Endangered Species Act
Section 7 Consultation

BIOLOGICAL OPINION

for

The proposed license amendment for the Potter Valley Project
(Federal Energy Regulatory Commission Project Number 77-110)

Action Agency: Federal Energy Regulatory Commission

Consultation Conducted By: National Marine Fisheries Service, Southwest Region

Date Issued: NOV 26 2002

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ABBREVIATIONS USED WITHIN THIS DOCUMENT

ACP	Aquatic Conservation Plan
BA	Biological Assessment
BO	biological opinion
BOF	California Board of Forestry
CC	California Coastal
CCC	Central California Coast
CDFG	California Department of Fish and Game
CLP	cumulative inflow into Lake Pillsbury
DBO	draft biological opinion
DEIS	Draft Environmental Impact Statement
DO	dissolved oxygen
DOI	Department of the Interior
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FL	fork length
HCP	Habitat Conservation Plan
MDN	marine-derived nutrients
NC	Northern California
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
PALCO	Pacific Lumber Company, Scotia Pacific Company LLC and Salmon Creek Corporation
PG&E	Pacific Gas and Electric Company
Project	Potter Valley Project
PVID	Potter Valley Irrigation District
RM	river mile
RPA	reasonable and prudent alternative
RVIT	Round Valley Indian Tribes
SCWA	Sonoma County Water Agency
SEC	Steiner Environmental Consulting
SL	standard length
SONCC	Southern Oregon/Northern California Coasts
SWRCB	State Water Resources Control Board
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VAFS	Van Arsdale Fisheries Station
VTN	Venture Tech Network

STANDARD UNITS OF MEASURE INCLUDED WITHIN THIS DOCUMENT

ac-ft	acre feet
EC	degrees Celsius
cm	centimeters
cm/s	centimeters per second
cfs	cubic feet per second
mg/l	milligrams per liter
mm	millimeters

I. BACKGROUND AND CONSULTATION HISTORY

A. Background

In October 1983, the Federal Energy Regulatory Commission (FERC) approved a contested settlement agreement and issued a new 50-year license (backdated to 1972) to the Pacific Gas and Electric Company (PG&E) for operations of the Potter Valley Project (FERC Project Number 77-110) in Northern California until April 14, 2022. The Potter Valley Project (Project) is a 9.4 megawatt storage and diversion project (FERC 2000) that has been in operation for over 90 years. The Project functions as an interbasin transfer system, diverting water from the Upper Eel River into the East Branch Russian River across a natural divide. The Project consists of Scott Dam and Lake Pillsbury, Cape Horn Dam and Van Arsdale Reservoir, and a diversion tunnel and powerhouse located on the East Branch Russian River. The historic average annual diversion is 160,000 acre-feet (ac-ft) (FERC 2000).

When FERC considers whether to re-license a hydropower project, it must review the project to ensure it is best adapted to a comprehensive plan for, among other things, the adequate protection, mitigation and enhancement of fish and wildlife, including related spawning grounds and habitat (Section 10(a) of the Federal Power Act). FERC concluded that there was not adequate information to determine the effects of Project operations on downstream fishery resources during the 1983 re-licensing proceeding. Therefore, FERC did not make the necessary fishery findings required by Section 10(a) of the Federal Power Act and instead FERC included Article 39 in the license. Article 39 required a ten-year study to evaluate the effects of Project operations on downstream fishery resources which also provided an opportunity for changes to Project structures and operations as necessary to protect and maintain andromous salmonids in the Eel River.

Article 39 of the license (FERC Project Number 77-110) states the following:

> "The Licensee shall, in consultation with the California Department of Fish and Game and the United States Fish and Wildlife Service develop a satisfactory study plan to determine the effects of the flow release schedule provided for in Article 38 on the salmonid fishery resources of the Upper Eel River and the East Branch of the Russian River. The plan shall further provide for the monitoring of the temperature regime of the Eel River downstream of Scott Dam.
>
> The monitoring shall commence within 6 months from the date of issuance of this license and shall continue for a period of 10 years. After completion of the monitoring program the Licensee shall, in consultation with the above agencies, review the results and file a report on the results of the monitoring program for Commission approval recommendations for modifications in the flow release schedule or project structures and operations necessary to protect and maintain the fishery resources. Letters documenting consultation with the above agencies on the report and recommendations shall be in the filing."

In October 1996, the National Marine Fisheries Service (NMFS) was invited to participate in analyzing the results of the ten-year study and to participate in developing a proposal to meet Article 39 objectives. This was due to the anticipated listing of coho salmon (*Oncorhynchus kisutch*) in the Eel River pursuant to the Endangered Species Act of 1973 as amended (ESA). After nearly 18 months of collaboration, PG&E and the agencies arrived at a compromise proposal to meet the license Article 39 objectives. NMFS believed that the proposal would likely improve conditions for salmonid fishery resources relative to more deleterious previous operating practices, but recognized that full analysis pursuant to section 7 of the ESA with FERC had not been completed. This proposal, known as the Fishery Review Group proposal, or PG&E proposal, was selected by FERC over three others as the preferred alternative in the Draft Environmental Impact Statement (DEIS) released in February 1999 (FERC 1999), largely because of the support from the resource agencies.

After the PG&E proposal was developed, NMFS participated in a separate Federal effort to analyze the PG&E proposal and to develop an additional alternative. This Federal effort resulted in the development of an alternative with increased benefits to the salmonid fishery in the Eel River. Therefore, in April 1999, the United States Department of Interior (DOI) and NMFS filed an alternate proposal with FERC for operations of the Potter Valley Project and fulfillment of the Article 39 objectives. By filing the DOI/NMFS proposal, NMFS rescinded its support for the PG&E proposal.

B. Consultation History

NMFS informed FERC of their obligation to initiate section 7 consultation on the proposed license amendment for the Project in February 1999. At this time, only coho salmon were ESA-listed in the Eel and Russian rivers and steelhead were listed in the Russian River. In March 1999, FERC initiated consultation with NMFS and provided NMFS with the DEIS for the Project. The DEIS identified the PG&E proposal as the proposed action . In early April 1999, NMFS requested additional information from FERC and notified FERC that formal section 7 consultation would not begin until NMFS receives the additional information. In late April 1999, NMFS along with various other agencies provided technical comments on the DEIS to FERC. Also in late April 1999, NMFS jointly with DOI filed an alternate proposal for operations of the Project that was designed to provide more benefits to salmonids in the Eel River and to satisfy Article 39 objectives. In May 1999, NMFS informed FERC that NMFS still did not have adequate information to initiate section 7 consultation. In August 1999, FERC maintained that the DEIS was sufficient information and requested that NMFS either concur that the proposed action would not likely adversely affect all listed species or critical habitat, or provide FERC with a biological opinion. In September 1999, noting that NMFS did not agree with FERC, NMFS notified FERC that a biological opinion would be completed in early 2000. Also, in September 1999 Chinook salmon in the Eel and Russian rivers were listed as threatened pursuant to the ESA. In January 2000, NMFS provided FERC with a draft biological opinion that concluded that implementation of the PG&E proposal would jeopardize ESA-listed salmonids in the Eel River. In March 2000, NMFS requested an extension of time from FERC to complete a final biological opinion in order to address comments that were received on the draft biological opinion. In June 2000, FERC submitted the final EIS (FEIS) to NMFS and informed

NMFS that the proposed action had changed from implementation of the PG&E proposal to implementation of the Potter Valley Irrigation District (PVID) proposal. Also in June 2000, steelhead in the Eel River became listed as threatened pursuant to the ESA. NMFS and various other agencies and the public provided extensive comments on the FEIS to FERC, including numerous requests for a supplemental EIS. In November 2000, NMFS provided FERC with a second draft biological opinion that concluded that implementation of the PVID proposal would jeopardize coho salmon, Chinook salmon and steelhead in the Eel River. Prior to finalizing the biological opinion, NMFS met with PG&E and California Department of Fish and Game (CDFG) to discuss the concerns that NMFS had with the PVID proposal. In June 2001, PG&E submitted a modified version of the PVID proposal to FERC. In July 2001, FERC requested that NMFS suspend preparation of the final biological opinion until September 2001. In October 2001, NMFS requested an update from FERC on the status of the suspension of the section 7 consultation. In May 2002, FERC finally notified NMFS to resume preparation of the final biological opinion with the PVID proposal, as analyzed in the FEIS and second draft biological opinion, as the proposed action. In late May, NMFS notified FERC that the final biological opinion would be completed by October 2002. In early October 2002, PG&E requested an extension of time request from FERC from October 13, 2002 to November 27, 2002 for NMFS to provide the final biological opinion. PG&E requested this extension of time so that PG&E can work closely with NMFS to develop a technically and economically feasible reasonable and prudent alternative. FERC informed NMFS that FERC will grant the requested extension of time in order for NMFS to work with PG&E on a reasonable and prudent alternative.

Below is a more detailed description of the consultation history in chronological order, for a complete record of this FERC proceeding or to view the documents mentioned below, please visit the FERC electronic filing website: http://www.ferc.gov/ferris.htm.

- February 23, 1999, NMFS, by letter, informed FERC of its obligation to initiate ESA section 7 consultation on the proposed license amendment for the Project.

- March 5, 1999, FERC provided a letter to NMFS stating that the letter, in conjunction with the DEIS, constituted as the Biological Assessment (BA) for section 7 consultation. In that letter, FERC stated "...our proposed action is approval of the licensee's recommendations to change the minimum flow regime at the project to benefit salmonids."

- April 1, 1999, NMFS responded by requesting more information related to impacts of the proposed action and stated that the formal consultation process will not begin until NMFS receives the additional information.

- April 9, 1999, FERC failed to provide the additional information as per NMFS request, instead FERC identified the location of the information and requested initiation of formal consultation.

- April 26, 1999, NMFS submitted comments on the DEIS to FERC. This letter identified modeling errors, lack of cost/benefit analysis for each proposal and other technical errors.

Also in that letter NMFS states; As pointed out by Sonoma County Water Agency (SCWA), analysis of the proposals in the DEIS produced results "dramatically different than that produced by all other parties".

- April 27, 1999, DOI submitted comments on the DEIS to FERC. This letter provided detailed comments on the DEIS and identified critical modeling and technical errors.

- April 27, 1999, DOI and NMFS filed an alternate proposal (DOI/NMFS proposal) with FERC for operations of the Project and fulfillment of the Article 39 objectives. This proposal included some key features of the other proposals and additional features that more closely approximate the natural hydrograph of the Eel River.

- May 13, 1999, FERC requested any information or determinations as to whether the DOI/NMFS proposal is likely to adversely affect listed salmonids or critical habitat in the Eel and Russian rivers.

- May 27, 1999, NMFS informed FERC that NMFS still did not have the information necessary to begin consultation, and reiterated its request for additional information to FERC. NMFS stated that proper evaluation of the effects of the proposed action can only be facilitated by a BA that contains reliable data and modeling results. NMFS also pointed out that public comments on the DEIS, a major component of FERC's BA, have revealed potentially serious flaws in modeling and other aspects of the analysis presented in the DEIS. Responding to the letter sent by FERC on May13, 1999, NMFS also stated that the DOI/NMFS proposal, as with all the other proposals, would likely adversely affect listed salmonid species and that only decommissioning of the project would eliminate adverse affects.

- June 17, 1999, NMFS transmitted the response of DOI and NMFS to comments made at the Potter Valley Project Technical Conference held by FERC in Santa Rosa, California on June 2 and 3, 1999. NMFS noted that at that conference, representatives of various public and private interests requested that FERC include an analysis of a decommissioning alternative. In this letter, NMFS and DOI concurred and recommended FERC analyze a full range of alternatives in the DEIS and requested that FERC issue a revised DEIS which would include a no project alternative or any other appropriate decommissioning alternative.

