the summit of Loma Prieta, elevation 3,790 feet (1,155 meters). Guadalupe River begins at the confluence of Alamitos Creek and Guadalupe Creek, just downstream of Coleman Road in San Jose. From here it flows north approximately 14 miles (22.5 kilometers) through heavily urbanized portions of San Jose, eventually discharging to the Bay via Alviso Slough. South of State Highway 237, the watershed has a total drainage area of approximately 170 square miles (440 square kilometers). Three tributaries join the Guadalupe River as it flows north towards San Francisco Bay: Ross, Canoas, and Los Gatos creeks. Los Gatos Creek joins the Guadalupe River in downtown San Jose (Santa Clara Watershed Watershed Management Initiative 2000).

Coyote Creek watershed is the largest watershed in this area, covering approximately 320 square miles (829 square kilometers) and draining most of the west-facing slope of the Diablo Range. The creek originates in the mountains of the Diablo Range northeast of Morgan Hill and flows northwest approximately 42 miles (67 kilometers) before entering the South Bay. After leaving the mountains, Coyote Creek flows about 30 miles (48 kilometers) northwest along the floor of the Santa Clara Valley to the Bay. Alteration of the creek began before 1900, resulting in the high-terrace riparian vegetation being replaced by orchards and farmlands. A middle terrace has managed to survive, with cottonwoods dominating the riparian corridor. In spite of alterations over nearly a century, lower Coyote Creek is considered the highest quality riparian corridor remaining in the South Bay Region (Santa Clara Basin Watershed Management Initiative 2000).

On the upper watersheds of the South Bay, scattered oak and madrone woodlands intermingle with grassland, in some areas forming a savanna. Residential development varies from light to the heavily- developed flat valley floor. Native trees in the riparian corridor include valley oak, coast live oak, willows, and California buckeyes. Common native riparian shrubs include coffeeberry, ocean spray, and creeping snowberry (Santa Clara Basin Watershed Management Initiative 2000).

2.9.4.2 Hydrology/Water Quality

All the creeks and rivers in this region are highly altered. Alameda Creek is usually a perennial stream in the upper parts of the watershed, but in the Sunol Valley, a high rate of infiltration normally results in a dry creek during the summer months. The hydrology of the Alameda Creek watershed has also been greatly altered by water supply activities. Creek channels are frequently used to move water from one facility to another, and thus a creek reach can have significant flow due to water releases from various facilities. Licensed, permitted or pending water rights are depicted in Figure 2.9.

Six major reservoirs are in the Guadalupe River watershed: Calero Reservoir on Calero Creek, Guadalupe Reservoir on Guadalupe Creek, Almaden Reservoir on Alamitos Creek, Vasona Reservoir, Lexington Reservoir, and Lake Elsman on Los Gatos Creek. These reservoirs, all built for water conservation and storage, also provide varying amounts of flood control. During the drier months, the Water District augments the natural recharge of groundwater along the Guadalupe River and its tributaries through an artificial recharge program. Prior to 1995, the Water District used temporary dams to enhance instream recharge. In 1995, the District lost its permits for the operation of such dams and has not been able to get them renewed (Santa Clara Basin Watershed Management Initiative 2000).

Two major reservoirs lie in the upper Coyote Creek watershed, Coyote Reservoir, built in 1936, and Anderson Reservoir, built in 1950. Nine major tributaries to Coyote Creek lie within the drainage area to these two reservoirs. Coyote Creek receives freshwater discharged from the San Jose-Santa Clara Water Pollution Control Plant just upstream from its confluence with the Bay. Some of this freshwater is pushed back upstream by incoming tides. Coyote Creek streamflows are extensively regulated. Downstream of Anderson Reservoir, water is diverted into a 6-mile canal and discharged for groundwater recharge in Metcalf and the Ford Road ponds. Consequently, the reach between Anderson Reservoir and Metcalf Pond runs dry in all but the wettest years. Downstream of the percolation ponds, the stream channel runs dry or intermittently most summers. Lower reaches are fed by groundwater, but water quantity and quality are low (Santa Clara Basin Watershed Management Initiative 2000).

2.9.4.3 Fish Resources

Despite the urbanization of the South Bay, many of the creeks retain some fish habitat. Thirteen native fish species are found in the Alameda Creek watershed. Alameda Creek watershed has supported anadromous steelhead trout in the past, and currently supports rainbow trout. The San Francisquito Creek watershed is famous for its reproducing steelhead trout population, but extremely high natural sedimentation rates and erosion due to human settlement are concerns. In addition to steelhead trout, native fish in the San Francisquito Creek are the California roach, Sacramento sucker, hitch, speckled dace, threespined stickleback, and prickly sculpin; seven nonnative species also exist. Stevens Creek supports a native fish fauna in its upper reaches, which includes resident rainbow trout, California roach, and Sacramento sucker. Nonnative fish are more common in the middle and lower reaches. The creek is also thought to support a reproducing population of steelhead trout (Santa Clara Basin Watershed Management Initiative 2000).

The Guadalupe River supports six of the seven native fish that occurred historically, but nonnative fish dominate the system. Fifteen nonnative species have been collected. The river continues to support a remnant run of steelhead trout, but the population had declined significantly by 1962 following construction of reservoirs on all main tributaries. From the time dams were installed in the river system up until 1999, steelhead trout were confined to the mainstem of the Guadalupe River and lower Los Gatos Creek, with limited spawning and rearing habitat. A small run of chinook salmon occurs in the Guadalupe River. At present it is unclear as to the origin of the Guadalupe River run of chinook salmon. Chinook salmon young spend only a few months in freshwater and leave the system before the summer months, when rearing conditions are marginal (Santa Clara Basin Watershed Management Initiative 2000).

Coyote Creek still has the most diverse native fish fauna among the Santa Clara Basin watersheds. Native fish species in the drainage are steelhead/rainbow trout, Pacific lamprey, California roach, hitch, Sacramento blackish, Sacramento sucker, threespined stickleback, prickly sculpin, riffle sculpin, tule perch and Sacramento perch. While less common than in Guadalupe River, chinook salmon have been observed in Coyote Creek since the mid 1980s. Numerous migration barriers for steelhead trout and salmon exist on Coyote Creek and its tributaries, including permanent dams, seasonal dams, drop structures, and dry stream reaches. Anderson Dam is the impassable terminal barrier on the mainstem. Some coho salmon were apparently present in Coyote Creek as late as the 1950's, at the time Anderson Dam was constructed (L.J. Hendricks, cited in Smith, 1998) (Santa Clara Basin Watershed Management Initiative 2000).

2.9.4.4 Fish Facilities

Rainbow trout of hatchery origin were stocked in Del Valle Reservoir by the East Bay Regional Park District and in Niles Canyon by the Department.

2.9.4.5 Recreational/Commercial Fishing Interests

There have been two recreational put-and-take fisheries within the Alameda Creek watershed, one at Shadow Cliffs Regional Park near Pleasanton, supported through a stocking program that was managed by EBRPD, and the second within Niles Canyon that was supported by CDF&G. Currently, hatchery-raised rainbow trout are no longer released at either location. EBRPD is in the process of developing a venue for a put-and-take fishery at the Fremont quarry ponds also used for groundwater recharge by the ACWD. The stocking of this fishery is anticipated to be in operation by the end of 2001.

2.9.4.6 Land Use/Planning

Land uses in the region include residential, commercial, light industrial, agricultural, ranch and parklands. Within the watershed are three counties, a number of cities and unincorporated areas, and different municipal agencies responsible for overseeing the various needs for water supply, flood control, and sewage treatment. Coyote Creek flows through unincorporated, predominately agricultural but rapidly urbanizing land between Morgan Hill and San Jose, and through the urbanized areas of San Jose close to the Bay.

2.10 Pacific Ocean

Like all salmon species, juvenile coho salmon forage and grow to maturity in the North Pacific Ocean and near shore environments. The Pacific Ocean environment that is part of this document includes waters from the coast to 3 miles (4.8 kilometers) off shore, and from the outlet of San Francisco Bay to the Oregon boarder. Although relatively little is known about ocean distribution of coho salmon, they inhabit waters of the North Pacific Ocean from California north to Point Hope Alaska, south along the Aleutian Islands, and from the Anadyr River, Russia, south to Hokkaido, Japan (Hassler et al. 1991; Sandercock 1991). Upon entry into the marine environment, some coho salmon may undertake lengthy ocean migrations, but most remain within a few hundred kilometers of their natal streams (Shapovalov and Taft 1954; Moyle 1976).

California coho salmon enter the ocean environment mainly as one-year old fish (Shapovalov and Taft 1954), although a small percentage emigrate as two-year olds (Boydstun et al. 1992). Peak emigration of juveniles to the ocean occurs in April or May, but emigration can begin as early as March and can continue into June. Upon entry into the ocean, juvenile coho salmon remain in near-shore waters (Shapovalov and Taft 1954), and probably stay there for a few months before dispersing. Juvenile coho salmon mostly remain within ocean waters associated with the continental shelf (Shapovalov and Taft 1954), and they forage in these areas to a depth of 90 meters. Primary food sources consist of marine invertebrates and other zooplankton and larval and small fishes.

Coho salmon smolts entering the ocean from California streams eventually move northward along the coast (Sandercock 1991). After about 12 months at sea, they begin migrating southward, but some appear to follow a counter-clockwise circuit in the Gulf of Alaska (Sandercock 1991). They apparently do not drift, but actively migrate in a circular pattern (Royce et al. 1968, as cited in Sandercock 1991). In the open ocean, coho salmon generally inhabit the upper areas of the water column to a depth of 30 meters. There are indications that stocks do not segregate in the open ocean, but mix with different age classes and other salmon species.

Mature California coho salmon leave the ocean and begin their spawning migration beginning in September (peak spawning is in November through January) (Shapovalov and Taft 1954). However, river entry can be delayed due to sand bar formation across the mouth of the stream, coinciding with dry conditions in summer and fall. Fish cannot enter the stream until the bar is broken, which usually occurs with the first significant storms of the wet season. There are indications that coho salmon will remain for a period of time at or near the mouth of a stream waiting for the bar to break (Shapovalov and Taft 1954).

Commercial fishing operations in California waters are prohibited from retaining coho salmon and must release them when caught. On the California coast, there are 19 ports (or groups of ports) at which sport anglers may launch their boats to fish for salmon. Crescent City is the most northerly of these and Avila the most southerly. There are many other ports south of Avila, but salmon are rare (California Department of Fish and Game 1965). Similar to commercial salmon fishing, ocean sport anglers must release coho salmon when caught.

2.11 Resources Unique or Rare to the Affected Environment

The following species are unique or rare in the affected environment and will be considered in the impact analysis for this proposed project. The list of species considered herein was restricted to those that could be directly impacted by in-stream activities of the proposed action (see tables on next pages).

Table 2.11a Special Status Aquatic Species from the Natural Diversity Database (NDDB) Within the Project Area				
Common Name:	**Watershed(s):**	**Scientific Name:**	**Federal Listing:**	**State Listing:**
Del Norte Salamander	Smith, Klamath, Trinity, Mad, Redwood (Hum), Eureka Plain	*Plethodon elongatus*	Species of Concern	None
California Tiger Salamander	Marin, San Francisco	*Ambystorna tigrinum*	Species of Concern	None
Foothill Yellow-legged Frog	Smith, Klamath, Trinity, Eel, Mad, Redwood (Hum), Russian, San Francisco	*Rana boylii*	Species of Concern	None
Northern Red-legged Frog	Smith, Eel, Mad, Redwood (Hum), Mendocino, Marin, San Francisco	*Rana aurora aurora*	Species of Concern	None
Tailed Frog	Smith, Klamath, Scott, Salmon, Trinity, Eel, Mad, Redwood (Hum),	*Ascaphus truei*	Species of Concern	None
Northwestern Pond Turtle	Shasta, Trinity, Eel, Mad, Redwood (Hum), Marin, Russian	*Clemmys marmorata marmorata*	Species of Concern	None
Sacramento Splittail	San Francisco	*Pogonichthys macrolepidotus*	Species of Concern	None
Russian River Tule Perch	Russian	*Hysterocarpus traski pomo*	Species of Concern	None
Sacramento Perch	San Francisco	*Archoplites interruptus*	Species of Concern	None
Delta Smelt	San Francisco	*Hypomesus transpacificus*	Threatened	Threatened
Tidewater Goby	Smith, Mad, Redwood (Hum), Eureka Plain, Marin, San Francisco	*Eucyclogobius newberryi*	Endangered	None
California Freshwater Shrimp	Marin, Russian, San Francisco	*Syncaris pacifica*	Endangered	Endangered

Table 2.11b Federal And State Endangered Species Act Status For California Anadromous Salmonids As Of 6/27/01

SPECIES: ESU (ESA) or Population segment (CESA)	**STATUS**	**EFFECTIVE DATE OF LISTING or ACTION**	**CRITICAL HABITAT DESIGNATED?**	**ESA SECTION 9 TAKE PROHIBITIONS APPLY?** [1]
COHO SALMON				
ESA - Southern Oregon/Northern Calif. Coasts	threatened	June 5, 1997	Yes	Yes (Interim)
ESA - Central California Coast	threatened	Dec. 2, 1996	Yes	Yes
CESA - South of San Francisco Bay	endangered	Dec. 31, 1995		
CESA - North of San Francisco	**candidate**	**Apr. 27, 2001**		
CHINOOK SALMON				
ESA - Sacramento River Winter-Run	endangered	Emergency listed as threatened Aug 1989; final listed as threatened Nov 1990; reclassified as endangered Feb 3, 1994	Yes	Yes
ESA - Central Valley Spring-Run	threatened	Nov. 15, 1999	Yes	No
ESA - Central Valley Fall and Late Fall-Run	candidate	Sep. 16, 1999	na	na
ESA - Southern Oregon and Northern California Coastal	not warranted	Sep. 16, 1999	na	na
ESA - California Coastal	threatened	Nov. 15, 1999	Yes	No
ESA - Upper Klamath - Trinity Rivers	not warranted	March 9, 1998	na	na
CESA - Sacramento River Winter-Run	endangered	Sep. 22, 1989		
CESA - Sacramento River Spring-Run	threatened	February 5, 1999		
STEELHEAD				
ESA - Southern California [2]	endangered	October 17, 1997	Yes	Yes
ESA - South-Central California Coast	threatened	October 17, 1997	Yes	Yes
ESA - Central California Coast	threatened	October 17, 1997	Yes	Yes
ESA - Central Valley, California	threatened	May 18, 1998	Yes	Yes
ESA - Northern California	threatened	August 7, 2000	No	No
ESA - Klamath Mountains Province	not warranted	March 28, 2001	na	na
COASTAL CUTTHROAT TROUT [3]				
ESA - Southern Oregon/California Coasts	not warranted	April 5, 1999	na	na

[1] For species listed as ESA endangered, ESA section 9 take prohibitions apply when final listing becomes effective. For ESA threatened species, section 9 take prohibitions do not apply unless and until an ESA section 4(d) rule is promulgated.