- July 9, 1999, by letter to FERC, the United Sates Forest Service (USFS) concurred with the DOI and NMFS that FERC issue a revised DEIS which would include a no-project alternative.

- July 21, 1999, NMFS provided FERC with additional information relevant to the analysis of the Project and its impacts to listed salmonids.

- August 19, 1999, FERC refused to provide the requested information and maintained that its DEIS and other information available constituted a complete BA. Also given that the requested information was contained in the BA sent on March 5, 1999, FERC requested that NMFS forward FERC, within 30 days either: 1)concurrence that the proposed action is not likely to adversely affect listed species or critical habitat; or 2) the biological opinion.

- September 3, 1999, noting that NMFS did not agree that FERC had supplied all of the information that is readily available to facilitate review of the potential effects of the proposed action, NMFS initiated formal consultation effective August 23, 1999 (date letter was received from FERC). NMFS noted that the biological opinion would be completed no later than November 22, 1999.

- September 10, 1999, NMFS corrected the timeline specified in the September 3, 1999 letter. Based on the initiation date of August 23, 1999, NMFS expected to conclude consultation by November 22, 1999, and provide the biological opinion to FERC no later than January 5, 2000.

- October 8, 1999, NMFS notified FERC that this proceeding was subject to the provisions of Section 10 of the Federal Power Act and recommended that FERC fully consider the substantial resource benefits that would accrue from restoring the aquatic resources of the Eel River impacted by the operation of the Project.

- October 14, 1999, FERC acknowledged receipt of the letters of September 3 and 10, 1999. FERC also requested that a draft biological opinion be provided to FERC and the FERC Service list for the Project by November 22, 1999.

- November 15, 1999, NMFS informed FERC that NMFS will strive to provide FERC with a draft biological opinion (DBO) by January 5, 2000 and also requested an extension for the completion of the final biological opinion.

- December 8, 1999, FERC responded to NMFS regarding the DBO and extension of time for the final biological opinion. FERC stated that they will decide whether or not to agree to an extension after they receive and review the DBO.

- January 14, 2000, NMFS submitted a DBO to FERC. This first DBO analyzed the PG&E proposal as the proposed action and concluded that implementation of the PG&E proposal was likely to jeopardize the continued existence of listed salmonids in the Eel River.

- February 9, 2000, the Environmental Protection Agency (EPA) notified FERC that they are aware that NMFS, DOI and USFS have asked for a revised DEIS which would include consideration of new flow proposals and/or decommissioning alternatives. The EPA stated that in their view, "preparation of a revised DEIS, including full consideration of a reasonable array of decommissioning options, is warranted."

- February 11, 2000, FERC provided comments to NMFS on the DBO and granted a 75 day extension (backdated to January 5, 2000) to provide FERC with the final biological opinion (BO).

- March 3, 2000, FERC provided NMFS with the licensee's (PG&E) comments on the DBO.

- March 15, 2000, NMFS requested a 60-day extension of the consultation period in order to evaluate and incorporate comments into the final biological opinion.

- May 19, 2000, NMFS advises FERC that in consideration of FERC's intent to modify the project description, NMFS will wait to issue the BO until NMFS receives a supplemental DEIS or a modified BA.

- June 9, 2000, FERC informed NMFS that it had changed the proposed agency action from the original PG&E proposal to the alternative proposed by the PVID, and requested that the NMFS' biological opinion reflect this change. Also with that letter, FERC provided the FEIS that identified the PVID proposal as the preferred alternative for this license amendment.

- June 26, 2000, NMFS reinitiated the section 7 consultation due to changes in the proposed action and new information in the FEIS. NMFS also expected that the BO would be completed no later than October 23, 2000.

- July 20, 2000, DOI submitted comments on the FEIS to FERC. The DOI comments on the FEIS included; Oakridge National Laboratory modifications of the DOI's software resulted in critical errors in the modeling of the DOI/NMFS proposal, FERC failed to disclose Oakridge National Laboratory's intention to modify the DOI's software, the selection of the Steiner Environmental Consulting (SEC) normalized unimpaired flow data set has also played a significant role in the modeling errors, and errors in the upper Russian River models. The DOI renewed its request that FERC issue a supplemental EIS and also stated that if the modeling had been correctly performed, the DOI/NMFS proposal would have been the presumptive choice for the preferred alternative.

- July 21, 2000, NMFS submitted comments on the FEIS to FERC. NMFS comments on the FEIS included; the improper definition of the no action alternative, the inappropriate analysis of alternatives, the failure to include a dam decommissioning alternative, the failure to disclose and analyze significant information, modeling errors and resulting concerns, and the questionable value of the pikeminnow predation analysis. NMFS also continued to recommend that FERC issue a revised, or supplemental EIS for this proceeding in accordance with Council on Environmental Quality regulations National Environmental Policy Act (NEPA) regulations (40 CFR Parts 1500-1508).

- July 28, 2000, FERC encouraged NMFS to consider comments that were filed on the first DBO and requested that NMFS provide FERC with a DBO as soon as it is available.

C October 20, 2000, NMFS requested from FERC an additional 90 days to complete the final BO. NMFS proposed that a DBO would be submitted to FERC by November 22, 2000 and a final BO would be submitted by January 22, 2001.

C November 8, 2000, FERC granted the 90-day extension to NMFS and stated that comments on the DBO will be provided to NMFS by December 22, 2000.

C November 20, 2000, DOI and NMFS filed a "Motion for order establishing interim flows in the Eel River" with FERC.

C November 21, 2000, NMFS provided the second DBO to FERC and the FERC Service List for the Project. This second DBO analyzed the PVID proposal as the proposed action and concluded that implementation of the PVID proposal would likely jeopardize the continued existence of listed salmonids in the Eel River and would be likely to adversely modify designated critical habitat.

C December 21, 2000, FERC provided comments to NMFS on the second DBO.

C January 3, 2001, FERC provided the licensee's (PG&E) comments on the second DBO to NMFS.

C January 5, 2001, NMFS requested a two week extension of time to February 5, 2001 for submission of the final BO to FERC.

C January 23, 2001, NMFS requested another extension of time until April 6, 2001 for submission of the final BO to FERC.

C February 7, 2001, FERC granted NMFS the requested extension of time until April 6, 2001 for submission of the final BO.

C February- June 2001, NMFS met with PG&E and CDFG to discuss technical issues related to the PVID proposal and the DOI/NMFS proposal.

C April 3, 2001, PG&E requested from FERC and NMFS an extension of time until June 29, 2001 for NMFS to submit the final BO to FERC.

C April 26, 2001, FERC granted an extension of time until June 29, 2001 for the submission of the final BO.

C June 14, 2001, PG&E submitted a modified PVID proposal to FERC for their review.

C July 12, 2001, FERC notified NMFS and requested suspension of the preparation of the BO while FERC reviews the modified PVID proposal that PG&E submitted in June 2001. Also in the letter, FERC stated that their review of the modified proposal and comments should be completed by September 6, 2001.

- August 3, 2001, by letter, NMFS responded to FERC's request to suspend preparation of the BO. NMFS stated that preliminary analysis for the modified PVID proposal suggests that listed salmonids would benefit from the proposed operational changes, and implementation of an aggressive pikeminnow control program. However, further analyses within the ESA section 7 consultation would be required if FERC identifies the modified proposal as the proposed action. NMFS also recommended that FERC issue a supplemental EIS for this proceeding which would include analysis of the June 2001 modified PVID proposal, along with an re-analysis of the DOI/NMFS proposal, the decommissioning alternative, and other reasonable alternatives to fulfill FERC's obligations under NEPA.

- October 4, 2001, by letter, NMFS requested an update from FERC on the status of the review of the June 2001 modified PVID proposal.

- December 20, 2001, DOI noted in a letter to FERC that the license amendment for the Potter Valley Project has remained unresolved for over 18 years and requested that FERC arrange a meeting of interested parties to discuss the status of the proceeding.

- May 7, 2002, FERC notified NMFS that they determined that a supplemental NEPA analysis is not warranted and that they would not adopt the June 2001 modified PVID proposal. Instead, FERC recommended the PVID proposal that was analyzed in the FEIS and the second DBO and requested that NMFS resume the preparation of the BO.

- May 31, 2002, NMFS responded to FERC's request for resumption of the consultation and let FERC know that NMFS expects to provide FERC with the final BO no later than October 13, 2002.

- October 7, 2002, PG&E sent FERC a letter to request an extension of time from October 13, 2002 to November 27, 2002 for NMFS to provide the final BO. PG&E requested this extension of time so that PG&E can work closely with NMFS to develop a technically and economically feasible reasonable and prudent alternative.

- October 10, 2002, by letter, FERC informed NMFS that FERC will grant the requested extension of time for NMFS to provide the final BO by November 27, 2002 in order for NMFS to work with PG&E on a reasonable and prudent alternative.

- November 5, 2002, NMFS met with PG&E to discuss the draft proposed reasonable and prudent alternative prepared by NMFS.

- November 13, 2002, PG&E electronically transmitted to NMFS their proposal for a reasonable and prudent alternative to the proposed action. This version of a reasonable and prudent alternative included additional modifications to NMFS' draft proposed reasonable and prudent alternative that were not agreed to at the November 5, 2002 meeting.

- November 20, 2002, NMFS transmitted to PG&E by facsimile the final version of the reasonable and prudent alternative which incorporated the modifications that were discussed at the November 5, 2002 meeting.

- November 22, 2002, PG&E electronically transmitted to NMFS comments on the final version of NMFS' reasonable and prudent alternative.

II. DESCRIPTION OF THE PROPOSED ACTION

In October 1983, FERC approved a contested settlement agreement and issued a new 50-year license (backdated to 1972) to PG&E for operations of the Potter Valley Project (FERC Project Number 77-110) in Northern California until April 14, 2022. At the time of the re-licensing proceeding for the Project in 1983, there was considerable debate as to how the Project should operate to provide flows adequate to protect and maintain the fisheries in the Eel River. FERC did not make the required fishery findings in 1983 to satisfy Section 10(a) of the Federal Power Act. Based on the language of the settlement agreement itself, FERC understood and anticipated that there would be "an evaluation of the effectiveness and need to modify the flow regime at the end of the 10-year period" in order to adjust as necessary to meet fishery needs. Therefore, the license issued to PG&E was conditioned by inclusion of Article 39 which directed PG&E to conduct a ten-year study of Article 38 flows, and then in consultation with the resource agencies make recommendations for modifications in the flow release schedule or Project structures and operations necessary "to protect and maintain the [salmonid] fishery resources." FERC's stated purpose of the proposed action is to modify the Article 38 flow regime and Project structures for the purpose of protecting and maintaining salmonid fishery resources in the Eel and Russian rivers. Although the purpose is to amend the license to satisfy Article 39, this amendment is a continuation of the process of bringing the original re-licensing proceeding to a closure. When FERC considers whether to re-license a hydropower project, it must review the project to ensure it is best adapted to a comprehensive plan for, among other things, the adequate protection, mitigation and enhancement of fish and wildlife, including related spawning grounds and habitat (Section 10(a) of the Federal Power Act). Upon closure of this FERC proceeding, the flow regime and modifications that are selected will remain in effect for the next twenty years, until 2022.

The proposed "Federal action" that is the subject of this consultation is the amendment by FERC of the Potter Valley Project (FERC Project Number 77-110) license to order PG&E to operate the Project and make physical modifications as detailed in the PG&E proposal for Project operations as modified by PVID. Details of the PG&E proposal are described in *Article 39 Joint Recommendation, developed by Pacific Gas and Electric Company, California Department of Fish and Game, U.S. Fish and Wildlife Service and National Marine Fisheries Service* (PG&E 1998a); *Proposed Changes in Minimum Flow Requirements at the Potter Valley Project, Final Environmental Impact Statement,* (FERC 2000); *Flow Implementation and Compliance Plan for the Potter Valley Fisheries Review Group Article 39 Flow Proposal,* (PG&E 1998b); and the PVID comments on the DEIS dated April 23, 1999; these documents are incorporated herein by reference.

The PVID proposal consists of amendments to Article 38 that prescribe minimum flow schedules for the Eel River below Scott Dam, the Eel River below Cape Horn Dam, and the East Branch Russian River (Figures 1 and 2). The PVID proposal would also provide a 5,000 ac-ft block of water to be released at the discretion of the resource agencies and would provide $60,000 annually to CDFG to support the Van Arsdale Fisheries Station (VAFS) and Sacramento pikeminnow (*Ptychocheilus grandis*) suppression efforts among other things.

The modifications of the original PG&E proposal that were incorporated into the PVID proposal are: 1) removal of the Lake Level Emergency Reductions provision, 2) diversion flow changes, 3) deferred water deliveries to PVID, 4) emergency use of Van Arsdale Reservoir water without the 50 percent flow reduction payback requirement. The Eel River minimum flows under the PVID proposal are the same as the PG&E proposal except that without the Emergency Provision, the 50 percent curtailment is not applied in critical conditions, and 5) PG&E in cooperation with state and Federal fish resource management agencies should develop a more specific process by which blockwater will be allocated annually over the period prior to December 1, as well as later in the water year.

The PVID proposal will be referred to throughout the rest of this BO as the proposed action. Under the proposed action, Eel River flows below Cape Horn Dam would be adjusted at least daily from October 1 through June 30 in response to natural flows in Tomki Creek based on a calculated relationship between Tomki Creek, a tributary of the Eel River below the Project, and unimpaired Eel River flows. Minimum releases below Cape Horn Dam would be calculated based on, approximately, a 13 times expansion of the average flow in Tomki Creek over the previous 8 to 24 hours. During the month of October, and between February 1 and July 7, minimum flows would be determined and adjusted once each day at 0830 hours. From November 1 through January 31, minimum flows would be determined and adjusted at 0830 hours, 1630 hours, and again at 0001 hours if there has been a four cubic feet per second (cfs) increase in flow at the Tomki Creek gage over the previous eight hours. Special provisions are included that would progressively reduce minimum flows during very dry periods as determined by cumulative inflow into Lake Pillsbury (CLP) and time of year.

Prescribed Eel River minimum flows below Cape Horn Dam would fluctuate between a 140 cfs cap and a 35 cfs floor from October 15 through March 31, and between a 200 cfs cap and 35 cfs floor April 1 through June 30 in normal water years. Beginning July 1, Eel River flows would be ramped down in a linear fashion to 5 cfs on July 7, and held at 5 cfs through the summer to October 1. In no event would flows ever be lower than 5 cfs below Cape Horn Dam. On October 1, Eel River flows would be dictated by flows in Tomki Creek, but attenuated by a multiplier that results in a progressively smaller effect until October 15, when there would no longer be a dampening effect. Between October 15 and June 30 actual flows between the floor and cap would be determined first by taking the average Tomki Creek flow for the proceeding 8 hours or 24 hours and multiplying by 13.37 for flows less than 8.6 cfs, or multiplying by 7.07 and then add 54.11 for flows of 8.6 cfs and above. A 5,000 ac-ft block of water would be available for release at the discretion of the resource agencies between December 1 and March 31 of each year or until the designated amount is expended. This blockwater would be used to improve conditions for adult salmon migration, spawning and incubation of eggs and alevins when a lack of rain in the Tomki Creek basin results in low flows in the Eel River.

Also under the proposed action, Scott Dam gate structures would be operated to release warmer surface water from Lake Pillsbury in the late winter and early spring period to attempt to stimulate the emigration of juvenile Chinook salmon from the area between Scott Dam and Cape Horn Dam. Water releases during this period will be made from surface water by reducing outflow from the "needle valve" (water from greater depths) and maximizing releases through the gate structures near the lake surface.

The "action area" is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR 402.2). The action area for the Potter Valley Project includes the entire mainstem Eel River below Scott Dam to the Pacific Ocean, and the East Branch Russian River below the Potter Valley Project powerhouse to its confluence with the mainstem Russian River, and below this confluence to the Pacific Ocean at Jenner (Figure 1).

III. STATUS OF THE SPECIES/CRITICAL HABITAT

The ESA defines a "species" to include any "distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." NMFS published a policy describing how it would apply the ESA definition of a "species" to anadromous salmonid species (56 FR 58612). More recently, NMFS and United States Fish and Wildlife Service (USFWS) published a joint policy, consistent with NMFS' policy, regarding the definition of distinct population segments (61 FR 4721). NMFS uses the term Evolutionarily Significant Units (ESU) to describe distinct population segments of salmonids. For purposes of conservation under the Endangered Species Act, an ESU is a distinct population segment that is substantially reproductively isolated from other conspecific population units and represents an important component in the evolutionary legacy of the species (Waples 1991). An ESU must satisfy two criteria: (1) It must be reproductively isolated from other population units of the same species, and (2) it must represent an important component in the evolutionary legacy of the biological species. The first criterion, reproductive isolation, need not be absolute, but must have been strong enough to permit evolutionarily important differences to occur in different population units. The second criterion is met if the population contributes substantially to the ecological/genetic diversity of the species as a whole.

Since the Project is an interbasin diversion of water that affects two basins, this biological opinion addresses effects of the proposed action in both the Eel River and Russian River basins (Figure 1). In the Eel River, threatened Southern Oregon/Northern California Coasts (SONCC) coho salmon, threatened California Coastal (CC) Chinook salmon (*Oncorhynchus tshawytscha*), threatened Northern California (NC) steelhead (*O. mykiss*), and designated critical habitat for coho salmon are included in the analyses. In the Russian River, threatened Central California Coast (CCC) coho salmon, threatened CC Chinook salmon, threatened CCC steelhead, and designated critical habitat for coho salmon are included in the analyses. Table 1 provides a summary of the ESA-listed salmonids addressed in this biological opinion.

Table 1. References for additional background on listing status, protective regulations, and biological information for the ESA-listed salmonids addressed in this opinion for both the Eel River and Russian River basins.

ESU	Listing Status	Basin	Protective Regulations	Biological Information
SONCC coho salmon	Threatened May 6, 1997 62 FR 24588	Eel River	Jul 18, 1997 62 FR 38479	Hassler 1987; Sandercock 1991; Weitkamp *et al.* 1995; NMFS 2001
CCC coho salmon	Threatened Oct 31, 1996 61 FR 56138	Russian River	Oct 31, 1996 61 FR 56138	Shapovalov & Taft 1954; Hassler 1987; Sandercock 1991; Weitkamp *et al.* 1995; NMFS 2001
CC Chinook salmon	Threatened Sep 16, 1999 64 FR 50394	Eel River, Russian River	Jan 9, 2002 67 FR 1116	Healey 1991; Allen and Hassler 1986; Myers *et al.* 1998; NMFS 1999
NC steelhead	Threatened Aug 7, 2000 65 FR 36074	Eel River	Jan 9, 2002 67 FR 1116	Barnhart 1986; Busby *et al.* 1996; NMFS 1997
CCC steelhead	Threatened Aug 18, 1997 62 FR 43937	Russian River	Sep 8, 2000 65 FR 42422	Shapovalov & Taft 1954; Barnhart 1986; Busby *et al.* 1996; NMFS 1997

A. Coho Salmon

1. <u>Species Description</u>

Coho salmon are native to the north Pacific Ocean. The historic distribution of coho salmon in North America included coastal streams from Alaska south to northwestern Mexico (Moyle 1976; Weitkamp *et al*. 1995). Currently, Scott and Waddel creeks in Santa Cruz County, California, are thought to have the southern-most persistent populations of coho salmon in North America (Weitkamp *et al*. 1995). Coho salmon are also found in Asia from the Anadyr River, Russia, south to Hokkaido, Japan and tributaries of Peter the Great Bay on the Sea of Japan (Hart 1973; Sandercock 1991).

2. <u>Life History and Biological Requirements</u>

Coho salmon are typically associated with small to moderately-sized coastal streams characterized by heavily forested watersheds; perennially-flowing reaches of cool, high-quality water; dense riparian canopy; deep pools with abundant overhead cover; instream cover consisting of large, stable woody debris and undercut banks; and gravel or cobble substrates.

The life history of the coho salmon in California has been well documented by Shapovalov and Taft (1954) and Hassler (1987). In contrast to the life history patterns of other anadromous salmonids, coho salmon in California generally exhibit a relatively simple 3-year life cycle. Adult salmon typically begin the freshwater migration from the ocean to their natal streams after heavy late-fall or winter rains breach the sand bars at the mouths of coastal streams (Sandercock 1991). Delays in river entry of over a month are not unusual (Salo and Bayliff 1958; Eames *et al*. 1981). Migration continues to March, generally peaking in December and January, with spawning occurring shortly after returning to the spawning grounds (Shapovalov and Taft 1954). Adult coho salmon enter the Eel River from September through November and reach the upper spawning reaches in November and December (CDFG 1997).

Female coho salmon choose spawning sites usually near the head of a riffle, just below a pool, where water changes from a laminar to a turbulent flow and there is small to medium gravel substrate. The flow characteristics of the location of the redd usually ensure good aeration of eggs and embryos, and flushing of waste products. The water circulation in these areas also facilitates fry emergence from the gravel. Preferred spawning grounds have nearby overhead and submerged cover for holding adults; water depth of 10-54 cm; water velocities of 20-80 cm/s; clean, loosely compacted gravel (1.3-12.7 cm diameter) with less than 20 percent fine silt or sand content; cool water (4-10EC) with high dissolved oxygen (8 mg/l); and an intergravel flow sufficient to aerate the eggs. The lack of suitable gravel often limits successful spawning in many streams.

Each female builds a series of redds, moving upstream as she does so, and deposits a few hundred eggs in each (Briggs 1953). Spawning takes about a week, with each female laying from 1,400-3,000 eggs (Moyle 2002). Fecundity of coho salmon is directly proportional to female size (Sandercock 1991). Briggs (1953) noted a dominant male accompanies a female during spawning, but one or more subordinate males also may engage in spawning. Coho salmon may spawn in more than one redd and with more than one partner (Sandercock 1991). The female may guard a nest for up to two weeks (Briggs 1953). Coho salmon are semelparous, they die after their first spawning season.

The eggs generally hatch between 4 to 8 weeks, depending on water temperature. Survival and development rates depend on temperature and dissolved oxygen levels within the redd. According to Baker and Reynolds (1986), under optimum conditions, mortality during this period can be as low as 10 percent; under adverse conditions of high scouring flows or heavy siltation, mortality may be close to 100 percent. McMahon (1983) found that egg and fry survival drops sharply when fines make up 15 percent or more of the substrate. The newly-hatched fry remain in the gravel from two to seven weeks until emergence from the gravels (Shapovalov and Taft 1954). Upon emergence, fry seek out shallow water, usually along stream margins. Low summer flows reduce potential rearing areas, may cause stranding in isolated pools, and increase vulnerability to predators (Sandercock 1991). Also the combination of reduced flows and high ambient air temperatures can raise the water temperature to the upper lethal limit of 25EC for juvenile coho (Brett 1952). As they grow, they often occupy habitat at the heads of pools, which generally provide an optimum mix of high food availability and good cover with low swimming cost (Nielsen 1992). Chapman and Bjornn (1969) determined that larger parr tend to occupy the head of pools, with smaller parr found further down the pools. As the fish continue to grow, they move into deeper water and expand their territories until, by July and August, they are in the deep pools. Juvenile coho salmon prefer well shaded pools at least 1 meter deep with dense overhead cover; abundant submerged cover composed of undercut banks, logs, roots, and other woody debris; preferred water temperatures of 12-15EC, but not exceeding 22-25EC for extended time periods; dissolved oxygen levels of 4-9 mg/l; and water velocities of 9-24 cm/s in pools and 31-46 cm/s in riffles. Water temperatures for good survival and growth of juvenile coho salmon range from 10-15EC (Bell 1973; McMahon 1983). Growth is slowed considerably at 18EC and ceases at 20EC (Stein *et al*. 1972; Bell 1973).