[2] NMFS has proposed to extend the range of the Southern California ESU to include populations of steelhead that occur in watersheds south of Malibu Creek to, and including, San Mateo Creek in San Diego County.

[3] ESA jurisdiction for coastal cutthroat trout was transferred from NMFS to the USFWS on 11/22/99.

2.11.1 COHO SALMON

Coho salmon, formally called silver salmon, are native to the northern Pacific from northern Japan to central California. The coho salmon life cycle is approximately three years from egg to adult, utilizing both fresh and salt water environments. Coho salmon generally return to their natal streams to spawn, where the young grow for one to two years, before they move to the ocean. Outmigration occurs from April to June with the peak in late April through May. Once in the ocean they gain in size and weight, mature into adults, and return to spawn. In some coastal streams, the first rains are needed to open the sand bar at the mouth before upstream migration can occur. The adults usually run from October to January, with the peak in November and December. Spawning usually occurs from December to January, but can be delayed by drought conditions.

Coho salmon require highly complex stream habitats. There are many components that make up these complex habitats, some of which are:

- large woody debris,
- under cut stream banks and root wads,
- dense canopy cover (understory and overstory),
- instream boulders,
- cool year round water temperatures, and
- low gradient, slow flowing deep pools.

Coho salmon were believed to be abundant in the early part of the twentieth century, and have now decreased in California to 90% of their original population size. There are many factors contributing to the decline of coho salmon, including:

- logging,
- roads,
- water diversion,
- decreased in-stream flows,
- channelization,
- man-made barriers (dams, culverts, etc),
- increased water temperatures,
- agriculture,
- urbanization, and
- gravel mining.

2.11.2 CHINOOK SALMON

Chinook salmon spawn in freshwater, migrate to the ocean as juveniles, achieve significant growth, and return to freshwater at varying degrees of sexual maturity. Four runs of chinook salmon are present in the area of the project, which are distinguished by their timing of reentry to fresh water: fall, late-fall, winter, and spring (Boydstun et al. 1992). The listing status of the different runs of chinook salmon are provided in the above table. Chinook salmon represent a highly valued biological resource and a significant biological legacy of California.

The appearance of the first upstream adult migrants, spawning and outmigration varies based on the run type and geographical area of the state, as follows:

- Adult fall-run salmon begin their upstream migration in August, and migration continues through November. Rearing and outmigration of fall-run begins in January and continues through June.

- Adult late fall-run salmon begin their upstream migration in December, and migration continues through March. Rearing and out-migration of late fall-run begins in May and continues through November.
- Adult winter-run salmon begin their upstream migration in January and migration continues through May. Rearing and outmigration of winter-run begins in August and continues through February.
- Adult spring-run salmon begin their upstream migration in July and migration continues through September. Rearing and outmigration of spring-run begins in November and continues through March.

Chinook salmon require high-quality habitat for migration, holding, spawning, egg incubation, emergence, rearing, and emigration to the ocean.

Numerous factors have contributed to the decline of chinook salmon populations, including:

- water flows,
- water diversions,
- dams and other structures (levees, bridges, rip-rap),
- dredging,
- sediment disposal,
- gravel mining,
- toxic discharges,
- predation and competition, and
- habitat loss.

2.11.3 STEELHEAD TROUT

Steelhead/rainbow trout range from Los Angeles to Alaska. Steelhead/rainbow trout exhibit one of the most complex life histories of any salmonid species. Those that exhibit anadromy have been called steelhead trout, while those that are resident are called rainbow trout; however, populations of this species are polymorphic in structure, i.e., the different life history forms comprise a single, panmictic population within the anadromous reaches of specific streams, and not discrete populations.

Winter and summer steelhead trout are found in the project area. Winter steelhead trout are sexually mature when they enter freshwater and spawn shortly thereafter. Summer steelhead trout are sexually immature and require several months to mature and spawn.

Numerous factors have contributed to the decline of steelhead trout populations, including:

- water diversions and extraction,
- dams and other structures (levees, bridges, rip-rap),
- logging,
- agriculture,
- gravel mining,
- urbanization, and
- harvest.

2.11.4 DELTA SMELT

The delta smelt is a small, slender fish about 2-3 inches (5-7.6 cm) long endemic to the Sacramento-San Joaquin Estuary. Adult smelt spawn in freshwater, primarily in the channels and sloughs of the Delta. Adults begin migration to freshwater spawning areas during November through January.

The spawning season for delta smelt varies from year to year, and may occur from late winter (December) to early summer (July), with a peak in April and May. During January through June, adhesive demersal eggs are spawned over aquatic vegetation, rocks, gravel, tree roots, and other submerged substrates. The eggs hatch within 9-14 days depending on water temperature and the buoyant larvae are carried by currents downstream to the upper end of the entrapment zone, i.e., the saltwater/freshwater interface of the Sacramento-San Joaquin Estuary. Larvae and juvenile smelt rear in or upstream of this interface, which, within the project area, includes Suisun Bay.

The one-year life span and relatively low fecundity of delta smelt contribute to their vulnerability to extinction when population abundance is low. Factors that may reduce population abundance and drive the species toward extinction include:

- reduced Delta inflow and outflow,
- extremely high Delta outflow (relatively rare flood events, i.e., 1983),
- entrainment in water diversions,
- perturbations to the smelt's food web (reduced abundance of phytoplankton and zooplankton, competition and predation by introduced species),
- presence of toxic substances (agricultural, industrial, and municipal discharges) in the smelt habitat, and
- loss of genetic integrity caused by reduced abundance of adult smelt.

2.11.5 SPLITTAIL

The splittail, a native minnow, is the only surviving member of its genus and is endemic to the Central Valley. Its counterpart, *Pogonichthys ciscoides*, from Clear Lake, Lake County, became extinct in the early 1970s. Splittail are large cyprinids, 12 to 16 inches long (300 mm to 400 mm). They are tolerant of brackish water as high as 10-12 parts per thousand (ppt) or 15-18 mmhos EC. Splittail are benthic foragers that feed extensively on opossum shrimp (*Neomysis mercedis*), although detrital material typically makes up a high percentage of their stomach contents. They will feed opportunistically on earthworms, clams, insect larvae, and other invertebrates.

Splittail live mostly in the slow-moving stretches of the Sacramento River, in the Delta, and in the Napa and Suisun marshes (Department unpublished data). They have been found in Suisun Bay, San Pablo Bay, and Carquinez Strait. Researchers in the 1960s reported finding them evenly distributed in the Delta, while a later study found them most abundant in the north and west Delta on flooded island areas in association with other native species.

The lower reaches of rivers, dead-end sloughs and larger sloughs such as Montezuma Slough are common areas for splittail spawning. They lay their demersal, adhesive eggs over beds of aquatic or flooded terrestrial vegetation (Department unpublished data). The onset of spawning appears to be associated with increasing water temperature and day length. Spawning starts late in January and continues until July, with the heaviest times being from February through April. Larvae remain in the shallow, vegetated areas in close proximity to the spawning sites and move into the deeper offshore habitat as they mature.

Their abundance in the Sacramento-San Joaquin estuary, especially the Delta, is strongly tied to outflow, presumably because spawning occurs over flooded vegetation. Thus, when outflows are high, reproductive success is high, but when outflows are low, reproduction is reduced.

Numerous factors have contributed to the decline of splittail populations, including:

- entrainment at water diversions,
- changed estuarine hydraulics, especially reduced outflows,
- modification of spawning habitat,

- climatic variation,
- toxic substances,
- predation and introduced species, and
- exploitation.

2.11.6 SACRAMENTO PERCH

The Sacramento perch evolved in the Central Valley, is the only native sunfish in California, and the only sunfish to evolve west of the Rocky Mountains (Moyles 1976). Sacramento perch can be found within the San Francisco Bay region of the project area. Sacramento perch evolved with the ability to withstand high turbidity, high temperature, and high salinity and alkalinity.

Factors contributing to the decline of the Sacramento perch populations include:
- competition with non-native fish species,
- egg predation by non-native fish species,
- habitat alteration and destruction, and
- altered flow regimes.

2.11.7 RUSSIAN RIVER TULE PERCH

The Russian River tule perch is a small fish found within the project area in the Russian River watershed. This species is native to low-elevation waters where they occupy a wide range of habitats, from sluggish, turbid channels to swift-flowing sections of the river, in most situations associated with emergent aquatic plants or overhanging banks. This species feeds on zooplankton and invertebrates. The males defend small territories against other males and against fish of other species under overhanging branches or plants.

Factors contributing to the decline of the Russian River tule perch populations include:
- competition with non-native fish species,
- gravel mining,
- increased turbidity,
- pollution,
- habitat alteration and destruction (especially emergent vegetation), and
- reduced flows.

2.11.8 TIDEWATER GOBY

The tidewater goby is a small fish that occurs uncommonly in shallow, marine areas and in the lower reaches of streams throughout the project area. While found in fresh to brackish waters, they are most abundant in the upper ends of lagoons created by small coastal streams. Within these waters, they inhabit mostly slow-moving areas or pools away from the main current, among emergent and submerged vegetation. They complete most of their life cycle in fresh water, with spawning occurring on bottoms of coarse sand grain substrate (Moyle 1976).

Numerous factors have contributed to the decline of tidewater goby populations, including:
- predation by and competition with non-native species,
- loss of critical estuarine habitat,
- loss of riparian habitat, and
- altered flow regimes.

2.11.9 CALIFORNIA TIGER SALAMANDER

The Tiger Salamander is most commonly found in annual grass habitats, but can also be found along stream courses in Marin County and the San Francisco Bay area. Adults are “sit and wait” predators and spend most of the year in subterranean refugia, especially ground squirrel borrows (Zeiner *et* al. 1988). They breed and lay eggs in vernal pools and other temporary ponds; streams are rarely used for reproduction.

Factors that have contributed to the decline of tiger salamander populations include:

- conversion of seasonal wetlands, and
- predation by non-native species.

2.11.10 DEL NORTE SALAMANDER

The Del Norte salamander is found in Del Norte, Siskiyou, and western Trinity and Humboldt counties, in habitats consisting of valley-foothill to montane riparian forests, and other hardwood and conifer forests. This species prefers to hide beneath rock slides, rotting logs and under slabs of bark in damp, in rubble and fine soils, but not wet situations (Zeiner *et* al. 1988). While associated with damp areas, the Del Norte salamander does not require standing water. Loss of habitat contributes to the rarity of this species.

2.11.11 YELLOW-LEGGED FROG

The foothill yellow-legged frog occurs in or near rocky streams in a variety of habitats. The project area is wholly contained within the current distribution of this species. Adults are carnivorous, while the tadpoles eat algae and diatoms along rocky stream bottoms. Egg clusters are attached to gravel or rock in moving water near stream margins. Unlike most other ranid frogs in California, this species is rarely encountered far from permanent water (even on rainy nights).

Numerous factors have contributed to the decline of the yellow-legged frog populations, including:

- predation by and competition with non-native species (especially bullfrog),
- loss of riparian habitat,
- gravel mining,
- pesticides, and
- altered flow regimes.

2.11.12 NORTHERN RED-LEGGED FROG

The Northern red-legged frog is the State's largest native frog. Its habitat is characterized by dense, shrubby riparian vegetation associated with deep, still, or slow-moving water that supports emergent vegetation. The project area is wholly contained within the current distribution of this species. Adults are carnivorous, while the aquatic larvae are mostly herbivorous. Eggs are deposited in permanent pools attached to emergent vegetation.