Preferred rearing habitat has little or no turbidity and high sustained invertebrate forage production. Juvenile coho salmon feed primarily on drifting terrestrial insects, much of which are produced in the riparian canopy, and on aquatic invertebrates growing in the interstices of the substrate and in the leaf litter in the pools. As water temperatures decrease in the fall and winter months, fish stop or reduce feeding due to lack of food or in response to the colder water, and growth rates slow down. During December-February, winter rains result in increased stream flows and by March, following peak flows, fish again feed heavily on insects and crustaceans and grow rapidly.

In the spring, as yearlings, juvenile coho salmon undergo a physiological process, called smoltification, which prepares them for living in the marine environment. They begin to migrate downstream to the ocean during late March and early April, and out migration usually peaks in mid-May, if conditions are favorable. At this point, the smolts are about 10-13 cm in length. After entering the ocean, the immature salmon initially remain in nearshore waters close to their parent stream. They gradually move northward, staying over the continental shelf (Brown *et al*. 1994). Although it is thought that they range widely in the north Pacific, movements of coho salmon from California are poorly known.

3. <u>Listing Status</u>

On October 27, 1993, NMFS published a notice (58 FR 57770) soliciting information about the status of all populations of coho salmon in Washington, Oregon, and California. NMFS determined that such an expanded status review was warranted due to the general decline in many West Coast coho salmon populations. NMFS established a Biological Review Team, comprised of staff from its Northwest Fisheries Science Center and Southwest Regional Office, and completed a coastwide status review for coho salmon (see: Weitkamp *et al*. 1995).

a. Southern Oregon/Northern California Coast Coho Salmon ESU

On May 6, 1997, NMFS issued a final determination that the SONCC coho salmon ESU was a “species” under the ESA, and that it would be listed as a threatened species (62 FR 24588). The geographic boundaries of the SONCC coho salmon ESU extend from Cape Blanco in southern Oregon to Punta Gorda in northern California, and include rivers and streams from the Rogue River (Oregon) to the Mattole River (California). The taking of this species is prohibited, pursuant to section 4(d) and section 9 of the ESA (62 FR 38479).

b. Central California Coast CohoSalmon ESU

October 31, 1996, NMFS issued a final determination that the CCC coho salmon ESU was a "species" under the ESA, and that it would be listed as a threatened species (61 FR 56138). The effective date of the determination was December 2, 1996. In a technical correction to the final listing determination (62 FR 1296), NMFS defined the CCC coho salmon ESU to include all coho salmon naturally-reproduced in streams between Punta Gorda in Humboldt County, California, and the San Lorenzo River in Santa Cruz County, California (inclusive), and included tributaries to San Francisco Bay. The taking of this species was prohibited, pursuant to section 4(d) and section 9 of the ESA in the final determination (61 FR 56138). Certain limitations to this taking prohibition were provided, including research and enhancement permits pursuant to section 10 of the ESA.

c. Status of CDFG Listing

The CDFG recently completed a report titled "Status Review of California Coho Salmon North of San Francisco: Report to the California Fish and Game Commission." The report concluded that the California portion of the SONCC coho salmon ESU should be listed as threatened under the California Endangered Species Act, and the CCC coho salmon ESU, which occur south of the SONCC coho salmon ESU, should be listed as endangered (CDFG 2002). The commission will decide whether are not to formally adopt the recommendations in the near future.

4. Status of Stocks

A comprehensive review of estimates of historic abundance, decline and present status of coho salmon in California is provided by Brown *et al*. (1994). They estimated that coho salmon annual spawning population in California ranged between 200,000 and 500,000 fish in the 1940s, which declined to about 100,000 fish by the 1960s, followed by a further decline to about 31,000 fish by 1991, of which 57 percent were artificially propagated. The other 43 percent (13,240) were natural spawners, which included naturally-produced, wild fish and naturalized (hatchery-influenced) fish. Brown *et al*. (1994) cautioned that this estimate could be overstated by 50 percent or more. Of the 13,240, only about 5,000 were naturally-produced, wild coho salmon without hatchery influence, and many of these were in individual stream populations of less than 100 fish each. In summary, Brown *et al*. (1994) concluded that the California coho salmon population had declined more than 94 percent since the 1940s, with the greatest decline occurring since the 1960s.

a. Southern Oregon/Northern California Coast Coho Salmon ESU

Based on limited data, the status of coho salmon populations within the SONCC ESU are depressed relative to their past abundance. Coho salmon populations are very depressed in the SONCC ESU, currently numbering fewer than 10,000 naturally-produced adults (62 FR 24588). The bulk of current coho salmon production in the SONCC coho ESU consists of stocks from the Rogue River, Klamath River, Trinity River, and Eel River basins. Smaller basins known to support coho salmon include the Elk River in Oregon, and the Smith and Mad Rivers and Redwood Creek in California. Current production is estimated to be less than 10 percent of historical levels. Spawning in this ESU is distributed over a relatively large number of basins, both large and small, with the bulk of the production being skewed to the southern portion of its range. The threats to this ESU are numerous and varied. Several human-caused factors, including habitat degradation, harvest, and artificial propagation, exacerbate the adverse effects of natural environmental variability brought about by drought, floods, and poor ocean conditions.

b. Central California Coast Coho Salmon ESU

Weitkamp *et al*. (1995) concluded that abundance data for the CCC coho salmon ESU were very limited. It has been conservatively estimated that the population in this ESU has declined from 50,000 to 6,000 naturally reproducing coho salmon; a population decline of approximately 88 percent (61 FR 56138). Recent population estimates vary from approximately 600 to 5,500 adults (Brown *et al*. 1994). Indigenous, naturally reproducing populations of coho salmon are believed to be in severe decline throughout this ESU.

The NMFS's Southwest Fisheries Science Center completed a revised status review update for the CCC coho salmon ESU on April 12, 2001 (NMFS 2001). The review found that the limited data available strongly suggests that the ESU's population continues to decline. Declines are now also observed in several stream sub-populations previously considered stable. The review concludes that the CCC coho salmon ESU is presently in danger of extinction and the condition of CCC coho salmon populations in this ESU is worse than indicated by previous reviews.

B. Chinook Salmon

1. Species Description

Chinook salmon historically ranged from the Ventura River in southern California north to Point Hope, Alaska, and in northeastern Asia from Hokkaido, Japan to the Anadyr River in Russia (Healey 1991). Myers *et al*. (1998) reports no viable populations of Chinook salmon south of San Francisco, California. Although chinook salmon are wide-ranging species, they are the least abundant Pacific salmon in North America (Moyle 1976; Page and Burr 1991).

2. Life History and Biological Requirements

Chinook salmon are anadromous and the largest member of *Oncorhynchus*, with adults weighing more than 120 pounds having been reported from North American waters (Scott and Crossman 1973; Page and Burr 1991). Chinook salmon exhibit two main life history strategies: ocean-type fish and river-type fish (Healy 1991). Ocean-type fish typically are fall- or winter run fish that spawn shortly after entering freshwater and their offspring emigrate shortly after emergence from the redd. River-type fish are typically spring- or summer-run fish that have a protracted adult freshwater residency, sometimes spawning several months after entering freshwater. Progeny of river-type fish frequently spend one or more years in freshwater before emigrating. The Chinook salmon in the Eel and Russian rivers are ocean-type fish.

Chinook salmon in the CC Chinook salmon ESU generally remain in the ocean for two to five years (Healey 1991), and tend to stay along the California and Oregon coasts. Some Chinook salmon return from the ocean to spawn one or more years before full-sized adults return, and are referred to as jacks (males) and jills (females). Fall-run Chinook salmon upstream migration occurs from August through December with a peak in October. Spawning occurs from late-September through December with a peak in late-October. These fish typically enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of rivers, and spawn within a few weeks of freshwater entry (Healey 1991). Run timing is also, in part, a response to stream flow characteristics. CC Chinook salmon in the Eel and Russian rivers are considered a fall-run population. Adult Chinook salmon can enter the Eel and Russian rivers as early as August, with spawning occurring from October through February (CDFG 1997).

Egg deposition must be timed to ensure that fry emerge during the following spring at a time when the river or estuary productivity is sufficient for juvenile survival and growth. Adult female Chinook salmon prepare redds in stream areas with suitable gravel composition, water depth, and velocity. Spawning generally occurs in swift, relatively shallow riffles or along the edges of fast runs at depths greater than 24 cm. Optimal spawning temperatures range between 5.6-13.9EC. Redds vary widely in size and location within the river. Preferred spawning substrate is clean, loose gravel, mostly sized between 1.3-10.2 cm, with no more than 5 percent fines. Gravels are unsuitable when they have been cemented with clay or fines or when sediments settle out onto redds, reducing intergravel percolation (62 FR 24588). Minimum intragravel percolation rate depends on flow rate, water depth, and water quality. The percolation rate must be adequate to maintain oxygen delivery to the eggs and remove metabolic wastes. The Chinook salmon's need for a strong, constant level of subsurface flow may indicate that suitable spawning habitat is more limited in most rivers than superficial observation would suggest. After depositing eggs in a redd, adult Chinook salmon guard the redd from 4 to 25 days before dying.

Chinook salmon eggs incubate for 90 to 150 days, depending on water temperature. Successful incubation depends on several factors including dissolved oxygen levels, temperature, substrate size, amount of fine sediment, and water velocity. Maximum survival of incubating eggs and pre-emergent fry occurs at water temperatures between 5.6-13.3EC with a preferred temperature of 11.1EC. Fry emergence begins in December and continues into mid-April (Leidy and Leidy 1984). Emergence can be hindered if the interstitial spaces in the redd are not large enough to permit passage of the fry. In laboratory studies, Bjornn and Reiser (1991) observed that Chinook salmon and steelhead fry had difficulty emerging from gravel when fine sediments (6.4 mm or less) exceeded 30-40 percent by volume.

After emergence, Chinook salmon fry seek out areas behind fallen trees, back eddies, undercut banks and other areas of bank cover (Everest and Chapman 1972). As they grow larger, their habitat preferences change. Juveniles move away from stream margins and begin to use deeper water areas with slightly faster water velocities, but continue to use available cover to minimize the risk of predation and reduce energy expenditure. Fish size appears to be positively correlated with water velocity and depth (Chapman and Bjornn 1969; Everest and Chapman 1972). Optimal temperatures for both Chinook salmon fry and fingerlings range from 12-14EC, with maximum growth rates at 12.8EC (Boles 1988). Chinook feed on small terrestrial and aquatic insects and aquatic crustaceans. Cover, in the form of rocks, submerged aquatic vegetation, logs, riparian vegetation, and undercut banks provide food, shade, and protect juveniles from predation.

The low flows, high temperatures, and sand bars that develop in smaller coastal rivers during the summer months favor an ocean-type life history (Kostow 1995). With this life history, smolts typically outmigrate as subyearlings during April through July (Myers *et al.* 1998). The ocean-type Chinook salmon in California tend to use estuaries and coastal areas for rearing more extensively than stream-type Chinook salmon. The brackish water areas in estuaries moderate the physiological stress that occurs during parr-smolt transitions.

3. Listing Status

In reviewing the biological and ecological information concerning west coast Chinook salmon, NMFS identified 11 ESUs for Chinook salmon from Washington, Oregon, and California (Myers *et al*. 1998). Initially, the CC Chinook salmon ESU was described as the Southern Oregon and Northern California Coastal Chinook salmon ESU (63 FR 11482). The Southern Oregon and Northern California Coastal Chinook salmon ESU included all naturally-spawned, coastal, spring and fall Chinook salmon spawning from Cape Blanco, Oregon to the southern extent of the current range for Chinook salmon at Point Bonita, California (the northern landmass marking the entrance to San Francisco Bay).