Numerous factors have contributed to the decline of northern red-legged frog populations, including:

- predation by and competition with non-native species (especially bullfrog),
- loss of critical wetland breeding habitat,
- loss of riparian habitats,
- pesticides, and
- altered flow regimes.

2.11.13 TAILED FROG

The tailed frog can be quite common in suitable habitats, which include many hardwood and coniferous forests from sea level to montane elevations in Del Norte, Siskiyou, Humboldt, Trinity, Shasta, Mendocino, and possibly Sonoma counties. Carnivorous adults forage primarily terrestrially along stream banks but also occasionally feed underwater. Tadpoles feed primarily on diatoms and some algae, which are scraped off the surface of submerged rocks in stream bottoms. Eggs are attached in globular masses to the underside of stones in the water. Permanent water is a critical component of this species habitat because of the aquatic larvae stages. This species may be sensitive to increased water temperatures and siltation.

Numerous factors have contributed to the decline of the tailed frog populations, including:

- predation by and competition with non-native species (especially bullfrog),
- loss of critical wetland breeding habitat,
- loss of riparian habitats,
- logging,
- gravel mining, and
- altered flow regimes.

2.11.14 WESTERN POND TURTLE

Western pond turtle is found throughout cismontane California in suitable aquatic habitat, which includes permanent ponds, lakes, streams, and irrigation ditches or permanent pools along intermittent streams. Pond turtles require basking sites such as partially submerged logs, rocks, mats of floating vegetation, or open mud banks. Hibernation in colder areas is passed underwater in bottom mud. During the spring and summer, females move overland to find suitable sites for egg-laying.

Major factors that contribute to the decline of the western pond turtle include:

- conversion of aquatic, wetland, riparian and adjacent upland habitats to other land uses, and
- altered flow regimes.

2.11.15 CALIFORNIA FRESHWATER SHRIMP

The California freshwater shrimp is the State's only native, stream-dwelling shrimp. This species resembles its marine relatives but rarely attains a carapace length of more than two inches (5cm). This species feeds on decomposing plants and other detrital material. It is found in pool areas of low-elevation, low-gradient streams, among exposed live tree roots of undercut banks, overhanging wood, debris, or overhanging vegetation. This species can tolerate warm water temperatures and no-flow conditions that are detrimental or fatal to native salmonids. Currently the shrimp is found in Marin, Napa, and Sonoma counties.

Numerous factors have contributed to the decline of the freshwater shrimp populations, including:

- urbanization,
- agricultural practices,
- gravel mining,
- timber harvesting,
- impoundments and water diversions,
- wastewater discharge,
- bank protection, and
- introduced predators.

3.0 ENVIRONMENTAL EFFECTS OF THE PROPOSED PROJECT

This section describes the environmental impacts, including potentially significant adverse environmental impacts, that may result from the proposed project (the 2084 Order). The discussion addresses both direct and reasonably foreseeable indirect impacts associated with the proposed project. Reasonably foreseeable, potentially significant cumulative impacts associated with the proposed project are discussed in a separate chapter.

Impacts have been classified in the following manner:

- Class 1: Significant and unavoidable impacts that cannot be mitigated to a less-than-significant level.
- Class 2: Significant impacts that can be mitigated to the level of less-than-significant.
- Class 3: Less-than-significant impacts. These impacts may be adverse, but not significant. Mitigation may also be proposed for these to further reduce the level of impact.

CEQA requires that significant impacts be mitigated to a less-than-significant level, to the extent feasible. Since the proposed project consists of regulations, mitigations for proposed regulations consist of alternative regulations. Therefore, proposed alternatives to the regulations are more fully evaluated in the alternative analysis, Chapter 5.0.

It is neither the objective nor the function of this document to evaluate the impacts of on-going activities in the project area. The environmental baseline, under CEQA, includes on-going activities. This document focuses on assessing changes to the existing environmental baseline resulting from the proposed project (the 2084 Order). To the extent that there are already on-going activities that affect the physical conditions, these are also part of the existing environmental baseline. Such on-going activities, permitted by law, that have the potential to impact biological resources may include agriculture, timber operations, gravel mining, water diversions and other activities addressed in the 2084 Order. This document only evaluates changes in the environmental baseline resulting from the 2084 Order.

3.1 Biological Resources

The discussion that follows below specifically addresses impacts on biological resources that will result from the proposed project. However, because of the narrow scope of the proposed project and the large geographic area affected by the project, impacts to biological resources are narrowly defined as those resources in the aquatic environment.

It is the policy of the Commission to protect and preserve all native species of fish, amphibians, reptiles, birds, mammals, invertebrates, and plants, including their habitats, which are designated threatened or endangered with extinction. The Commission has listed a number of species that occur in the project area as endangered or threatened. Those that occur within the in-stream habitat of the coho salmon were discussed in the prior section of this document. Provisions that lessen impacts on coho salmon will likely also lessen impacts on co-occurring listed species'.

3.1.1 FISHING PROVISIONS

Fishing for other species of game fish is allowed within the waters of the project area (both inland and ocean). The sport fishing regulations that may affect coho salmon north of San Francisco are found in § 7.00 and 7.50, Title 14 of the California Code of Regulations. The relevant sections are found in Appendix B. Under the Salmon Fishery Management Plan (FMP), required by the Magnuson-Stevens Fishery Conservation and Management Act, the cumulative impacts of the California ocean salmon sport fisheries have been (and will be) given sufficient consideration. The FMP assumes that ocean fisheries' management south of Cape Falcon, Oregon, based on key stocks of the California and southern Oregon coho salmon, provides adequate protection for those stocks. The Pacific Fishery Management Council's (PFMC) considerations related to reducing impacts on chinook salmon can also be expected to have a benefit for coho salmon.

The estimated ocean fishery impacts for 2001 on Rogue/Klamath coho salmon under the adopted PFMC ocean salmon fishing regulations for the area south of Humbug Mountain in southern Oregon are 2.15% in the sport fishery and 0.64% in the commercial fishery, for a total impact of 2.79%. The regulations, both sport and commercial, allow for chinook salmon fishing, but any coho salmon must be released; thus, the calculated coho salmon impacts stem from hook-and-release mortality. The allowable impact under the federal biological opinion for this stock is 13.0% (PFMC 2001). The Department adopts the federal salmon fishing regulations that apply to federal waters (3-200 miles) for state waters (0-3 miles) pursuant to §7652 of the Fish and Game Code. The conforming regulations are found at §182, Title 14, California Code of Regulations. The federal regulations are found at Part 660.401 et seq. of Title 50 Code of Federal Regulations. The federal regulations prohibit the retention of coho salmon caught in ocean chinook-directed fisheries off California. There is directed fishing off Oregon and Washington for hatchery-marked coho salmon from Oregon and Washington hatcheries. These fisheries may impact some California coho salmon but are taken into account under the Klamath/Rogue impact ceiling (13%).

This section of the 2084 Order (the project) restates existing law that has been in effect since coho salmon were listed under the Federal Endangered Species Act; therefore, the project does not increase impacts on biological resources or listed species.

3.1.2 SUCTION DREDGING

Suction dredging, in accordance with Title 14 CCR, §228, is allowed within the waters of the project area. Figure 3.1.2 displays the period of time suction dredging is allowed by counties within the project area. The restrictions previously imposed by regulations, and the ESA and CESA incidental take authorization, seek to eliminate the impacts these activities could have on listed salmonids. Impacts to listed salmonids are eliminated by restricting suction dredging actions to locations and times when such activities will not impact the listed species. This section of the 2084 Order restates existing law that was already in effect and fully implemented statewide prior to the state candidacy of the coho salmon. Therefore, the project will not result in an increase in potentially significant impacts on the existing environment due to suction dredging, including impacts on biological resources such as coho salmon.

Figure 3.1.2 Suction Dredging

3.1.3 HABITAT RESTORATION PROVISIONS

Habitat restoration projects that are in the process of implementation during the candidacy period are located in the counties shown on Figure 3.1.3. Short-term impacts to coho salmon and other listed species may occur from the construction of these habitat restoration projects; however, such impacts were evaluated on a project-by-project basis as part of the CEQA process prior to implementation of these projects (e.g., Notice of Determination SCH#2001042013, filed on May 23, 2001). Short-term impacts on the aquatic environment that this class of projects can cause include increased siltation and sedimentation during the construction period, loss or alteration of the riparian corridor until revegetation is successful, and short-term direct impacts to aquatic biota in the vicinity of the project. The requirements included in the 2084 Order do not differ from that which were already in effect and fully implemented statewide prior to the state candidacy of the coho salmon; therefore, the project will not cause an increase in potentially significant impacts on the existing environment, including impacts on biological resources such as coho salmon.

3.1.4 RESEARCH AND MONITORING PROVISIONS

Department activities associated with research and monitoring studies may impact various species of listed salmonids. These activities are being done in accordance with federal ESA and CESA take authorization and §783.1(c), Title 14, California Code of Regulations; and therefore, the project does not increase the impact on listed salmonids.

Take of coho salmon, in the course of research and monitoring by other public agencies and private parties, is authorized subject to restrictions in Exhibit B, Appendix A. Research and monitoring methods for which incidental take is authorized may include, but are not limited to: electrofishing and snorkel surveys to estimate abundance, presence/absence, community structure, or other population parameters; rotary screw trapping, fyke trapping, and seining to estimate juvenile outmigration abundance and timing; tagging of wild and hatchery coho salmon to estimate survival and movement; angler surveys to estimate catch rate; spawner surveys to estimate habitat usage and spawning escapement; collection of scales and tissues for genetic and life history analyses; measurements of habitat parameters such as gravel quality and quantity, water temperature, physicochemical analysis, and water quality; diet analysis; and trapping to estimate emergence timing and fry survival. These activities result in very little to no killing of coho salmon.

The restrictions imposed by the 2084 Order and the ESA and CESA incidental take authorizations, minimize the impacts of these activities on listed salmonids to a less than significant level (Class 3).

3.1.5 HATCHERY OPERATION PROVISIONS

The 2084 Order allows the operation of hatcheries in waters where coho salmon may be present and, at a few locations, hatcheries that target coho salmon for the collection of gametes. For hatchery operations, take may be intentional, such as the collection of broodstock, or incidental, such as take that may result from interactions between hatchery and listed fish. Therefore, hatchery operations are likely to result in a take of this candidate species, and perhaps, other listed salmonids. NMFS has published a 4(d) rule, which provides exceptions for take

Figure 3.1.3 Habitat Restoration Projects

prohibitions under Section 9, for all listed steelhead ESUs (evolutionarily significant unit) within the project, except for the Northern California steelhead trout (which extends from Redwood Creek in Humboldt County to Gualala River). This steelhead trout ESU and the remaining listed chinook salmon and coho salmon ESUs within the project area are the subject of a proposed Section 4(d) rule that NMFS published in August, 2001. Under this proposed rule and the current steelhead trout 4(d) rule, hatchery operations are exempted from the ESA take prohibitions if operations are conducted in accordance with a Hatchery and Genetics Management Plan.

The restrictions imposed by the federal ESA and CESA incidental take authorization, minimize the impacts these activities have on listed salmonids. The requirements included in the 2084 Order (the project) do not differ from those which were already in effect and fully implemented statewide prior to the state candidacy of the coho salmon; therefore, the project will not cause an increase in potentially significant impacts on the existing environment, including impacts on biological resources such as coho salmon.

3.1.6 GRAVEL MINING PROVISIONS

Provisions in the 2084 Order that have the effect of minimizing the potential take of coho salmon will also protect many of the co-occurring species, and will minimize impacts to stream morphology. Restrictions on in-stream activities, such as gravel mining, will benefit these other species. The requirements included in the 2084 Order (the project) are more protective than provisions already in effect in counties included in the project area. The 2084 Order does not increase impacts over the baseline condition.

3.1.7 WATER DIVERSIONS

Provisions in the 2084 Order will have the effect of minimizing the potential take of coho salmon by requiring that newly constructed (after April 26, 2001) or repaired, upgraded, or reconstructed screens on water diversions meet Department standards and will also protect many of the co-occurring species. Therefore, this provision in the 2084 Order will have a beneficial impact on biological resources, including listed species.

The existing baseline condition includes many unscreened diversions located within the project area. The 2084 does not require that fish screens be added to existing unscreened diversions; thereby not changing the baseline conditions, which continue to have the potential to degrade the quality of the environment, or reduce the number or restrict the range of listed salmonids. It would be infeasible, in terms of time and financial resources, to screen all existing unscreened diversions in the project area in the near future. However, it should be noted that the 2084 Order does not increase impacts over the baseline condition.

3.1.8 FOREST PRACTICES

Provisions in the 2084 Order extend interim, minimum standards for timber operations that have the potential for take of coho salmon and co-occurring species. These provisions will not increase impacts on coho salmon and other existing species and will reduce impacts to riparian corridors along fish bearing streams. Once again, the 2084 Order generally does not change the baseline condition. If the Board of Forestry does not extend the rule “Protection for Threatened and Impaired Watersheds, 2000," beyond December 31, 2001, then this provision of the 2084 Order will be stricter than existing Board of Forestry regulations, and result in a beneficial impact to the environment and to biological resources.

3.2 Hydrology/Water Quality

The provisions of the 2084 Order designed to protect the coho salmon will provide a net benefit to hydrology and water quality. Projects that may adversely impact water quality, increase run-off, or divert water will be evaluated as part of the CEQA analysis required prior to project permitting and implementation. Such project-specific impacts are beyond the scope of this project (2084 Order) and the scope of this document.

3.3 Land Use/Planning

The impact of the 2084 Order on the following planning or land-use documents, statutes, or regulations were analyzed for the project area because conflicts with an adopted plan (e.g., the Pacific Lumber Company Habitat Conservation Plan) or other regulatory scheme (e.g., CESA) are typically an indication that the proposed project may result in potentially significant environmental impacts or physical impacts.

3.3.1 RIVERS AND HARBORS ACT OF 1899, SECTION 10 (33 USC 403)

Section 10 of the Rivers and Harbors Act of 1899 prohibits the unauthorized obstruction or alteration of any navigable waters of the United States without a permit from the Army Corps of Engineers (Corps). Examples of activities requiring a permit from the Corps are the construction of any structure in or over any navigable water, excavation or deposition of materials in such waters, and various types of work performed in such waters, including placement of fill and stream channelization. Nothing in the proposed project will conflict with any existing Section 10 permit.

3.3.2 ENDANGERED SPECIES ACT (16 USC 1531 et seq.)

Section 7 of the Endangered Species Act of 1973, as amended, requires federal agencies, in consultation with U.S. Fish and Wildlife Service (USFWS) and NMFS, to ensure that their actions do not jeopardize the continued existence of endangered or threatened species, or result in the destruction or adverse modification of the critical habitat of these species. Section 10 of this Act otherwise requires activities that may result in "take" of federally listed species to obtain take authorization from USFWS or NMFS, which requires that impacts on the species be minimized and mitigated. The 2084 Order does not alter or conflict wit the requirements of the ESA, which apply to many of the activities addressed in the 2084 Order.

3.3.3 FISH AND WILDLIFE COORDINATION ACT (16 USC 661 et seq.)

The Fish and Wildlife Coordination Act requires federal agencies to consult with USFWS and state fish and game agencies before undertaking or approving projects that control or modify surface water projects. Consultation is intended both to promote the conservation of wildlife resources by preventing their loss or damage and to provide for the development and improvement of wildlife resources in connection with water projects. Nothing in the proposed project will conflict with the Fish and Wildlife Coordination Act.

3.3.4 NATIONAL HISTORIC PRESERVATION ACT (16 USC 470 seq.)

Section 106 of the National Historic Preservation Act requires federal agencies to evaluate the effects of federal undertakings on historical, archeological, and cultural resources. Agencies are required to identify historical or archeological properties near proposed project sites, including properties listed in the NRHP and those properties that the agency and the SHPO agree are eligible for listing in the NRHP. Nothing in the proposed project will interfere with compliance with the National Historic Preservation Act.

3.3.5 FARMLANDS PROTECTION POLICY ACT

Memoranda from the U.S. Council on Environmental Quality to heads of agencies dated August 30, 1976, and August 11, 1980, and the Farmlands Protection Policy Act of 1981 require agencies preparing EISs to include farmland assessments designed to minimize adverse impacts on prime and unique farmlands, as described in Chapter 31, “Land Use and Agriculture”. Nothing in the proposed project will conflict with this policy.

3.3.6 BAY-DELTA ACCORD

Nothing in the proposed project will conflict with continued implementation of the Bay-Delta Accord.

3.3.7 NATIVE FISH RECOVERY PLAN

Nothing in the proposed project will conflict with achieving the goals of the Native Fish Recovery Plan.

3.3.8 WINTER-RUN CHINOOK SALMON RECOVERY PLAN

Nothing in the proposed project will conflict with the goals in the draft winter-run chinook salmon recovery plan.

3.3.9 CALFED BAY-DELTA PROGRAM

Nothing in the proposed project will conflict with the planning process underway by the CALFED Bay-Delta Program.

3.3.10 ECOSYSTEM RESTORATION PROGRAM PLAN (ERPP)

Nothing in the proposed project is inconsistent with the objectives, targets, and actions in the CALFED ERPP.

3.3.11 STATE WATER RESOURCES CONTROL BOARD (SWRCB) 1995 WATER QUALITY CONTROL PLAN (WQCP)

Nothing in the proposed project will conflict with implementation of the SWRCB's 1995 WQCP.

3.3.12 SUISUN MARSH PROTECTION PLAN

Under the 1984 Plan of Protection for the Marsh and the 1987 Suisun Marsh Preservation Agreement to mitigate the effects of upstream water projects on the marsh, the staged construction of extensive marsh water control facilities was planned. To date, the salinity control structure on Montezuma Slough, a major waterway in the Marsh, has been constructed. This facility helps to ensure that a dependable supply of suitable salinity water is available to preserve marsh habitat, including food plants for waterfowl. Nothing in the proposed project will conflict with continued implementation of the Suisun Marsh Protection Plan.

3.3.13 CLEAN WATER ACT, SECTION 404 (33 USC 1344)

Under Section 404 of the Clean Water Act, a Department of the Army permit must be obtained from the Corps for the discharge of dredged or fill material into water of the United States, including wetlands. Nothing in the proposed project will conflict with any existing 404 permit. The Corps has issued two Letters of Permission (LOPs) as detailed in Section 3.3.14 and 3.3.18.

3.3.14 LETTER OF PERMISSION PROCEDURE: GRAVEL MINING AND EXCAVATION ACTIVITES IN DEL NORTE COUNTY, LOP 96-2 (US ARMY CORPS OF ENGINEERS

The gravel extraction restrictions of the LOP 96-2 (Appendix C) are more permissive than the standards set forth in Exhibit C of the 2084 Order. The only location where this discrepancy would be noted is on the lower Smith River, Del Norte County, where trenching is practiced. However, the lack of replenishment this year makes it unlikely that any trenching or mining will be allowed within the analysis period of this document. For the 12-month period covered by the 2084 Order, this impact was deemed less-than-significant (Class 3).

3.3.15 COUNTY OF HUMBOLDT EXTRACTION REVIEW TEAM (CHERT)

Nothing in the proposed project will conflict with continued gravel mining as provided for through the reviews and recommendation of this team.

3.3.16 MEMORANDUM OF AGREEMENT (MOA) AND PROGRAMMATIC ENVIRONMENTAL IMPACT REPORT ON GRAVEL REMOVAL FROM THE LOWER MAD RIVER (HUMBOLDT COUNTY BOARD OF SUPERVISORS MAY 31, 1994)

Nothing in the proposed project will conflict with continued implementation of this MOA.

3.3.17 INTERIM MONITORING PROGRAM AND ADAPTIVE MANAGEMENT PRACTICES FOR GRAVEL REMOVAL FROM THE LOWER EEL AND VAN DUZEN RIVERS (HUMBOLDT COUNTY BOARD OF SUPERVISORS JULY 2, 1996)

Nothing in the proposed project will conflict with continued implementation of the Interim

Monitoring Program and Adaptive Management Practices called for under this plan.

3.3.18 LETTER OF PERMISSION PROCEDURE, GRAVEL MINING AND EXCAVATION ACTIVITIES WITHIN HUMBOLDT COUNTY: LOP 96-1 (US ARMY CORPS OF ENGINEERS)

LOP 96-1 (Appendix D) is less restrictive than the County's CHERT; therefore, the CHERT takes precedence over mining activities in the County. As with the analysis above, nothing in the proposed project will conflict with continued gravel mining as provided for through the reviews and recommendation of this team.

3.3.19 GARCIA RIVER GRAVEL MANAGEMENT PLAN AND THE UPPER RUSSIAN RIVER AGGREGATE RESOURCES MANAGEMENT PLAN (UNADOPTED PLANS PREPARED FOR MENDOCINO COUNTY WATER AGENCY)

In-stream mining in the project's watersheds in Mendocino County, in general, is taking place following the recommendations of these two unapproved plans. These two plans are consistent with the 2084 Order. One portion of one mining operation has previously practiced trenching on the Middle Fork of the Eel River; this one operation would not be in compliance with the 2084 Order, unless prior approval from Department is gained pursuant to Exhibit C, #2 of the 2084 Order. With prior approval for this operation, nothing in the proposed project will conflict with the continued adherence to current in-stream mining practices in these rivers.

3.3.20 SONOMA COUNTY AGGREGATE RESOURCES MANAGEMENT PLAN AND ENVIRONMENTAL IMPACT REPORT, (SONOMA COUNTY BOARD OF SUPERVISORS, 1994)

In-stream gravel mining as permitted by this document allows an earlier start and a later completion date than the 2084 Order; however, the document defers to Department concurrence of project conditions through the Streambed Alteration Agreement (SAA) process. Department personnel, though the SAA process have the opportunity to require operations to adhere to the 2084 Order; therefore, the proposed project will not likely conflict significantly with the County's Aggregate Resources Management Plan (Class 3 level of impact).

3.3.21 PACIFIC LUMBER COMPANY HABITAT CONSERVATION PLAN

Nothing in the proposed project will conflict with continued implementation of the Pacific Lumber Company's Habitat Conservation Plan.

3.3.22 FOREST PRACTICE ACT

The Z'Berg-Nejedly Forest Practice Act of 1973 (Division 4, Chapter 8 of the Public Resources Code) establishes the Legislature's concerns throughout the state relating to the use, restoration, and protection of forest resources. Under the Forest Practice Act (FPA) a person can conduct timber operations if a Timber Harvesting Plan (THP), prepared by a registered professional forester (RPF), has been submitted to Department of Forestry and Fire Protection (CDF) in accordance with specified requirements, and approved by the Director of CDF. THPs must include a description of the affected land, the logging methods to be used, an outline of methods to be used to avoid excessive erosion in watershed areas, any provisions for protecting unique areas, and a certification by the RPF preparing the plan that the area has been inspected. Under current law, state agencies with jurisdiction over watersheds, wildlife or fisheries are allowed to comment on THPs. When a THP is submitted by a landowner for CDF approval, a review team evaluates the plan and makes a recommendation to the Director of the CDF as to whether the plan should be denied, approved, or approved with the addition of measures to mitigate potential environmental impacts. Members of the review team primarily include representatives from CDF, the Regional Water Quality Control Board, the Department, the Department of Conservation/Division of Mines and Geology and occasionally Department of Parks and Recreation or the Coastal Commission. These agencies currently function primarily in an advisory role, because the FPA allows only the chair of the CDF review team to make a recommendation to the Director of CDF. The FPA gives CDF sole discretion to approve THPs. Nothing in the proposed project will conflict with any existing THP or the existing THP review process.

3.4 Mineral Resources

By restricting the allowable area for gravel extraction, this 2084 Order has the potential to reduce accessibility to a classified or designated mineral resource as defined in the Surface Mining and Reclamation Act of 1975. The location of mineral resources that would not be available through this 2084 Order for extraction include:

- The lower Smith River, Del Norte County, where trenching is practiced. However, the lack of replenishment this year makes it unlikely that any trenching will be allowed within the expected duration of the 2084 Order.
- The Middle Fork of the Eel River, Mendocino County, where trenching is practiced.

For the candidacy period covered by the 2084 Order, this impact was deemed less-than-significant (Class 3) because an operator that wishes to practice trenching (or deviate from any other provision in the 2084 Order) may seek an individual section 2081 permit under CESA.

3.5 Recreation

3.5.1 FISHING

Since coho salmon were previously listed under the federal Endangered Species Act, the effect of the current project (the 2084 Order) on recreational sport fishing is moot; that is, coho salmon may not be taken. Specifically, Section 7.00 states that "silver [coho] salmon are fully protected, and may not be taken in any of the waters of the State. Incidentally hooked silver [coho] salmon must be immediately released unharmed to the waters where they are hooked."

3.5.2 SUCTION DREDGING

The current project (the 2084 Order) does not differ with that of prior regulations that were fully implemented throughout the project area. Therefore, the project will have no impact on suction dredging activities that are currently conducted in compliance with state law (i.e., in compliance with §228, Title 14, California Code of Regulations).

3.6 Other Environmental Impacts

Other environmental impacts typically discussed in relation to proposed projects have been considered. For each of these impacts, the Department has been determined that there is a low potential for environmental impacts. For this reason, no further analysis has been conducted. Impacts considered include:

- **Aesthetics**
- **Agriculture Resources**
- **Air Quality**
- **Geology / Soils**
- **Hazards & Hazardous Materials**
- **Noise**
- **Population / Housing**
- **Public Services**
- **Transportation /Traffic**
- **Utilities / Service Systems**
- **Short-term uses versus long-term productivity**

3.7 Growth-Inducing Impacts

The 2084 Order addresses incidental take for inland and ocean sport and commercial fishing, suction dredging, research and monitoring, hatchery operations, habitat restoration, gravel mining, water diversions (relative to screening), Streambed Alteration Agreements, the Pacific Lumber Company Habitat Conservation Plan, and forest practices. All the covered activities involve ongoing recreational activities, natural resource extraction, agricultural, and similar uses in the rural context, and do not involve land use development entitlements or urban infrastructure projects that would induce growth.