California Coastal Chinook Salmon ESU

On September 16, 1999, NMFS issued a final determination stating that new information supported splitting the Southern Oregon and Northern California Chinook salmon ESU into two ESUs - the Southern Oregon and Northern California Chinook salmon ESU and the California Coastal Chinook salmon ESU (64 FR 50394). The CC Chinook salmon ESU consists of coastal Chinook salmon populations from Redwood Creek (Humboldt County) south through the Russian River. Other coastal populations to the north of the CC Chinook salmon ESU (and originally proposed as threatened) were considered part of a separate Southern Oregon and Northern California Coastal ESU that did not warrant listing at that time (63 FR 11482). On January 9, 2002 NMFS promulgated take prohibitions for CC Chinook salmon (67 FR 1116).

4. Status of Stocks

California Coastal Chinook Salmon ESU

Although northern coastal California streams support small, sporadically monitored populations of fall-run Chinook salmon, estimates of absolute population abundance are not available for most populations encompassing this ESU (Myers *et al*. 1998). In 1965, CDFG (1965) estimated escapement for this ESU at over 76,000, predominately in the Eel River (55,500) with smaller populations in Redwood Creek (5,000), Mad River (5,000), Mattole River (5,000), Russian River (500) and several smaller streams in Humboldt County. Data available to assess trends in abundance are limited. Recent trends have been mixed, with predominately strong negative trends in the Eel River Basin and in streams that are farther south along the California coast (Myers *et al*. 1998).

C. Steelhead

1. Species Description

Steelhead are native to the north Pacific Ocean and in North America are found in coastal streams from Alaska south to northwestern Mexico (Moyle 1976; Busby *et al*. 1996). At this time NMFS has listed only the anadromous life form of rainbow trout: steelhead.

2. Life History and Biological Requirements

Steelhead spend from one to five years in saltwater, however, two to three years are most common (Busby *et al.* 1996). Some return as "half-pounders" that over-winter one season in freshwater before returning to the ocean in the spring. The distribution of steelhead in the ocean is not well known. Coded wire tag recoveries indicate that most steelhead tend to migrate north and south along the continental shelf (Barnhart 1986).

The timing of upstream migration is correlated with higher flow events, such as freshets or sand bar breaches, and associated lower water temperatures. The minimum stream depth necessary for successful upstream migration is 13 cm (Thompson 1972). The preferred water velocity for upstream migration is in the range of 40-90 cm/s, with a maximum velocity, beyond which upstream migration is not likely to occur, of 240 cm/s (Thompson 1972; Smith 1973).

Steelhead can be divided into two reproductive ecotypes, based upon their state of sexual maturity at the time of river entry and the duration of their spawning migration: stream maturing and ocean maturing. Stream maturing steelhead enter fresh water in a sexually immature condition and require several months to mature and spawn; whereas ocean maturing steelhead enter fresh water with well developed gonads and spawn shortly after river entry. These two reproductive ecotypes are more commonly referred to by their season of freshwater entry (i.e., summer [stream maturing] and winter steelhead [ocean maturing]). Fukushima and Lesh (1998) state that adult winter steelhead immigrate to the Eel River from September through June, while adult summer steelhead immigrate from March through September. Shapovalov and Taft (1954) found summer steelhead to enter the Eel River in considerable numbers as early as August and hold in the mainstem until November before ascending the South Fork Eel River. Migration and spawning durations of Eel River steelhead are incredibly protracted: fully 20 percent of the South Fork Eel steelhead runs observed by Shapovalov and Taft (1954), began entering the mainstem in August and had not spawned before March the following spring. Only winter steelhead are found in the Russian River. Winter steelhead begin returning to the Russian River in December, with the run continuing into April. Most spawning takes place from January through April. Steelhead may spawn more than once before dying (iteroparity), in contrast to other species of the *Oncorhynchus* genus. Repeat spawning rates typically range from 13-24 percent in California coastal streams.

Adult summer steelhead typically oversummer in pools. Freshwater distribution of adult summer steelhead is affected by pool dimension, the amount and type of cover, and water temperature (Reviewed in Nakamoto 1994; Nielsen 1994; Baigun *et al*. 2000). Use of coolwater areas by adult summer steelhead has been documented in the Eel River (Jones 1980; Nielsen *et al*. 1994). Although Nakamoto (1994) found that pool temperature accounted for an insignificant amount of variation in adult summer steelhead density, the use of the coolwater areas by adult summer steelhead in New River (a tributary of the Trinity River in northern California) tended to increase with water velocity and cover availability. Nakamoto (1994) found that adult summer steelhead density was more strongly controlled by physical habitat characteristics than by the availability of thermal refugia, and that adult summer steelhead selected moderately deep habitats to rear and avoided shallow, small, or high-gradient habitat types. Nielsen *et al*. (1994) documented a temporal aspect to thermal stratification to pools within the Middle Fork Eel River with a corresponding change in behavior of summer steelhead. Summer steelhead migrate among pools, with some pools used more commonly for holding, while other pools are used for foraging (Nielsen *et al*. 1994).

Steelhead spawn in cool, clear streams featuring suitable water depth, gravel size, and current velocity. Intermittent streams may be used for spawning (Everest 1973; Barnhart 1986). Reiser and Bjornn (1979) found that gravels of 1.3-11.7 cm in diameter and flows of approximately 4 cfs were preferred by steelhead. The survival of embryos is reduced when fines of less than 6.4 mm comprise 20-25 percent of the substrate. Studies have shown a higher survival of embryos when intragravel velocities exceed 20 cm/hr (Coble 1961; Phillips and Campbell 1961;). The number of days required for steelhead eggs to hatch is inversely proportional to water temperature and varies from about 19 days at 15.6ºC to about 80 days at 5.6ºC. Fry typically emerge from the gravel two to three weeks after hatching (Barnhart 1986).

Since rearing juvenile steelhead reside in freshwater all year, adequate flow and temperature are important to the population at all times (CDFG 1997). Generally, throughout their range in California, steelhead that are successful in surviving to adulthood spend at least two years in freshwater before emigrating downstream. Emigration appears to be more closely associated with size than age. In Waddell Creek, Shapovalov and Taft (1954) found steelhead juveniles migrating downstream at all times of the year with the largest numbers of young-of-year and yearling steelhead moving downstream during spring and summer. Smolts can range from 14-21 cm in length.

Upon emerging from the gravel, fry rear in edgewater habitats and move gradually into pools and riffles as they grow larger. Older fry establish territories which they defend. Cover is extremely important in determining distribution and abundance, with more cover leading to more fish (Bjornn and Reiser 1991). Young steelhead feed on a wide variety of aquatic and terrestrial insects, and emerging fry are sometimes preyed upon by older juveniles. In winter, they become inactive and hide in any available cover, including gravel or woody debris.

Water temperature influences the growth rate, population density, swimming ability, ability to capture and metabolize food, and ability to withstand disease of these rearing juveniles (Barnhart 1986; Bjornn and Reiser 1991). Rearing steelhead juveniles prefer water temperatures of 7.2-14.4ºC and have an upper lethal limit of 23.9ºC. They can survive up to 27EC with saturated dissolved oxygen conditions and a plentiful food supply. Fluctuating diurnal water temperatures also aid in survivability of salmonids (Busby *et al.* 1996).

Dissolved oxygen (DO) levels of 6.5-7.0 mg/l affected the migration and swimming performance of steelhead juveniles at all temperatures (Davis *et al.* 1963). Reiser and Bjornn (1979) recommended that DO concentrations remain at or near saturation levels with temporary reductions no lower than 5.0 mg/l for successful rearing of juvenile steelhead. Low DO levels decrease the rate of metabolism, swimming speed, growth rate, food consumption rate, efficiency of food utilization, behavior, and ultimately the survival of the juveniles.

During rearing, suspended and deposited fine sediments can directly affect salmonids by abrading and clogging gills, and indirectly cause reduced feeding, avoidance reactions, destruction of food supplies, reduced egg and alevin survival, and changed rearing habitat (Reiser and Bjornn 1979). Bell (1973) found that silt loads of less than 25 mg/l permit good rearing conditions for juvenile salmonids.

3. Listing Status

In February 1994, NMFS received a petition seeking protection under the ESA for 178 populations of steelhead in Washington, Idaho, Oregon, and California. At the time, NMFS was conducting a status review of coastal steelhead populations in Washington, Oregon, and California. In response to the broader petition, NMFS expanded the ongoing review to include inland steelhead occurring east of the Cascade Mountains in Washington, Idaho, and Oregon. After considering biological and environmental information, NMFS identified 15 ESUs; 12 for coastal steelhead and 3 for the inland form (Busby *et al*. 1996).

a. Northern California Steelhead ESU

Following completion of a comprehensive status review of west coast steelhead (*Oncorhynchus mykiss*, or *O. mykiss*) populations throughout Washington, Oregon, Idaho, and California, NMFS published a proposed rule to list 10 ESUs as threatened or endangered under the ESA on August 9, 1996 (61 FR 41541). One of these steelhead ESUs, the Northern California ESU, was proposed for listing as a threatened species. Because of scientific disagreements, NMFS deferred its final listing determination for five of these steelhead ESUs, including the Northern California ESU, on August 18, 1997 (62 FR 43974). After soliciting and reviewing additional information to resolve these disagreements, NMFS published a final rule in March 1998 that the Northern California ESU did not warrant listing under the ESA because available scientific information and conservation measures indicated the ESU was at a lower risk of extinction than at the time of the proposed rule (63 FR 13347). Because the State of California did not implement conservation measures that NMFS considered critically important in its decision to not list the Northern California steelhead ESU, NMFS completed an updated status review for the ESU and reassessed the State and Federal conservation measures that were in place to protect the ESU. Based on this reconsideration, NMFS proposed to list the Northern California steelhead ESU as a threatened species under the ESA on February 11, 2000 (65 FR 6960). On June 7, 2000, NMFS published a final determination that NC steelhead would be listed as threatened under the ESA effective August 7, 2000 (65 FR 36074). On January 9, 2002 NMFS promulgated take prohibitions for NC steelhead (67 FR 1116).

The NC steelhead ESU contains populations of winter steelhead and includes what is presently considered to be the southernmost population of summer steelhead in North America, in the Middle Fork Eel River (65 FR 36074). NMFS recognizes that some degree of reproductive isolation can and probably does occur between winter and summer steelhead; therefore, the two ecotypes represent significant portions of the population within the NC steelhead ESU (Adams 2000).

b. Central California Coast Steelhead ESU
On August 18, 1997, NMFS issued a final determination that the CCC steelhead ESU is a "species" under the ESA and that it would be listed as a threatened species (62 FR 43937). The CCC steelhead ESU includes all naturally-produced steelhead (and their progeny) in coastal California streams from the Russian River to Aptos Creek, and the drainages of San Francisco and San Pablo Bays eastward to the Napa River (inclusive), excluding the Sacramento-San Joaquin River Basin. On July 10, 2000, NMFS published a final 4(d) rule for CCC steelhead (65 FR 42422).

4. Status of Stocks
West coast steelhead are presently distributed across 15 degrees of latitude, from approximately 49EN at the United States-Canada border south to 34EN at the mouth of Malibu Creek, California. In some years steelhead may be found as far south as the Santa Margarita River in San Diego County (Busby *et al.* 1996). Historically, steelhead likely inhabited most coastal and many inland streams along the west coast of the United States. During this century, however, over 23 indigenous, naturally reproducing stocks have been extirpated, and many more are at risk for extinction.

a. Northern California Steelhead ESU
Steelhead abundance data for this ESU are very limited, however, data from the Cape Horn Dam on the Eel River show strong declines prior to 1970 (63 FR 13347). The upper reaches, in particular, have suffered drastic declines since 1988 (CDFG 1997). Specific risks during the protracted freshwater spawning and rearing periods of this ESU include impediments to fish passage, including dams and other blockages, water diversions, and degradation of instream habitats. The Middle Fork Eel River has the southern-most summer steelhead population in North America (Roelofs 1983), and is one of the largest summer steelhead populations in California (CDFG 1997). However, Nehlson *et al*. (1991) and Higgins *et al*. (1992) identified summer steelhead in the Middle Fork Eel River as being at some risk of extinction. Higgins *et al*. (1992) mention that summer steelhead in the North Fork Eel River are at the highest risk of extinction. The most recent data shows current summer and winter steelhead abundance is well below estimates from the 1980s, and is greatly reduced from levels in the 1960s (65 FR 6960).

b. Central California Coast Steelhead ESU
Only two estimates of historical (pre-1960s) abundance specific to this ESU are available: an average of about 500 adults in Waddell Creek in the 1930s and early 1940s (Shapovalov and Taft 1954), and 20,000 steelhead in the San Lorenzo River before 1965 (Johnson 1964). In the mid-1960s, 94,000 steelhead adults were estimated to spawn in the rivers of this ESU, including

50,000 and 19,000 fish in the Russian and San Lorenzo rivers, respectively (CDFG 1965). Recent estimates indicate an abundance of about 7,000 fish in the Russian River (including hatchery steelhead) and about 500 fish in the San Lorenzo River. These estimates suggest that recent total abundance of steelhead in these two rivers is less than 15 percent of their abundance 30 years ago. Recent estimates for several other streams (Lagunitas Creek, Waddell Creek, Scott Creek, San Vincente Creek, Soquel Creek, and Aptos Creek) indicate individual run sizes of 500 fish or less. Steelhead in most tributaries to San Francisco and San Pablo bays have been virtually extirpated (McEwan and Jackson 1996). Fair to good runs of steelhead apparently still occur in coastal Marin County tributaries. In a 1994 to 1997 survey of 30 San Francisco Bay watersheds, steelhead occurred in small numbers at 41 percent of the sites, including the Guadalupe River, San Lorenzo Creek, Corte Madera Creek, and Walnut Creek (Leidy 1997).

Little information is available regarding the contribution of hatchery-produced fish to natural spawning of steelhead, and little information on present run sizes or trends for this ESU exists. However, given the substantial rates of declines for stocks where data do exist, the majority of natural production in this ESU is likely not self-sustaining (62 FR 43937).

D. Threats to Salmon and Steelhead Populations

Threats to naturally reproducing salmon and steelhead are numerous and varied. Among the most serious and ongoing threats to the survival of these ESUs in the action area are changes to natural hydrology, and habitat degradation and loss. The following discussion provides an overview of the types of activities and conditions that adversely affect salmon and steelhead ESUs in California watersheds.

1. <u>Habitat Degradation and Destruction</u>
A major cause of the decline of salmon and steelhead is the loss or severe decrease in quality and function of essential habitat. Most of this habitat loss and degradation has resulted from anthropogenic watershed disturbances caused by agriculture, logging, urban development, water diversion, road construction, erosion and flood control, dam building, and grazing. Most of this habitat degradation is associated with the loss of essential habitat components necessary for salmon and steelhead survival. For example, the loss of deep pool habitat as a result of sedimentation and stream flow reductions has reduced rearing and holding habitat for juvenile and adult salmonids.

The alteration of the estuaries in conjunction with increased sediment loads in the watersheds from land use activities and lower stream flows due to water diversions and other watershed changes have delayed sandbar breaching in the fall, delayed adult salmon and steelhead migration into streams, reduced and degraded estuary rearing habitat for juvenile salmon and steelhead, and created a poor freshwater-saltwater transition zone for salmon and steelhead smolts (CDFG 1998a).

2. <u>Natural Stochastic Events</u>
Natural events such as droughts, landslides, floods, and other catastrophes have adversely affected salmon and steelhead populations throughout their evolutionary history and yet they have survived. The effects of these events are oftentimes exacerbated by anthropogenic changes to watersheds such as logging, road building, and water diversion. Additionally, the ability of species to rebound from natural stochastic events may be limited as a result of other existing anthropogenic factors or depressed populations.

3. <u>Ocean Conditions</u>
Variability in ocean productivity has been shown to affect salmon production both positively and negatively. Beamish and Bouillion (1993) showed a strong correlation between North Pacific salmon production from 1925 to 1989 and their marine environment. Beamish *et al.* (1997) noted decadal-scale changes in the production of Fraser River sockeye salmon that they attributed to changes in the productivity of the marine environment. They (along with many others) also reported the dramatic change in marine conditions occurring in 1976-77, whereby an oceanic warming trend began. El Niño conditions, which occur every 3-5 years, negatively effect ocean productivity. Johnson (1988) noted increased adult mortality and decreased average size for Oregon's Chinook and coho salmon during the strong 1982-83 El Niño. It is unclear to what extent ocean conditions have played a role in the decline of salmon and steelhead; however, ocean conditions have likely affected populations throughout their evolutionary history. El Niño conditions are currently forming in the Pacific Ocean negatively effecting ocean conditions and thus, negatively effecting salmonid populations.

4. <u>Flows</u>
Depletion and storage of natural flows have drastically altered natural hydrological cycles in many California rivers and streams. Alteration of streamflows has increased juvenile salmonid mortality for a variety of reasons: migration delay resulting from insufficient flows or habitat blockages; loss of usable habitat due to dewatering and blockage; stranding of fish resulting from rapid flow fluctuations; entrainment of juveniles into unscreened or poorly screened diversions; and increased juvenile mortality resulting from increased water temperatures (Chapman and Bjornn 1969; Berggren and Filardo 1993; 61 FR 56138).

Important elements of water quality include water temperatures within the range that corresponds with migration, rearing and emergence needs of fish and the aquatic organisms upon which they depend (61 FR 56138). Desired conditions for coho salmon include an abundance of cool (generally in the range of 11.8EC to 14.6EC, well oxygenated water that is present year-around, free of excessive suspended sediments and other pollutants that could limit primary production and benthic invertebrate abundance and diversity (Reiser and Bjornn 1979; 61 FR 56138).

5. <u>Harvest</u>
There are few good historical accounts of the abundance of salmon and steelhead harvested along the California coast (Jensen and Swartzell 1967). Early records did not contain quantitative data by species until the early 1950s. In addition, the confounding effects of habitat

deterioration, drought, and poor ocean conditions on salmon and steelhead survival make it difficult to assess the degree to which recreational and commercial harvest have contributed to the overall decline of salmonids in West Coast rivers.

6. Artificial Propagation

Releasing large numbers of hatchery fish can pose a threat to wild salmon and steelhead stocks through genetic impacts, competition for food and other resources, predation of hatchery fish on wild fish, and increased fishing pressure on wild stocks as a result of hatchery production (Waples 1991). The genetic impacts of artificial propagation programs are primarily caused by the straying of hatchery fish and the subsequent hybridization of hatchery and wild fish. Artificial propagation threatens the genetic integrity, and diversity that protects overall productivity against changes in environment (61 FR 56138). The potential adverse impacts of artificial propagation programs are well documented (reviewed in Waples 1991, National Research Council 1995, National Research Council 1996, Waples 1999).

7. Marine Mammal Predation

Predation is not believed to be a major factor contributing to the decline of West Coast salmon and steelhead populations relative to the effects of fishing, habitat degradation, and hatchery practices. However, predation may have substantial impacts in localized areas. Harbor seal (*Phoca vitulina*) and California sea lion (*Zalophus californianus*) numbers have increased along the Pacific Coast (NMFS 1999a). At the mouth of the Russian River, Hanson (1993) reported that the foraging behavior of California sea lions and harbor seals with respect to anadromous salmonids was minimal. Hanson (1993) also stated that predation on salmonids appeared to be coincidental with the salmonid migrations rather than dependent upon them.

Marine mammal predation may significantly influence salmonid abundance in some local populations when other marine mammal prey are absent and physical conditions lead to the concentration of adult and juvenile salmonids (NMFS 1999a). Low flow conditions in streams can also enhance predation opportunities, particularly in central and northern California streams, where adult salmon and steelhead may congregate at the mouths of streams waiting for high flows for access (CDFG 1995).

The relative impacts of marine predation on anadromous salmonids are not well understood, but most investigators believe that marine predation is a minor factor in salmon and steelhead declines. Predators play an important role in the ecosystem, culling out unfit individuals, thereby strengthening the species as a whole. The exacerbated impact of certain predators on salmonid populations has been to a large degree the result of ecosystem modifications which have reduced those salmonid populations.

8. Reduced Marine-derived Nutrient Transport

Reduced marine-derived nutrient (MDN) transport to watersheds is another consequence of the past century of decline in salmon abundance (Gresh *et al.* 2000). Salmon may play a critical role in the survival of their own species in that MDN has been shown to be vital for the growth of juvenile salmonids (Bilby *et al.* 1996; Bilby *et al.* 1998). The return of salmon to rivers makes a significant contribution to the flora and fauna of both terrestrial and riverine ecosystems (Gresh *et al.* 2000). Evidence of the role of MDN and energy in ecosystems infers this deficit may indicate an ecosystem failure that has contributed to the downward spiral of salmonid abundance (Bilby *et al.*1996).

E. Critical Habitat

Section 4(a)(3)(A) of the ESA requires that, to the extent prudent and determinable, critical habitat be designated concurrently with the listing of a species. Critical habitat is defined in section 3(5)(A) of the ESA as "(I) the specific areas within the geographical area occupied by the species . . . on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species . . . upon a determination by the Secretary of Commerce (Secretary) that such areas are essential for the conservation of the species" (see 16 U.S.C. 1532(5)(A)). The term 'conservation', as defined in section 3(3) of the ESA, means ". . . to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary" (see 16 U.S.C. 1532(3)). Therefore, critical habitat is the geographic area and habitat functions necessary for the recovery of the species.

In designating critical habitat, NMFS considers the following requirements of the species: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, or rearing offspring; and, generally, (5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of this species (50 CFR 424.12(b)). In addition to these factors, NMFS also focuses on known physical and biological features (primary constituent elements) within the designated area that are essential to the conservation of the species and that may require special management considerations or protection. These essential features may include, but are not limited to, spawning sites, food resources, water quality and quantity, and riparian vegetation. NMFS has excluded from critical habitat designation all tribal lands in northern California and areas identified as inaccessible reaches of rivers that are above longstanding, naturally impassable areas or dams which block access to historical habitats of listed salmonids.

1. Coho Salmon

On May 5, 1999 NMFS designated critical habitat for the SONCC, and the CCC coho salmon ESU's (64 FR 24049). The designations include all accessible reaches of rivers between Mattole River in California and the Elk River in Oregon, and rivers between Punta Gorda and the San Lorenzo River in Santa Cruz County, California; this designation also includes two rivers entering the San Francisco Bay: Arroyo Corte Madera Del Presidio and Corte Madera Creek. Critical habitat includes the water, substrate, and adjacent riverine and estuarine riparian zones.

Adjacent riparian areas are defined as the area adjacent to a stream that functions to provide shade, sediment, nutrient or chemical regulation, streambank stability, and input of large woody debris and other organic matter.

Areas that are excluded from critical habitat designation include tribal lands in northern California and areas that NMFS has identified as inaccessible reaches of rivers that are above longstanding, naturally impassable areas, or above dams which block anadromy. Dams identified by NMFS as barriers to anadromy within the action area are:

- Scott Dam on the Eel River
- Warm Springs Dam on Dry Creek (tributary to Russian River)
- Coyote Dam on the Russian River

Logging, agricultural and mining activities, urbanization, stream channelization, dams, wetland loss, and water withdrawals and unscreened diversions for irrigation have been identified as causes contributing to the modification and curtailment of coho salmon habitat within the CCC coho salmon ESU (64 FR 24049). Essential features of the designated critical habitat include adequate (1) substrate; (2) water quality; (3) water quantity; (4) water temperature; (5) water velocity; (6) cover/shelter; (7) food; (8) riparian vegetation; (9) space; and (10) safe passage conditions.