3.8 Significant Irreversible Environmental Changes

Once again, the 2084 Order addresses incidental take for inland and ocean sport and commercial fishing, suction dredging, research and monitoring, hatchery operations, habitat restoration, gravel mining, water diversions (relative to screening), Streambed Alteration Agreements, the Pacific Lumber Company Habitat Conservation Plan, and forest practices. All the covered activities involve ongoing activities that existed prior to candidacy and will the 2084 Order will continue these activities only during candidacy (expected to be approximately 12 months); therefore, there will be no significant irreversible environmental changes.

3.9 Economic Impact

The proposed project has the potential to result in minor economic impacts in areas within the project boundaries where gravel operations take place. However, economic or social effects of a project are not considered significant effects on the environment (CEQA Guidelines §15131(a)).

The minor economic impacts caused by the 2084 Order would not result in impacts to the environment (e.g., “blight” in a downtown area).

4.0 Cumulative Impacts

Cumulative impacts result from the incremental impact of the proposed project in combination with other closely related past, present, and reasonably foreseeable future actions. Cumulative impacts can result for individually minor, but collectively significant, actions taking place over time. The cumulative impact assessment for the 2084 Order is based on the following principles from the CEQA Guidelines, §15130:

- The focus of the analysis should be on the significant cumulative impacts.
- The analysis should emphasize impacts of related projects; that is, projects that occur in or near the project area and that affect the same resources.
- The analysis should be mostly qualitative in nature, and presented in less detail than a project-specific impact assessment. The level of discussion should be guided by the standards of practicality and reasonableness.

Typically, this analysis is done in the context of land development. Lead agencies generally include lists of past, present and reasonably anticipated development projects that could adversely affect regions. This analysis can also include projections that are contained in general plans.

Because this proposed project differs in some fundamental aspects from a typical development project, the cumulative impact analysis differs from that traditionally done. For the purpose of this project, the cumulative impact analysis answers the following question: Will the 2084 Order's incremental impact contribution be cumulatively considerable (i.e., significant) when considered in conjunction with the related effects of other past, present and reasonably foreseeable future projects?

4.1 Combined Factors

The proposed project authorizes ten different types of activities. As described in Chapter 3, the 2084 Order will merely allow for continuation of existing activities for the candidacy period, and will not result in impacts that are significant during the candidacy period.

Activities that may be associated with cumulative reductions in coho salmon population size (inland and ocean fishing, research and monitoring, water diversions, habitat restoration actions, gravel mining, and logging) may adversely affect coho salmon, individually and in combination, beyond the candidacy period. The impacts caused by the 2084 Order may have an incremental impact contribution, when considered in conjunction with the related effects of other past, present and reasonably foreseeable future projects. However, the impacts from the project are not significant even when considered in the context of cumulative effects, because they will continue under the 2084 Order only during the candidacy period, and will result in certain increased protections for coho salmon and its habitat over baseline conditions.

4.2 Future Take Authorization

If coho salmon are listed as endangered or threatened under CESA, it is expected that any future take authorization will be accomplished primarily through §2081 of the Fish and Game Code, which requires that impacts be minimized and fully mitigated. Therefore, activities addressed in the 2084 Order would continue after a listing, only if they do not result in take or meet the applicable take authorization standard.

5.0 Analysis Of Alternatives (Mitigation) To The Proposed Project

This section of the environmental document discusses a range of alternatives to the proposed project that would feasibly attain most of the basic project objectives and would avoid or substantially lessen any of the effects of the proposed project (CEQA 21100 and CEQA Guidelines 15126(d)). Since the proposed project is regulations, mitigation to proposed regulations are alternative regulations. Alternatives to the regulations are more fully evaluated in this alternative analysis for the 2084 Order, even though no significant impacts have been identified for the proposed action. In addition, this section includes alternatives that were suggested during the comment period for the Notice of Preparation (SCH# 2001062016) and the public scoping meeting. The advantage or disadvantage for each alternative is evaluated over the period of the 2084 Order (i.e., approximately 12 months). The outcome of this evaluation may have been different if the 2084 Order were in effect longer than the candidacy period. Therefore, these analyses should not be used for any future take authorization. It is expected that any future take authorization will be accomplished primarily through §2081 of the Fish and Game Code, which requires that impacts be minimized and fully mitigated.

It is not the objective of this section to evaluate any potential impacts of on-going activities in the project area. The environmental baseline, under CEQA, includes on-going activities. This document focuses on assessing the changes to the existing environmental baseline that will result because of the proposed project (the 2084 Order). To the extent that there are already on-going activities that affect the physical conditions, these are also part of the existing environmental baseline. Such on-going activities that are permitted by law that have the potential to impact biological resources may include agriculture, timber operations, gravel mining, and water diversions. This document only evaluates the changes in the physical condition (environmental baseline) caused by the 2084 Order.

Under the "No Project" alternative, there would be no take authorization pursuant to Fish and Game Code §2084 during the candidacy period. Incidental take permits under Fish and Game Code §2081 could be sought on a project-by-project basis for activities that could result in take of coho salmon. This could lead to a dramatic increase in the number of take permits processed in the project area, but the Department would work to ensure that necessary permits are processed within time periods set forth in regulation. The analysis of this alternative includes the possibility that some of the activities permitted under the 2084 Order would be curtailed during times and at locations when incidental take might occur.

5.1 Inland and Ocean Sport and Commercial Fishing

5.1.1 PROJECT

Coho salmon may not be retained during sport or commercial fishing in any waters of the State. Incidentally hooked or netted coho salmon must be immediately released unharmed to the waters where they are hooked or netted.

5.1.2 NO PROJECT

As described previously, existing state and federal law allows the incidental capture of coho salmon during commercial fishing. Mortality associated with commercial capture and release of coho salmon is not prohibited by CESA (Fish and Game Code §2083). Without the 2084 Order, the incidental capture of coho by hook and line during recreational fishing would not be expressly authorized, but under another provision within §2084, the Commission may authorize the taking of any fish by hook and line for sport. Without such authorization from the Commission, persons engaging in sport fishing in the project area may need §2081 incidental take permits authorizing incidental take of coho salmon.

To completely eliminate take of coho salmon would require closing the waters included in Figure 1.5, and out into the Pacific Ocean to the 3-mile mark, to all types of fishing for significant periods each year. The loss of income to coastal communities, derived from the recreational ocean salmon sport fishery, would exceed $34 million (PFMC 2001). In the absence of fishing opportunity for salmon, anglers would probably switch to other species, such as groundfish that include rockfish, flatfish, etc., whose stocks are sustaining fishing at or near the maximum rate at current levels of harvest. If fishing effort is transferred to other species, the loss of income to coastal communities may be expected to be moderated to some degree; however, the economic impact would remain significant. Current regulations minimize impacts on coho salmon to the lowest level that is feasible without closing the waters to all fishing.

5.1.3 ALTERNATIVE 1

Commercial and sport anglers may retain marked hatchery coho salmon that are caught. Incidentally hooked or netted unmarked coho salmon must be immediately released unharmed to the waters where they are hooked or netted.

Currently in California, most hatchery-produced coho salmon are marked with a maxillary clip for hatchery monitoring and evaluation purposes. However, this mark is difficult to see and is not readily identifiable to the angling public as a hatchery mark. The inability by the layperson to reliably identify a hatchery-marked fish could result in the inadvertent take of a wild fish. To implement this alternative would require a public education program (for identifying maxillary clips) and a change in fishing regulations to allow for retention of hatchery-produced coho salmon. Issues concerning the interactions between hatchery and wild stocks of coho salmon are being further researched during the status review. Until more information is available, this alternative cannot be adequately evaluated.

5.1.4 ALTERNATIVE 2

Begin immediately marking 100% of all the hatchery coho salmon production with a mark that is identifiable to commercial and sport anglers, and allow anglers the opportunity to retain hatchery-marked coho salmon adults. Unmarked coho salmon may not be retained during sport or commercial fishing in any waters of the State. Incidentally hooked or netted unmarked coho salmon must be immediately released unharmed to the waters where they are hooked or netted.

The most readily identifiable mark used to identify hatchery-produced fish is the adipose fin clip. However, this mark can only be used on salmon that have been inserted with a coded-wire tag.

An alternative would be to clip a pectoral or pelvic fin; however, there is an associated reduction in survival of fish that are marked in this way. Marking 100% of all hatchery-produced coho salmon would require a substantial increase in staffing and funds.

Because of the three-year life cycle of the coho salmon, this alternative would not result in an increase in the number of readily identifiable hatchery-marked adults within the period of time being evaluated by this document. To implement this alternative would require a significant increase in funding and staffing at the hatcheries, and a change in fishing regulations. Issues concerning the interactions between hatchery and wild stocks of coho salmon are being further researched during the status review. Until more information is available, this alternative cannot be adequately evaluated.

5.2 Suction Dredging

5.2.1 PROJECT

Incidental take of coho salmon during suction dredging that complies with §228, Title 14, California Code of Regulations, is authorized during the candidacy period.

5.2.2 NO PROJECT

Suction dredge operators might need to obtain §2081 permits, depending on the timing and location of their activities, or could face additional restriction from those in §228, Title 14, CCR. While the no project alternative would result in greater protection for the species, the no project alternative would constrict economic and recreational activity and is not warranted since the project does not have any significant impacts.

5.3 Research and Monitoring

5.3.1 PROJECT

Take of coho salmon by department personnel in the course of research and monitoring is authorized pursuant to §783.1(c), Title 14, CCR. Take of coho salmon in the course of research and monitoring by public agencies and private parties is authorized subject to restrictions in Exhibit B, Appendix A. Research and monitoring methods for which incidental take is authorized may include, but is not limited to: electrofishing and snorkel surveys to estimate abundance, presence/absence, community structure, or other population parameters; rotary screw trapping, fyke trapping, and seining to estimate juvenile outmigration abundance and timing; tagging of wild and hatchery coho salmon to estimate survival and movement; angler surveys to estimate catch rate; spawner surveys to estimate habitat usage and spawning escapement; collection of scales and tissues for genetic and life history analyses; measurements of habitat parameters such as gravel quality and quantity, water temperature, physicochemical analysis, and water quality; diet analysis; and trapping to estimate emergence timing and fry survival. The proposed project will not result in a significant impact to this species, and will be beneficial for the species in terms of increased available scientific data.

5.3.2 NO PROJECT

To completely eliminate take of coho salmon would require stopping many research and monitoring studies. While this alternative would reduce take of coho salmon juveniles and adults, implementation of the no project alternative would preclude the collection of valuable information that is essential to the ultimate recovery of coho salmon, and hence could have detrimental long-term effects.

5.4 Hatchery Operations

5.4.1 PROJECT

Take of coho salmon by the Department of Fish and Game (Department) for hatchery management purposes is authorized pursuant to §783.1(c), Title 14, CCR. The 2084 Order does not differ from regulations in existence prior to the candidacy that were fully implemented statewide; therefore, the 2084 Order does not cause a significant impact.

5.4.2 NO PROJECT

This alternative would not affect the take authorization contained in §783.1(c), Title 14, CCR, and in §1001 of the Fish and Game Code; and therefore, would be indistinguishable from the proposed project.

5.5 Habitat Restoration

5.5.1 PROJECT

Incidental take of coho salmon resulting from planning, assessment, inventory, construction, maintenance and monitoring activities related to the Department of Fish and Game Fisheries Restoration Grants Program and carried out in the manner prescribed in the department's "California Salmonid Stream Habitat Restoration Manual - Third Edition, January 1998", is authorized. Incidental take resulting from Fisheries Restoration Grants Program activities not carried out in such manner is authorized only if the activity is performed under the supervision or oversight of, or is funded by the department. This includes incidental take resulting from activities performed by department employees related to constructing, installing, operating and maintaining facilities or stream features designed to eliminate or minimize barriers to fish migration and fish rescue operations as authorized pursuant to §783.1(c), Title 14, CCR.

The 2084 Order does not alter the regulatory environment, and therefore does not impact the environment. The long-term benefit for these activities for coho salmon outweighs any potential short-term impact, and the activity will not jeopardize the continued existence of the population.

5.5.2 NO PROJECT

The Department's own restoration projects could proceed without the 2084 Order under the take authorization in §783.1(c), Title 14, CCR. Restoration work by others would need to be permitted through §2081(a) or §2081(b). While this alternative might reduce impacts on aquatic species, any benefits to aquatic species would be few in comparison to the larger benefits that restoration activities provide to the ecosystem as a whole.

5.5.3 ALTERNATIVE 1

Add an additional requirement to the proposed project that reads: *Incidental take of coho salmon resulting from activities related to the Department Fisheries Restoration Grants Program and carried out per NMFS Guidelines under the U.S. Army Cops Regional General Permit for Fish Passage/Sediment Reduction Projects at water crossings (RGP-1) (Appendix E).* Projects carried out under the Department Fisheries Restoration Grants Program are currently subject to the RPG-1, where applicable. Therefore, this alternative does not differ from the proposed project.

5.6 Extraction of Gravel Resources

5.6.1 PROJECT

Incidental take of coho salmon resulting from the extraction of gravel resources in a stream or river, is authorized for the coho candidacy period, provided that such activities are conducted in accordance with the measures specified in Exhibit C, Appendix A. These measures include a requirement that any measures identified by the Department as necessary to protect coho salmon be implemented. Therefore, the 2084 Order lessens the impacts that gravel mining activities may have on the environment over the baseline conditions.