NMFS has identified activities that may require special management considerations for the conservation of the freshwater and estuarine life stages of coho salmon. These activities include, but are not limited to (1) land management; (2) timber harvest; (3) point and non-point water pollution; (4) livestock grazing; (5) habitat restoration; (6) beaver removal; (7) irrigation water withdrawals and returns; (8) mining; (9) road construction; (10) dam operation and maintenance; (11) diking and streambank stabilization; and (12) dredge and fill activities.

2. Chinook Salmon

On February 16, 2000 NMFS designated critical habitat for the CC Chinook salmon ESU (65 FR 7764). However, on April 30, 2002, critical habitat designation for the CC Chinook salmon ESU was vacated by the Washington D.C. District Court, resolving claims challenging the process by which NMFS designates critical habitat.

3. Steelhead

On February 16, 2000 NMFS designated critical habitat for the CCC steelhead ESU (65 FR 7764). However, on April 30, 2002, critical habitat designation for the CCC steelhead ESU was vacated by the Washington D.C. District Court, resolving claims challenging the process by which NMFS designates critical habitat.

To date, NMFS has not yet designated critical habitat for the NC steelhead ESU.

IV. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species. The environmental baseline includes past and present impacts of all Federal, state, or private actions and other human activities in the action area (50 CFR § 402.2). The environmental baseline establishes the base condition for the natural resources, human usage, and species status in the action area which is used as a point of comparison for evaluating the effects of the proposed action.

The Potter Valley Project construction and operations have occurred for over 90 years and are thus, part of the environmental baseline. Therefore, NMFS will treat all effects that occurred during the life of the Project to this point as part of the environmental baseline for this biological opinion. The "Effects of the Proposed Action" section will consider the expected effects of the proposed Project operations (Article 38 flows as amended by the implementation of the PVID proposal) into the future.

A. Eel River

The Eel River Basin is the third largest river system in California located in northern California in Humboldt, Mendocino, Lake, Glenn, and Trinity counties. The entire Eel River Basin drains 3,681 square miles (CDFG 2002) with a mean annual discharge of 6.5 million ac-ft (FERC 2000). Major sub-basins of the Eel River include the mainstem Eel River (1,477 square miles), Middle Fork Eel River (753 square miles), North Fork Eel River (283 square miles), South Fork Eel River (690 square miles) and Van Duzen River (428 square miles) (CDFG 2002).

Since 1922, Eel River flows have been regulated and water has been diverted to the Russian River Basin for hydroelectric power and agriculture via the Potter Valley Project. There are two major dams on the Upper Eel River associated with the Potter Valley Project (Figure 2). Cape Horn Dam impounds the 700 ac-ft Van Arsdale Reservoir (CDFG 2002) which was constructed in 1907 with fish passage facilities that have been improved since construction[1]. Twelve miles upstream, Scott Dam impounds the 94,000 ac-ft storage reservoir, Lake Pillsbury (CDFG 2002), which was constructed in 1921 without fish passage facilities.

Flows are highly variable among seasons and years. Climate in the basin is also variable, with a gradation from a Mediterranean climate in the middle and upper basin to a marine influenced coastal climate in the lower basin. Flows near the mouth of the Eel River range from 12 cfs to 752,000 cfs in the historic record and are consistently and vastly different between wet and dry seasons of every year.

The headwaters of the Eel River receives an average of 70 inches of rain per year at and near the basin divide (USGS 1969). Approximately 92 percent of the 288 square mile drainage area

[1] Soon after construction, CDFG recognized that the ladder design presented difficulties to migrating fish. In 1962 and 1987, major modifications were made to the ladder to improve passage of salmonids (SEC 1998).

above Scott Dam is in the Mendocino National Forest and Snow Mountain Wilderness (Figure 3). Highest elevations are nearly 7,000 feet. In the upper Eel River above Scott Dam, there are approximately 38 square miles (13 percent) of land at or over 5,000 feet in elevation (Figure 3). Above 5,000 feet, snowpack is dependable and remains through May and into June many years, but is nearly always melted by mid-July. Average snow fall accounts for 17.1 inches of water by April 1 (DWR 1995).

In the Eel River mainstem reach from river mile (RM) 60 to 120, precipitation at Dos Rios is typically 40 to 50 inches of rain per year. Much of the channel flows over bedrock and gravel bars with limited riparian vegetation. A thermal barrier to anadromous fish has been shown to form in summers near Fort Seward or throughout the entire reach (SEC 1998). Excessive water temperatures for salmonids may be reached as early as late May, during hot years with low flows, but more commonly occurs during late June and early July. Adverse water temperature conditions are likely the result of an aggrading streambed and lost riparian vegetation from a variety of anthropogenic sources and exacerbated by the floods in 1955 and 1964, and low summer flows. The changes to spawning and rearing habitat caused by the 1955 and 1964 floods, in combination with overfishing and poor ocean conditions, caused a decline from which Chinook salmon populations never fully recovered (Moyle 2002).

Although salmonid population levels are much lower than historical numbers, the Eel River supports mainstem populations of Chinook salmon and steelhead that utilize the mainstem for migration, spawning, incubation, and rearing. The Eel River is also an important migration corridor for tributary populations of coho salmon, Chinook salmon and steelhead. Directly below the Project, Chinook salmon and steelhead use the mainstem Eel River for spawning and steelhead use the mainstem Eel River for rearing. Project flows can influence passage conditions into tributaries, especially for Tomki and Outlet creeks. Tomki Creek is utilized mostly by Chinook salmon and steelhead while Outlet Creek supports steelhead, Chinook salmon and a small remnant population of coho salmon (CDFG 2002).

1. Salmonid Population Trends

Both long and short-term trends in abundance for salmon and steelhead are in apparent decline. Overall population trends for the Eel River reflect at least an 80 percent decline in salmon and steelhead from the early 1960's, and roughly a 97 percent decline over the last century (Table 2).

The CDFG, in a 1965 report to the California Department of Water Resources, characterized the Eel River as ". . . one of California's most important anadromous fish streams; ranking second in silver (coho) salmon and steelhead trout production, and third in king (Chinook) salmon production" (DWR 1965). Recent population estimates of natural SONCC coho salmon of 10,000 (62 FR 24588), when compared to estimates by NMFS of Eel River coho salmon runs of less than 1,000 fish (approximately 10 percent of the ESU) indicate that the Eel River population is important to the overall survival and recovery of the SONCC coho salmon ESU. Similarly, the Eel River is also important for the survival and recovery of the CC Chinook salmon ESU and NC steelhead ESU. In 1965, CDFG estimated Eel River Chinook salmon spawning escapement at 55,500, which represents 73 percent of the Chinook salmon production within the CC Chinook salmon ESU (CDFG 1965). Eel River steelhead spawning escapement in 1964 was estimated at 82,000, about 41 percent of the overall production within the NC steelhead ESU (Busby *et al.* 1996).

Table 2. Estimates of Eel River Basin and Upper Eel River sub-basin anadromous salmonid runs.

		Estimate of Individuals				
Basin	Era	Coho	Chinook	Steelhead	Total	Reference
Eel River	1900 (preproject)	70,000*	175,000*	255,000*	>500,000	CDFG 1997
	1964	14,000	55,500	82,000	151,500	CDFG 1965
	late 1980's	1,000	10,000	20,000	31,000	CDFG 1997
	Present**	<1,000	<5,000	<9,000	<15,000	
Upper Eel River	1900 (preproject)	Not Available	Not Available	Not Available	Not Available	
	1964	500	13,000	10,000	23,500	CDFG 1965
	late 1980's	Not Available	Not Available	Not Available	Not Available	
	Present**	<100	<1,000	<1,000	<3,000	

* NMFS estimate based upon 1964 run proportions.
** NMFS estimate of wild runs averaged over the last 10 years (1989 to 1999).

All species of wild anadromous salmonids in the Upper Eel River were reduced to very low population numbers before 1979. Of the 27 years of Chinook salmon counts before 1979 at VAFS, fully 19 of those years had fewer than 20 adult returns. Estimated wild steelhead returns at VAFS averaged far less than 1,000 fish since 1960 and Upper Eel River coho salmon returns were already estimated to be reduced to 500 fish by 1964 (CDFG 1965).

Coho salmon were historically more widespread throughout the major sub-basins of the Eel River, even occurring as far upstream as Tomki Creek in the Upper Eel River (Brown and Moyle 1991). Coho salmon in the North Fork Eel River and Middle Fork Eel River are now believed to be extirpated (Brown and Moyle 1991; CDFG 1994). Recent surveys have confirmed the presence of coho salmon in the Eel River and in tributaries such as the Van Duzen River, South Fork Eel River and in tributaries to Outlet Creek (CDFG 2002). However, coho salmon were noticeably absent in the Van Duzen River and in many of the smaller tributaries to the Eel River where coho salmon had been historically (CDFG 2002). Although coho salmon were recently confirmed in many of the South Fork Eel River tributaries, there were nearly as many streams in which coho salmon were not observed (CDFG 2002). However, the South Fork Eel River does have a significant, although remnant, population of coho salmon compared to the other sub-basins (CDFG 1997). Coho salmon have been reported at the Van Arsdale Fisheries Station located at Cape Horn Dam four times. There were 47 coho salmon in 1946/47, one in 1984/85, one in 2000 and four in 2001 (CDFG 2002; CDFG unpublished data).

Chinook salmon were also historically more widespread and numerous in the Eel River Basin. Counts at Cape Horn Dam on the Upper Eel River reflected drastic reductions in 1992/93 through 1994/95, when less than five Chinook each year were counted (CDFG 1997). In contrast, Chinook salmon runs observed in the South Fork Eel River and the Van Duzen River in 1992/93 through 1994/95 indicated a slight increase in numbers (CDFG 1997). More recent counts at Van Arsdale show an increase in returns of Chinook salmon relative to the counts in the mid-1990's. The 2001/02 return year showed an increase in returns similar to increases experienced in the mid-1980's. A total of 955 Chinook salmon (671 natural and 284 hatchery) were counted at VAFS in 2001/02 (CDFG unpublished data).

Steelhead were also historically more widespread and numerous in the Eel River Basin. The Eel River Basin supports both winter and summer steelhead. Recent data shows current summer and winter steelhead abundance is well below estimates from the 1980s, and is greatly reduced from levels in the 1960s (65 FR 6960). However, returns in 2001/02 showed an increase in returns similar to increases experienced in the mid-1980's. A total of 311 winter steelhead (229 natural and 82 hatchery) were counted at VAFS in 2001/02 (CDFG unpublished data).

The Middle Fork Eel River has one of the most significant populations of summer steelhead in California (CDFG 1997). Earlier summer steelhead counts in the Middle Fork Eel River were commonly in the thousands as high as 6,000 and counts since 1966 have ranged from 198 to 1,601 (CDFG 1997). Summer steelhead counts on the Middle Fork Eel River for 2001 were 422 and in 2002 were 417 (CDFG unpublished data).

Similar to the Eel River, salmonid returns were higher relative to previous years in most California streams in 2001/02. Moyle (2002) states that declines in salmonid populations will continue, interrupted by times of high returns from fortuitous natural conditions, unless major restoration efforts are successful. The recent increase in salmonid populations is probably due to better survival during spring outmigration and during the ocean life history phase. Changes in upwelling regimes and ocean productivity have been linked to fluctuations in the productivity of salmon species in the northeast Pacific Ocean (Sandal *et al.* 2002). Recent studies have suggested that a major regime shift in the northeast Pacific ocean occurred following the 1997-98 El Niño event (Bograd and Schwing 2002). An intrusion of cold arctic water in the northeast Pacific Ocean combined with increased upwelling has lead to substantial increases in more desirable copepods (Peterson 2002) and baitfish (Emmet *et al.* 2002) for salmonids to prey upon. These changes in the marine environment coupled with wetter spring conditions during outmigration and substantial rains in late-fall of 2001 resulted in increased numbers of coho salmon and Chinook salmon returns in many California streams.