5.6.2 NO PROJECT

Gravel extraction activities that may result in take of coho would require individual §2081 permits. While this alternative would allow project-specific mitigation of impacts, it might also reduce aggregate production at least in the short-term while permits are processed. Aggregate is a basic construction material for roads, highways, and buildings.

5.6.3 ALTERNATIVE 1

Incidental take of coho salmon resulting from the extraction of gravel resources in a stream or river, is authorized for the coho salmon candidacy period, provided that such activities are conducted in accordance with the measures specified in the Army Corps of Engineers Letter of Permission Procedure, Gravel Mining and Excavation Activities within Humboldt County (LOP 96-1) (Appendix D).

The project region includes areas with less than 20 inches (51 cm) of rain per year and areas with greater than 100 inches (254 cm) of rain per year, and fluvial geomorphology varies widely among the project's counties and even within watersheds. This LOP 96-1 was provided specifically for Humboldt County and may not be applicable throughout the project region.

5.6.4 ALTERNATIVE 2

Incidental take of coho salmon resulting from the extraction of gravel resources in a stream or river, is authorized for the coho salmon candidacy period, provided that such activities are conducted in accordance with the Surface Mining and Reclamation Act of 1975, with a Department Stream Alteration Agreement (SAA) and with the measures specified in the appropriate aggregate management plan for the regions, i.e., CHERT, LOP 96-2 (Appendix C), LOP 96-1, and the Sonoma County ARM. Those counties without an adopted aggregate management plan must adhere to Exhibit C, Appendix A, of the 2084 Order.

This alternative would have the advantage of tailoring the take provision to the region, assuming that the regional restrictions minimized take of coho salmon. While the Sonoma County ARM and the implementation of Humboldt Counties CHERT may be adequate, as augmented by an SAA, other regions of the project area have yet to formally adopt such plans or do not have such plans in place even informally. Therefore this alternative would require that only those counties without adopted plans adhere to the 2084 Order, as amended by any required SAA. This alternative is viable and would allow the project to be tailored to the region; however, the level of impact on the environment would not be significantly different from the proposed project.

5.6.5 ALTERNATIVE 3

The incidental take provisions should require the retention of proper geomorphology and should define the sediment budget.

This alternative would be difficult to implement since neither term is easily defined, except on a reach-by-reach basis. This type of site-specific requirement is best implemented through the SAA.

5.6.6 ALTERNATIVE 4

The incidental take provisions should (additionally) require turbidity monitoring guidelines.

Since turbidity threshold levels have not been developed for the entire project area, it would be difficult to implement such guidelines.

5.6.7 ALTERNATIVE 5

This alternative would change the second sentence of Exhibit C, Appendix A, to read "The maximum amount permitted to be removed shall be no more than the amount of sand and gravel that is annually replenished, ***except in those cases where it can be demonstrated that there is significant aggradation above historic levels resulting from events such as mass wasting****, and …"*

This addition to the language in Exhibit C, Appendix A, is viable and would reduce the potential for an adverse impact on the environment by the 2084 Order should an event, such as a landslide, occur within a waterway in the project area within the candidacy period.

5.6.8 ALTERNATIVE 6

This alternative would change the first sentence of paragraph 6 of Exhibit C, Appendix A, to read "Large woody debris (LWD) shall be stockpiled before gravel extraction begins and redistributed and the gravel bar after the extraction site has been reclaimed at the end of the extraction ***season or left in place, undisturbed, with gravel extraction occurring around the LWD.***

This addition to the language in Exhibit C, Appendix A, is viable and would reduce the potential for an adverse impact on the environment by the 2084 Order should a circumstance arise where operations can take place without the need for removal of LWD.

5.6.9 ALTERNATIVE 7

This alternative would delete paragraph 7, which restricts tree removal, from the language in Exhibit C, Appendix A.

The case could be made that restricting removal of vegetation to areas where extraction has occurred within the past two years is unnecessarily restrictive and will only serve to encourage additional extraction over a greater area. There is no circumstance within the project area where such encouragement seems likely to happen within the candidacy period. While this is a viable alternative, it would lessen the protections for trees over that provided for in the 2084 Order.

5.7 Water Diversions

5.7.1 PROJECT

Incidental take of coho salmon resulting from diversion of water, for any purpose, is authorized during the candidacy period, subject to the following conditions:

(A) Existing unscreened diversions may continue in operation through the candidacy period. Upon any future determination by the commission that coho salmon shall be added to the list of threatened or endangered species, incidental take for such diversions must be authorized under Fish and Game Code §2081(b) or be determined exempt from the permitting requirement under Fish and Game Code §2080.1.

(B) Diversions approved and constructed after the effective date of this section shall be screened and shall meet the Department of Fish and Game Fish Screening Criteria (dated June 19, 2000) included in this regulation as Exhibit D, Appendix A.

(C) Existing fish screens that are repaired, upgraded, or reconstructed during the candidacy period must meet the Department of Fish and Game Fish Screening Criteria (dated June 19, 2000) included in this regulation as Exhibit D, Appendix A.

At this time, the Department is unable to quantify the number and identify the location of all unscreened diversions within the range of the coho salmon. Existing unscreened diversions included in the 2084 Order are unlikely to jeopardize the continued existence of the population during the candidacy period. The 2084 Order, however, does not increase impacts to the environment over the baseline condition.

5.7.2 NO PROJECT

The no project alternative would require many diverters in the project area to obtain §2081 permits or to restrict diversions to periods during which take of coho salmon is not likely. While this alternative may reduce the take of coho salmon, it could require adjustment to or temporary disruption of diversions while necessary take authorizations are obtained, which may impact agriculture and public services.

5.7.3 ALTERNATIVE 1

*Current language in Item (B) in the proposed project above should be deleted and replaced with the following****: (B) No new diversion permits will be authorized during the candidacy period, unless the permittee can demonstrate conclusively that the river/stream is not over-appropriated.***

Under the 2084 Order, new diversions are required to be screened in accordance with Department standards. Screening of any new diversions will eliminate potential entrapment impacts, and impacts to the environment in general. The Department of Fish and Game does not have authority over water rights; such authority lies with the State Water Resources Control Board. Where appropriate, the Department currently protests water rights permits that have the potential to degrade the quality of the environment, or reduce the number or restrict the range of coho salmon. Since water rights permits are outside the Department's jurisdiction, this alternative is not feasible.

5.7.4 ALTERNATIVE 2

Take is authorized for only those diversions that are equipped with fish screens that meet Department or NMFS fish screening criteria.

At this time, the Department is unable to quantify the number and identify the location of all unscreened diversions within the range of the coho salmon. This alternative, no provisions for incidental take of coho salmon at unscreened diversions, would require screening or individual §2081 permits. While this alternative may reduce the take of coho salmon, it could require adjustment to or temporary disruption of diversions while necessary take authorizations are obtained, which may impact agriculture and public services.

5.7.5 ALTERNATIVE 3

Take is authorized for only those water diversions that are in compliance with Fish and Game Code 5937, which requires passage of water below dams to keep in good condition any fish below that dam.

This alternative may provide substantial environmental benefits; however, it would be infeasible (in terms of limited staff and resources) for the Department to locate all diversions and then determine whether or not the diversion is in compliance with 5937.

5.8 Department of Fish and Game Streambed Alteration Agreements (SAA)

5.8.1 PROJECT

Incidental take of coho salmon during the candidacy period is authorized for any project carried out in compliance with section 1601 or 1603 of the Fish and Game Code, for which a Lake or Streambed Alteration Agreement (Agreement) has been entered into between the department and the party undertaking the activity, provided that:

(A) any measures identified by the department as necessary to protect coho salmon are incorporated into the signed Agreement and are fully implemented by the party undertaking the activity; and

(B) the project otherwise complies with other relevant provisions of section 749.1, Title 14, CCR (the 2084 Order). Projects that will involve the extraction of mineral resources shall also comply with subsection (a)(6), and projects involving water diversions shall also comply with subsection (a)(7) of §749.1, Title 14, CCR.

5.8.2 NO PROJECT

All activities subject to §1601 or §1603 that could result in take of coho salmon would require a §2081 permit. While this alternative might reduce take of coho salmon, it could lead to a temporary disruption of these activities while permits are processed.

5.9 Pacific Lumber Company Habitat Conservation Plan

5.9.1 PROJECT

Incidental take of coho salmon resulting from activities within the Plan and Permit Area described as Covered Activities in the "Habitat Conservation Plan for the Properties of The Pacific Lumber Company (PALCO), Scotia Pacific Holding Company, and Salmon Creek Corporation, February 1999", is authorized during the candidacy period insofar as activities are conducted in accordance with the relevant Operating Conservation Plans.

5.9.2 NO PROJECT

The Implementation Agreement for the PALCO Habitat Conservation Plan (HCP) includes the following provision in section 6.2.1. "Subject to compliance with other terms of the Agreement and the HCP, the State Permit shall become effective as to each Covered Species which is not a State Listed Species concurrent with the regulation of such species under CESA". Coho salmon is a covered species for the HCP. Therefore, there is no substantive distinction between the proposed project and no-project. The inclusion of this measure in the proposed project simply provides clarity to interested parties.

5.10 Forest Practices

5.10.1 PROJECT

Incidental take of coho salmon is authorized during the candidacy period for otherwise lawful timber operations that comply with conditions specified in the revised final rule language, "Protection for Threatened and Impaired Watersheds, 2000", sections 895, 895.1, 898, 898.2, 914.8, 934.8, 954.8, 916, 936, 956, 916.2, 936.2, 956.2, 916.9, 936.9, 956.9, 916.11, 936.11, 956.11, 916.12, 936.12, 956.12, 923.3, 943.3, 963.3, 923.9, 943.9 and 963.9, Title 14, CCR (which can be found on the Board of Forestry website at: www.fire.ca.gov/BOF/pdfs/FRLZ00011814.pdf).

5.10.2 NO PROJECT

The no project alternative would require timber harvest plans that might result in take of coho salmon to obtain §2081 permits from the Department. This alternative could delay the start of timber harvest activities, at least initially, as permits are processed.

5.10.3 ALTERNATIVE 1

Incidental take of coho salmon is authorized for timber harvest operations that comply with Option 9 of the Northwest Forest Plan. Conservation measures for this Plan were developed by the Forest Ecosystem Management Assessment Team (FEMAT). Option 9 is the preferred alternative identified in the final EIS for management of federal lands administered by the U.S. Forest Service and the U.S. Bureau of Land Management (BLM), which are within the range of the northern spotted owl. This option provides comprehensive protections for terrestrial and aquatic species in National Forests and BLM managed lands in western Washington, western Oregon, and northern California. Components of Option 9 include:

- *establishment of areas withdrawn from timber harvest for protection of forest health and other values;*
- *establishment of old growth and late-successional reserves where timber harvest is prohibited or limited;*
- *establishment of adaptive management areas where timber harvest and forest operations are limited to new management approaches that integrate and achieve ecological and economic health;*
- *riparian reserves that establish substantial buffer zones on fish-bearing streams (minimum of 300 feet (91 meters) on either side), permanent non-fish bearing streams (minimum of 150 feet (45.7 meters) on either side), and intermittent streams (minimum of 100 feet (30.5 meters) on either side);*
- *identification of key watersheds that contain at-risk populations of anadromous salmonids and resident fishes, where watershed analysis is required before harvest activities can be implemented and where there can be no net increase in road mileage.*

Application of Option 9 measures to private timberlands would substantially reduce the potential for incidental taking of coho salmon and impacts to their habitat, primarily through establishment of greater protection in the riparian zones and reserves where little or no timber harvest would be allowed.

However, it would be difficult to apply many of the protections of Option 9 on private timberlands because this option was developed for large tracts of public forest lands, and may not be appropriate on private timber lands with respect to land-use patterns and history, management objectives and directives, and ecological and economic considerations. Also, identification and establishment of reserves and key watersheds will take several years of data collection and analyses, which is beyond the time period being evaluated by this document. The conservation measures included in Option 9 could be applied immediately through Fish and Game Code 2084. In many cases, however, these measures may provide greater protection than is needed to avoid "take". For purposes of a short-term strategy throughout the project area, this application is unwarranted.

5.10.4 ALTERNATIVE 2

Incidental take of coho salmon is authorized for timber harvest operations that comply with the National Marine Fisheries Service (NMFS) Short-Term HCP Guidelines (Appendix F). Major components of these guidelines include:

- *The delineation of an outer Aquatic Protection Zones (APZ) boundary on Class I or II waters where timber operations or other management activities will not be conducted, except specific road-related activities.*
- *The delineation of an outer Aquatic Management Zone (AMZ) boundary on Class III waters where timber harvest or other management activities are restricted.*
- *The implementation of specific measures to minimize surface erosion in riparian areas within APZs and AMZs.*
- *The identification of the Channel Migration Zone (CMZ) where timber operations are other management activities is restricted.*
- *The preparation of a road management plan and long-term transportation plan for the ownership or watershed, which addresses fine sediment discharge, gully and landslide erosion, impacts to fish passage, impacts to water temperature and volume, impacts of fire suppression, and impacts of chemicals on the watershed.*

Application of the NMFS Short-Term HCP Guidelines on timberlands would substantially reduce the potential for incidental taking of coho salmon and impacts to their habitat, primarily through establishment of greater protection in the riparian zones where timber harvest, or other management activities, is disallowed or restricted. It may be difficult for small landowners to address measures that require analyses at the watershed level. However, application of the more protective riparian buffer zones could be done immediately and would result in greater protections for habitat and hence less potential for incidental take of coho salmon. Yet in many cases, these measures may provide greater protection than is needed to avoid "take". For purposes of a short-term strategy throughout the project area, this alternative is unwarranted; in addition, if more restrictive buffer zones were adopted, it may result in the inability of operators to conduct business, which may result in a significant socio-economic impact.

5.10.5 ALTERNATIVE 3

Incidental take of coho salmon is authorized for timber operations that comply with the following Habitat Conservation Plan. The Pacific Lumber Company Habitat Conservation Plan (PALCO HCP) includes a comprehensive management strategy for the benefit of four covered fish species, four amphibians, one reptile, four birds and two mammals. The aquatic components of *this strategy principally benefit the fish and amphibian species, but are also relied upon to provide habitat benefits for the terrestrial species. Aquatic components include, but are not limited to, riparian buffers that significantly restrict timber operations, no-harvest prohibitions on potential landslide areas, wet-weather road use restrictions, erosion control measures and watershed analysis. Further contents of the PALCO HCP include:*

- *A stated goal of the aquatics conservation plan to maintain or achieve a properly functioning aquatic habitat condition.*
- *A requirement for assessing the existing road network and associated sediment sources on its lands within five years as part of watershed analysis.*
- *A requirement that roads and landings be storm proofed to the standards identified in Weaver and Hagans (1994) within first 20 years of the HCP, at a minimum rate of 750 miles per decade and 75 miles per year.*
- *A set of restrictions for wet weather road use.*
- *The identification of a hillslope management mass-wasting strategy, including areas with inner gorges, unstable areas, headwall swales, and mass wasting hazard areas rated as high, very high and extreme.*
- *For Class I waters, a requirement for a 170-foot (51.8-meter) riparian management zone with no harvest within first 100 feet (30.5 meters), and restricted harvesting in the outer 100-170 feet (30-52 meters).*
- *For Class II waters, a requirement for a 130-foot (40-meter) riparian management zone with no harvest within the first 30 feet (9 meters), and restricted harvesting in the outer 30-130 feet (9-40 meters).*
- *For Class III waters, a requirement for a 50-100 foot (15-30.5 meter) riparian management zone, dependent on slope. No harvest within the first 30 feet (9 meters), and restricted harvesting in the outer zone.*

Application of these measures across the range of coho salmon in California would substantially reduce the potential for "taking" coho salmon or adversely impacting habitat. However, the PALCO HCP was developed to cover 17 species and to be implemented over a fifty-year period. The measures in this plan are not, in all cases, appropriate for coho salmon alone during the short candidacy period. In addition, it is not feasible to implement all these measures within the period being evaluated by this document.

There are potentially simple modifications to PALCO HCP strategy, which could be made to facilitate implementation during the coho salmon candidacy period. Implementation of measures for streams known to contain coho salmon, which include wider riparian buffers with restricted timber operations, wet weather road use restrictions, and erosion control measures, could result in a reduced potential to take coho salmon. This alternative, however, would still impose a management strategy intended to provide for eight aquatic species and nine terrestrial species for the specific purpose of protecting coho salmon.

5.10.6 ALTERNATIVE 4

This alternative would read the same as the proposed project with the following addition, ***"except when a review team member from the Department of Fish and Game or appropriate Regional Water Quality Control Board makes recommendations, including recommendations for a pre- and post-harvest water quality monitoring plan, that are not incorporated as mitigation prior to the THP approval by CDF."*** *In other words, this alternative* ***requires*** *the* *incorporation of Department and RWQCB recommendations into THPs prior to approval by CDF.*

This alternative may require the modification of the Forest Practices Rules (Title 14, CCR, Chapters 4, 4.5, and 10) or an addition to the Rules (e.g., at §898.2, Title 14, CCR, Special Conditions Requiring Disapproval of Plans), which is outside the Department's jurisdiction. It is unlikely that such a new regulation could be adopted within the timeframe of this project.

5.10.7 ALTERNATIVE 5

This alternative would require a Registered Professional Forester (RPF) to supervise all aspects of timber operations and to certify the operations have been completed according to the provisions and mitigation measures in the approved THP and in compliance with all FPRs and listing measures.

This alternative would require modifications of the Forest Practices Rules (Title 14, California Code of Regulations Chapters 4, 4.5, and 10), which is under the jurisdiction of another agency. However, this alternative may be infeasible due to a lack of an adequate number of RPFs to supervise all timber operations in the project area.

5.10.8 ALTERNATIVE 6

For this Alternative, the FPA would be applied without the threatened and impaired watershed rule.

The Threatened and Impaired Watershed rule was adopted specifically because the BOF determined that their Rules were not adequately protecting Impaired Watersheds. Application of the FPA without the Threatened and Impaired Watershed Rule would adopt less restrictive measures, specifically in riparian zones, than any other alternative. To adopt an alternative that does not include such rules would be inconsistent with the NMFS findings and BOF's actions, and would have an unmitigatable impact on many resources, including coho salmon.

5.11 Additions, Modifications or Revocation

5.11.1 PROJECT

(A) Incidental take of coho salmon north of San Francisco from activities not addressed in this section may be authorized during the candidacy period by the commission pursuant to Fish and Game Code §2084 or by the department pursuant to Fish and Game Code §2081, on a case-by-case basis.
(B) The commission may modify or repeal this regulation in whole or in part, pursuant to law, if it determines that any activity or project may cause jeopardy to the continued existence of coho salmon north of San Francisco.

This section restates law for the purposes of providing clarity and does not have a significant effect on the environment.

5.11.2 GENERAL MODIFICATION 1

The current 2084 Order does not exempt hatchery-produced coho salmon from protection (the Federal ESA allows this distinction to be made in Federal listing actions; however, a recent court case in Oregon has called this into question). This alternative would exempt all marked coho salmon from the listing action. This exemption would exclude marked coho salmon from any protections under the CESA and would specifically allow fishing for marked coho salmon.

This alternative would adversely impact the overall population of coho salmon (inclusive of hatchery fish), would have an unknown effect on wild populations of coho salmon, and would have a beneficial effect on recreation by allowing fishing for marked coho salmon. Issues concerning the interactions between hatchery and wild stocks of coho salmon are being further researched during the status review. Until more information is available, this alternative cannot be adequately evaluated.

5.11.3 GENERAL MODIFICATION 2

Since in-stream gravel mining, Streambed Alteration Agreements, Forest Practices, and channel maintenance activities may have cumulative effects on a watershed, this alternative requires that all these activities combined shall comprise not more than 2 percent of any river and tributary miles within a given year.

This alternative would require the Department, BOF, and lead agencies involved in permitting these activities to design, create, maintain, and coordinate a database system (such as a geographic information system), accessible to all agencies, that would allow such a cumulative analysis of all proposed projects. While this alternative has merit, it would be infeasible, in terms of time to complete and available resources, within the project time limits. However, such a system would be beneficial in the future for cumulative effects analyses and for resource management.

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Appendix A

Section 749.1 is added to Title 14, CCR, to read:

749.1. Special Order Relating To Incidental Take Of Coho Salmon (*Oncorhynchus kisutch)* During Candidacy Period.

The commission finds that, based on current knowledge and protection and management efforts outlined in this regulation, including **Exhibits A through D**[*], the level of habitat loss and take of coho salmon which is likely to occur during the period that this regulation is in effect will not cause jeopardy to the continued existence of the species.

(a) **Take Authorization**.

Based upon the above findings, the commission authorizes the take of coho salmon north of San Francisco **(Exhibit A)** during the candidacy period subject to the terms and conditions herein.

(1) **Inland and Ocean Sport and Commercial Fishing**.

Coho salmon may not be retained during sport or commercial fishing in any waters of the State. Incidentally hooked or netted coho salmon must be immediately released unharmed to the waters where they are hooked or netted.

(2) **Suction Dredging**.

Incidental take of coho salmon during suction dredging that complies with Section 228, Title 14, CCR, is authorized during the candidacy period.

(3) **Research and Monitoring**.

(A) Take of coho salmon by department personnel in the course of research and monitoring is authorized pursuant to Section 783.1(c), Title 14, CCR.

(B) Take of coho salmon in the course of research and monitoring by public agencies and private parties is authorized subject to restrictions in **Exhibit B.**

(4) **Hatchery Operations**.

Take of coho salmon by the Department of Fish and Game for hatchery management purposes is authorized pursuant to Section 783.1(c), Title 14, CCR.

(5) **Habitat Restoration**.

(A) Incidental take of coho salmon resulting from planning, assessment, inventory, construction, maintenance and monitoring activities related to the Department of Fish and Game Fisheries Restoration Grants Program and carried out in the manner prescribed in the department's "California Salmonid Stream Habitat Restoration Manual - Third Edition, January 1998", is authorized. Incidental take resulting from Fisheries Restoration Grants Program activities not carried out in such manner is authorized only if the activity is performed under the supervision or oversight of, or is funded by the department.

(B) Incidental take resulting from activities performed by department employees related to constructing, installing, operating and maintaining facilities or stream features designed to eliminate or minimize barriers to fish migration and fish rescue operations is authorized pursuant to Section 783.1(c), Title 14, CCR.

(6) **Extraction of Gravel Resources**.

Incidental take of coho salmon resulting from the extraction of gravel resources in a stream or river, is authorized for the coho candidacy period provided that such activities are conducted in accordance with the measures specified in **Exhibit C.**

(7) **Water Diversions**.

Incidental take of coho salmon resulting from diversion of water, for any purpose, is authorized during the candidacy period, subject to the following conditions:

(A) Existing unscreened diversions may continue in operation through the candidacy period. Upon any future determination by the commission that coho salmon shall be added to the list of threatened or endangered species, incidental take for such diversions must be authorized under Fish and Game Code Section 2081(b) or be determined exempt from the permitting requirement under Fish and Game Code Section 2080.1.

(B) Diversions approved and constructed after the effective date of this section shall be screened and shall meet the Department of Fish and Game Fish Screening Criteria (dated June 19, 2000) included in this regulation as **Exhibit D.**

(C) Existing fish screens that are repaired, upgraded, or reconstructed during the candidacy period must meet the Department of Fish and Game Fish Screening Criteria (dated June 19, 2000) included in this regulation as **Exhibit D.**

(8) **Department of Fish and Game Streambed Alteration Agreements**.

Incidental take of coho salmon during the candidacy period is authorized for any project carried out in compliance with section 1601 or 1603 of the Fish and Game Code, for which a Lake or Streambed Alteration Agreement (Agreement) has been entered into between the department and the party undertaking the activity, provided that:

(A) any measures identified by the department as necessary to protect coho salmon are incorporated into the signed Agreement and are fully implemented by the party undertaking the activity; and

(B) the project otherwise complies with other relevant provisions of this section. Projects that will involve the extraction of mineral resources shall also comply with subsection (a)(6), and projects involving water diversions shall also comply with subsection (a)(7) of Section 749.1, Title 14, CCR.

(9) **Pacific Lumber Company Habitat Conservation Plan**.

Incidental take of coho salmon resulting from activities within the Plan and Permit Area described as Covered Activities in the "Habitat Conservation Plan for the Properties of The Pacific Lumber Company, Scotia Pacific Holding Company, and Salmon Creek Corporation, February 1999", is authorized during the candidacy period insofar as activities are conducted in accordance with the relevant Operating Conservation Plans.

(10) **Forest Practices**.

Incidental take of coho salmon is authorized during the candidacy period for otherwise lawful timber operations that comply with conditions specified in the revised final rule language, "Protection for Threatened and Impaired Watersheds, 2000", sections 895, 895.1, 898, 898.2, 914.8, 934.8, 954.8, 916, 936, 956, 916.2, 936.2, 956.2, 916.9, 936.9, 956.9, 916.11, 936.11, 956.11, 916.12, 936.12, 956.12, 923.3, 943.3, 963.3, 923.9, 943.9 and 963.9, Title 14, CCR (which can be found on the Board of Forestry website at www.fire.ca.gov/BOF/pdfs/FRLZ00011814.pdf).

(11) **Additions, Modifications or Revocation**.

(A) Incidental take of coho salmon north of San Francisco from activities not addressed in this section may be authorized during the candidacy period by the commission pursuant to Fish and Game Code Section 2084 or by the department pursuant to Fish and Game Code Section 2081, on a case-by-case basis.

(B) The commission may modify or repeal this regulation in whole or in part, pursuant to law, if it determines that any activity or project may cause jeopardy to the continued existence of coho salmon north of San Francisco.

*A copy of Exhibits A through C which are referenced in this regulation is available upon request from the Fish and Game Commission, 1416 Ninth Street, Box 944209, Sacramento, CA 94255-2090 (Telephone 916 653-4899).

NOTE

Authority: Sections 200, 202, 205, 240 and 2084, Fish and Game Code. Reference: Sections 200, 202, 205, 240 and 2084, Fish and Game Code.

EXHIBIT 2-B

Incidental Take Authorization Standards For Research And Monitoring During The Candidacy Period For Coho Salmon

Research Proposals

Take of coho salmon during the candidacy period is authorized for individuals, agencies, or universities and landowners for purposes of research and monitoring provided that:

(i) For ongoing research, a written, detailed project proposal describing objectives, methods (gear, sampling schedules and locations), efforts to minimize adverse effects to the species, estimated level of take of the species, and a copy of a permit authorizing take pursuant to the Federal Endangered Species Act shall be provided to the appropriate Department Regional Manager within 45 days of this regulation becoming effective.

(ii) For research which has not yet commenced, a written, detailed project proposal describing objectives, methods (gear, sampling schedules and locations), efforts to minimize adverse effects to the species, estimated level of take of the species, and a copy of a permit authorizing take pursuant to the Federal Endangered Species Act shall be provided to the appropriate Department Regional Manager.

(iii) The research or monitoring may commence once the Department issues written concurrence that the research and monitoring activities conducted are consistent with the Department's research and monitoring programs and are sufficient to protect coho salmon. The Department may specify additional terms and conditions for the protection of coho salmon and the reporting of all data collected to the Department.

Alternative Procedure

At the discretion of the Department, research and monitoring activities not addressed by the above procedures may receive separate authorization for take of coho salmon by the Department pursuant to Fish and Game Code Section 2081.

Department of Fish and Game Contacts

Regional Manager, Northern California - North Coast Region; 601 Locust Street, Redding, CA 96001 - (530) 225-2300.

Regional Manager, Central Coast Region; 7329 Silverado Trail, P.O. Box 46, Yountville, CA 94599 - (707) 944-5500.

EXHIBIT 2-C

Incidental Take Authorization Standards For In-Stream Gravel Extraction During The Candidacy Period For Coho Salmon

I. A gravel extraction plan including design features, mitigation measures, and enhancement recommendations that minimize impacts to salmonids shall be prepared by the operator and submitted to the Department for review and approval before extraction may begin. The maximum amount permitted to be removed shall be no more than the amount of sand and gravel that is annually replenished in the proposed extraction area, and cumulative extraction quantities shall be consistent with the long-term average annual sustained yield based on estimates of mean annual recruitment.

II. Extraction of gravel shall be accomplished by "skimming" or grading of gravel from bars above the low water channel unless another technique is approved in advance by the Department. The gravel bars shall be sloped from the bank down towards the thalweg and downstream to avoid stranding of salmonids. No holes or depressions shall be allowed to remain in the extraction area. No extraction of the streambanks shall be allowed.

III. Low flow channel confinement shall be maximized by utilizing the low flow silt line, where available, in designing the vertical offset. The silt line measurement shall be taken on or before July 15th of any year unless an alternate date is approved, in advance, by the Department. The vertical offset shall be at least one foot (0.3 meter). A larger vertical offset, as determined by the Department, may be necessary to maximize the low flow channel confinement.

IV. Gravel bar stability shall be protected by minimizing extraction on the upstream one-third of gravel bars. No extraction shall be allowed in riffle sections. The Department shall review proposed gravel extraction plans during an annual site inspection and make specific recommendations to protect salmonid habitat.

V. Channel crossing construction shall not begin before June 15. Removal of channel crossings shall be completed by September 30. If temporary culverts are installed, they will be installed in such a manner so that they will not impede the passing of fish up and down stream.

VI. Large woody debris (LWD) shall be stockpiled before gravel extraction begins and redistributed on the gravel bar after the extraction site has been reclaimed at the end of the extraction season. To the extent possible, vehicular access onto gravel mining sites shall be controlled to minimize the loss of LWD from firewood collectors.

VII. Trees exceeding 1 inch DBH shall not be removed, and clumps of smaller trees shall not be removed except by prior approval of the Department. The disturbance or removal of vegetation shall be minimized, shall not exceed that necessary to complete operations and shall be limited to areas where extraction has occurred within the past two years.

The project shall comply with Section 1601 or 1603 of the California Fish and Game Code, and a Lake or Streambed Alteration Agreement shall be obtained from the Department. Any measures identified by the Department as necessary to protect coho salmon shall be incorporated into the signed agreement and shall be fully implemented.

EXHIBIT 2-D

Department OF FISH AND GAME
Fish Screening Criteria
June 19, 2000

1. STRUCTURE PLACEMENT

A. Streams And Rivers (flowing water): The screen face shall be parallel to the flow and adjacent bankline (water's edge), with the screen face at or streamward of a line defined by the annual low-flow water's edge.

The upstream and downstream transitions to the screen structure shall be designed and constructed to match the back-line, minimizing eddies upstream of, in front of and downstream of, the screen.

Where feasible, this "on-stream" fish screen structure placement is preferred by the California Department of Fish and Game.

B. In Canals (flowing water): The screen structure shall be located as close to the river source as practical, in an effort to minimize the approach channel length and the fish return bypass length. This "in canal" fish screen location shall only be used where an "on-stream" screen design is not feasible. This situation is most common at existing diversion dams with headgate structures.

The National Marine Fisheries Service - Southwest Region "Fish Screening Criteria for Anadromous Salmonids, January 1997" for these types of installations shall be used.

C. Small Pumped Diversions: Small pumped diversions (less than 40 cubic-feet per second) which are screened using "manufactured, self-contained" screens shall conform to the National Marine Fisheries Service - Southwest Region "Fish Screening Criteria for Anadromous Salmonids, January 1997".

D. Non-Flowing Waters (tidal areas, lakes and reservoirs): The preferred location for the diversion intake structure shall be offshore, in deep water, to minimize fish contact with the diversion. Other configurations will be considered as exceptions to the screening criteria as described in Section 5.F. below.

2. APPROACH VELOCITY (Local velocity component perpendicular to the screen face

A. Flow Uniformity: The design of the screen shall distribute the approach velocity uniformly across the face of the screen. Provisions shall be made in the design of the screen to allow for adjustment of flow patterns. The intent is to ensure uniform flow distribution through the entire face of the screen as it is constructed and operated.

B. Self-Cleaning Screens: The design approach velocity shall not exceed:

1. Streams And Rivers (flowing waters) - Either:

   a. 0.33 feet per second, where exposure to the fish screen shall not exceed fifteen minutes, or

   b. 0.40 feet per second, for small (less than 40 cubic-feet per second) pumped diversions using "manufactured, self-contained" screens.

2. In Canals (flowing waters) - 0.40 feet per second, with a bypass entrance located every one-minute of travel time along the screen face.

3. Non-Flowing Waters (tidal areas, lakes and reservoirs) - The specific screen approach velocity shall be determined for each installation, based on the species and life stage of fish being protected. Velocities which exceed those described above will require a variance to these criteria (see Section 5.F. below).

(Note: At this time, the U.S. Fish and Wildlife Service has selected a 0.2 feet per second approach velocity for use in waters where the Delta smelt is found. Thus, fish screens in the Sacramento-San Joaquin Estuary should use this criterion for design purposes.)

C. Screens Which Are Not Self-Cleaning: The screens shall be designed with an approach velocity one-fourth that outlined in Section B. above. The screen shall be cleaned before the approach velocity exceeds the criteria described in Section B.

D. Frequency Of Cleaning: Fish screens shall be cleaned as frequently as necessary to prevent flow impedance and violation of the approach velocity criteria. A cleaning cycle once every 5 minutes is deemed to meet this standard.

E. Screen Area Calculation: The required wetted screen area (square feet), excluding the area affected by structural components, is calculated by dividing the **maximum** diverted flow (cubic-feet per second) by the allowable approach velocity (feet per second). Example:

1.0 cubic-feet per second / 0.33 feet per second = 3.0 square feet

Unless otherwise specifically agreed to, this calculation shall be done at the **minimum** stream stage.

3. SWEEPING VELOCITY (Velocity component parallel to screen face)

A. In Streams And Rivers: The sweeping velocity should be at least two times the allowable approach velocity.

B. In Canals: The sweeping velocity shall exceed the allowable approach velocity. Experience has shown that sweeping velocities of 2.0 feet per second (or greater) are preferable.

C. Design Considerations: Screen faces shall be designed flush with any adjacent screen bay piers or walls, to allow an unimpeded flow of water parallel to the screen face.

4. SCREEN OPENINGS

A. Porosity: The screen surface shall have a minimum open area of 27 percent. We recommend the maximum possible open area consistent with the availability of appropriate material, and structural design considerations.

The use of open areas less than 40 percent shall include consideration of increasing the screen surface area, to reduce slot velocities, assisting in both fish protection and screen cleaning.

B. Round Openings: Round openings in the screening shall not exceed 3.96mm (5/32in). In waters where steelhead rainbow trout fry are present, this dimension shall not exceed 2.38mm (3/32in).

C. Square Openings: Square openings in screening shall not exceed 3.96mm (5/32in) measured diagonally. In waters where steelhead rainbow trout fry are present, this dimension shall not exceed 2.38mm (3/32in) measured diagonally.

D. Slotted Openings: Slotted openings shall not exceed 2.38mm (3/32in) in width. In waters where steelhead rainbow trout fry are present, this dimension shall not exceed 1.75mm (0.0689in).

5. SCREEN CONSTRUCTION

A. Material Selection: Screens may be constructed of any rigid material, perforated, woven, or slotted that provides water passage while physically excluding fish. The largest possible screen open area which is consistent with other project requirements should be used. Reducing the screen slot velocity is desirable both to protect fish and to ease cleaning requirements. Care should be taken to avoid the use of materials with sharp edges or projections which could harm fish.

B. Corrosion And Fouling Protection: Stainless steel or other corrosion-resistant material is the screen material recommended to reduce clogging due to corrosion. The use of both active and passive corrosion protection systems should be considered.

Consideration should be given to anti-fouling material choices, to reduce biological fouling problems. Care should be taken not to use materials deemed deleterious to fish and other wildlife.

C. Project Review And Approval: Plans and design calculations, which show that all the applicable screening criteria have been met, shall be provided to the Department before written approval can be granted by the appropriate Regional Manager.

The approval shall be documented in writing to the project sponsor, with copies to both the Deputy Director, Habitat Conservation Division and the Deputy Director, Wildlife and Inland Fisheries Division. Such approval may include a requirement for post-construction evaluation, monitoring and reporting.

D. Assurances: All fish screens constructed after the effective date of these criteria shall be designed and constructed to satisfy the current criteria. Owners of existing screens, approved by the Department prior to the effective date of these criteria, shall not be required to upgrade their facilities to satisfy the current criteria unless:

1. The controlling screen components deteriorate and require replacement (i.e., change the opening size or opening orientation when the screen panels or rotary drum screen coverings need replacing),

2. Relocation, modification or reconstruction (i.e., a change of screen alignment or an increase in the intake size to satisfy diversion requirements) of the intake facilities, or

3. The owner proposes to increase the rate of diversion which would result in violation of the criteria without additional modifications.

E. Supplemental Criteria: Supplemental criteria may be issued by the Department for a project, to accommodate new fish screening technology or to address species-specific or site-specific circumstances.

F. Variances: Written variances to these criteria may be granted with the approval of the appropriate Regional Manager and concurrence from both the Deputy Director, Habitat Conservation Division and the Deputy Director, Wildlife and Inland Fisheries Division. At a minimum, the rationale for the variance must be described and justified in the request.

Evaluation and monitoring may be required as a condition of any variance, to ensure that the requested variance does not result in a reduced level of protection for the aquatic resources.

It is the responsibility of the project sponsor to obtain the appropriate fish screen criteria as provided herein. Project sponsors should contact the Department of Fish and Game, the National Marine Fisheries Service (for projects in marine and anadromous waters) and the U.S. Fish and Wildlife Service (for projects in anadromous and fresh waters) for guidance.

Copies of the criteria are available from the Department of Fish and Game through the appropriate Regional office, which should be the first point of contact for any fish screening project.

Northern California and North Coast Region; 601 Locust Street, Redding, CA 96001 - (530) 225-2300.

Sacramento Valley and Central Sierra Region; 1701 Nimbus Drive, Rancho Cordova, CA 95670 - (916) 358-2900.

Central Coast Region; 7329 Silverado Trail/P.O. Box 46, Yountville, CA 94599 - (707) 944-5500.

San Joaquin Valley-Southern Sierra Region; 1234 E. Shaw Avenue, Fresno, CA 93710 - (209) 243-4005.

South Coast Region; 4649 View Crest Avenue, San Diego, CA 92123 - (619) 467-4201.

Eastern Sierra and Inland Deserts Region; 4775 Bird Farms Road, Chino Hills, CA 91709 - (909) 597-9823.

Marine Region; 20 Lower Ragsdale Drive, #100, Monterey, CA 93940 - (831) 649-2870.

Technical assistance can be obtained directly from the Habitat Conservation Division; 1416 Ninth Street, Sacramento, CA 95814 - (916) 653-1070.

The National Marine Fisheries Service - Southwest Region “Fish Screening Criteria for Anadromous Salmonids, January 1997" are also available from their Southwest Region; 777 Sonoma Avenue, Room 325, Santa Rosa, CA 95402 - (707) 575-6050.

Appendix B

Appendix C

Appendix D

Appendix E

Appendix F

Appendix G