2. Impacts to Salmonids and Salmonid Habitat

a. Historic and Current Salmonid Fishery

The Eel River historically provided an abundance of salmonids to Native Americans. Arriving Europeans garnered great economic wealth from Eel River fisheries. In the 50 years prior to the construction of the Project, fish packing and cannery records show that 15,000 to nearly 600,000 salmonids were caught annually in commercial fisheries. The fishery supported seven canneries and eighteen seining companies from 1853 to 1912. By 1881, the run had declined noticeably, but due to increasing prices for canned salmon, the canneries were able to continue (Trush 1992). Economic value of the fishery has been estimated to have ranged from two to ten million dollars annually in 1979 dollar value (testimony of E. Renner, October 12, 1979).

It is difficult to determine the impact commercial and recreational ocean fisheries had on the decline of Chinook and coho salmon originating from the Eel River. Steelhead are not targeted in the ocean and are seldom caught incidentally in the ocean fisheries. Salmon originating from the Eel River are most likely caught by fishermen off of the nearby ports of Eureka and Fort Bragg. The various salmon stocks are mixed in the ocean and are primarily managed to meet the combination of NMFS' requirements established through ESA section 7 consultations and the spawning escapement goals established for certain key stocks under the Pacific Coast Salmon Fisheries Management Plan. Key California stocks include those from the Klamath and Sacramento rivers. Management goals related to those stocks will have a direct effect on harvest of Eel River stock due to the nature of the mixed stocks in the ocean. NMFS issued biological opinions in 1996 and 1997 requiring reductions in ocean harvest impacts on Sacramento River winter-run Chinook salmon, and in 1998 and 1999 limiting the ocean exploitation rate on Oregon coho salmon and SONCC coho salmon and prohibiting retention of coho salmon in ocean fisheries off California. These reductions will reduce the catch of Chinook salmon from the Eel River and will eliminate the intentional take of coho salmon, as no coho salmon are currently allowed to be taken in California waters.

The Pacific Coast Fisheries Management Plan spawning escapement objective for the Klamath River is between 33 percent and 34 percent of the potential adult natural spawners, but no fewer than 35,000 naturally spawning adults in any one year. In 1993, the DOI quantified the Federally reserved fishing rights of the Yurok and Hoopa Valley Indian tribes of the Klamath Basin. The Tribes are entitled to 50 percent of the total available harvest of Klamath-Trinity Basin salmon. Application of Tribal fishing rights has required significant reductions in the ocean harvest rate on Klamath River fall Chinook salmon, and will permanently constrain

California and Oregon commercial troll seasons relative to pre-1993 seasons. As mentioned previously, any reduction in ocean harvest will reduce the catch of salmon originating from the Eel River.

In 1996 and 1997, NMFS issued biological opinions requiring reductions in fishing effort off California in order to protect Sacramento River, winter-run Chinook salmon, an endangered species. The 1997 opinion required that the Pacific Fisheries Management Council reduce ocean harvest sufficiently to increase the adult spawning escapement of winter-run Chinook salmon by 31 percent relative to a base period (1989-1993). The restrictions necessary to meet this requirement have been applied to both the California recreational and commercial salmon fisheries. Recreational effort averaged 188,000 angler trips from 1996 to 1998, compared to an average of 227,000 during the prior 10 year period. Nominal commercial effort has declined substantially over the past 20 years. It is likely, however, that the effective effort has not declined as sharply, since those participants remaining in the fishery are usually the more proficient fishermen. Since 1992, commercial troll effort off California has been largely limited to the San Francisco and Monterey areas. Commercial and sport fisheries in areas north of Point Arena, where Klamath River fall Chinook salmon make up a significant portion of the catch, are capable of taking the entire ocean allocation of Klamath River fall Chinook salmon in relatively short periods of time. Fishing seasons have been severely restricted in these areas to allow longer seasons south of Point Arena and permit access to the relatively abundant stocks of Central Valley fall-run Chinook salmon.

On April 28, 2000, NMFS issued an opinion on the effects of the Pacific Coast Salmon Plan on Central Valley spring-run Chinook salmon, a threatened species and CC Chinook salmon. In that opinion, NMFS determined that the proposed implementation of the Pacific Coast Salmon Plan was not likely to jeopardize the Central Valley spring-run Chinook salmon ESU but was likely to jeopardize the CC Chinook salmon ESU. A Reasonable and Prudent Alternative was provided which avoids jeopardizing the CC Chinook salmon by limiting Klamath River fall-run Chinook salmon (a surrogate species) harvest rates and improvements in the manner of monitoring and estimating harvest rates. By limiting this northern California fishery, Eel River fish will also be protected.

b. Timber Harvest

Forestry management on non-Federal timberlands, which utilizes existing California Forest Practice Rules, falls short of providing adequate protections for salmonid habitats (65 FR 36074). Ongoing forest activities on non-Federal lands are likely to continue to degrade essential salmonid habitat values. Environmental impacts identified with timber harvest may include increased sediment production from roads and other sources, loss of large woody debris recruitment, reduced function of riparian areas, reductions in water quality and quantity, increased water temperatures and loss of channel complexity. Timber harvest activities have altered watershed conditions by changing the quantity and size distribution of sediment, leading to stream channel instability, pool filling by coarse sediment, or introduction of fine sediment to spawning gravels. These conditions may have contributed to a reduction in overall habitat complexity within the action area which in turn reduces the survival of salmonid populations.

On March 1, 1999, USFWS and NMFS approved a Habitat Conservation Plan (HCP) for, jointly, Pacific Lumber Company, Scotia Pacific Company LLC and Salmon Creek Corporation (collectively "PALCO.") This HCP establishes long-term sustained yield timber harvest levels; avoids or mitigates potentially significant adverse impacts on listed and other species; avoids or mitigates potentially significant adverse impacts upon water quality, fisheries, and aquatic wildlife; and establishes procedures to document implementation and evaluate the efficacy of the HCP measures.

A portion of the action area for the PALCO HCP is within the middle and lower sections of the Eel River basin, downstream of the junction with the South Fork Eel River. Within the first ten years of the permit, PALCO expects to harvest timber on 26,234 acres within the Eel River basin (PALCO 1999). This area has the most Class I and Class II stream miles and the highest number of road crossings per mile of any stream in the action area (17.7 crossings per mile) which increases the potential risk of sedimentation to salmonids within this watershed (PALCO 1999). Included in the HCP is an Aquatic Conservation Plan (ACP) to minimize, mitigate and monitor the effects of timber harvesting activities on aquatic ecosystems. The goal of the ACP is to maintain or achieve over time properly functioning aquatic habitat conditions, which are essential to the long-term survival of salmonids. The six main elements of the plan consists of: riparian management strategy, hillslope management, road management, watershed analysis, a disturbance index, and monitoring.

More than 75,000 acres of habitat within the Eel River basin are managed by PALCO, and are addressed by the HCP. An additional 290,000 acres are managed by other private timber companies and other landowners, and are not subject to the restrictions and monitoring agreed to in the HCP. Since 1973, timber harvests have been reviewed by the state, and in some cases, Federal agencies, for significant environmental impacts and mitigation under the timber harvest plan preparation process, as described above.

Timber harvest continues to be a major economic use of the Eel River watershed. It is reasonable to expect that on 290,000 acres, over the Project's remaining 20 year license, some negative effects from timber harvest and management will continue to occur. In the most recent designation of critical habitat (65 FR 7764), NMFS noted that human activities in the riparian zone and upslope areas can harm stream function and salmonids, both directly and indirectly. These activities include timber harvests that can increase sediment inputs, destabilize banks, reduce organic litter and woody debris, increase water temperatures and generally decrease the value of the habitat for salmonids.

c. Potter Valley Project Impacts

An inadequate fish ladder at Cape Horn Dam and an unscreened tunnel diversion impacted the fishery resources of the Eel River (Week 1992). In 1972, PG&E installed a fish screen at the Project at the request of CDFG. This horizontal traveling screen was not effective due to design problems. Frequent breakdowns of the screen were caused by the sediment and organic debris loads that the screen was not designed to handle. In March 1983, CDFG concluded that the screen should be removed and replaced by a properly designed screen. A state-of-the-art fish screen, completed in 1995, now protects juvenile salmonids at the diversion. The pre-1995 fish screen entrained thousands of juvenile steelhead and salmon.

Prior to the completion of the1995 fish screen, entrainment of salmonids at the intake structure was a major concern for resource agencies. Day (1968) estimated that between April 1961 and March 1962, 24,766 juvenile steelhead were entrained. These data, along with historical estimates of entrainment collected by Venture Tech Network (VTN 1982), Beak Consultants, Inc (1986), and SEC (1998) were used as the basis for estimating the adult equivalents lost due to entrainment for steelhead. For the 1984/85 brood year, the estimated loss of adult steelhead due to the entrainment of juveniles was 65 adults equivalents, which was nine percent of the run (SEC 1998). While a new screen was in the design phase, two interim approaches were used to minimize entrainment of salmonids migrating downstream. Pulses of blockwater were used in 1985 and 1986 in an attempt to move downstream migrants past the diversion. From 1987-1995 various types of fish rescue were conducted to minimize impacts of the diversion. Since 1985/86, estimated number of adult steelhead equivalents lost to entrainment has decreased to between zero and eight fish per year (SEC 1998). Similar patterns at lower levels were seen for Chinook salmon entrainment, although SEC (1998) concluded that entrainment did not have a major impact on returns.

Approximately 160,000 ac-ft of water are diverted to the Russian River Basin annually (FERC 2000). Historical minimum bypass flows during summer (July through September) to the Eel River below Cape Horn Dam (the lower and fish passable dam of the two Project dams) average 5 cfs during summer (Table 3).

Historic and current operations at the Project have imposed summer flows that are regularly lower and annually less variable than unimpaired flows. Consistently low summer flow releases have generally occurred earlier in the season under Project operations than would normally occur. Under such operations, the upper Eel River below Cape Horn Dam and mid-river reaches downstream can warm to a greater extent earlier in the season than under higher natural flows (VTN 1982). This accelerated attenuation of flow and warming of water temperatures during late spring/early summer has most likely restricted the period of suitable juvenile emigration conditions and opportunities for summer rearing. A thermal barrier forms in late spring/early summer near Fort Seward (Kubicek 1977; Friedrichson 1998; SEC 1998) which negatively affects the success of anadromous salmonid emigrations. Excessive water temperatures for salmonids can be reached as early as late May, during hot years with low flows, but more commonly occurs during late June and early July.

Scott Dam was constructed in 1921 without fish passage facilities. Anadromous salmon and steelhead runs have been extirpated from habitat above Lake Pillsbury by the construction of Scott Dam (USFS and BLM 1995). VTN (1982) reported that prior to construction, 35 to 45 miles of spawning and rearing habitat existed above Scott Dam which supported 2,000 to 4,000 fall Chinook salmon and winter steelhead. However, recent studies by the Mendocino National Forest (USFS and BLM 1995) estimate 100 to 150 miles of potential anadromous salmonid habitat have been blocked by the dam. Abundant residual steelhead (landlocked after the construction of Scott Dam) were documented in and above Lake Pillsbury by CDFG surveys (CDFG 1993 stream survey- unpublished data). Habitat to support winter and summer steelhead, spring and fall Chinook salmon, and possibly coho salmon is currently blocked.

Table 3. Average monthly diversion rates of the Project from the Eel River under Article 38 (from DWR 1976; FERC 2000).

Month	Unimpaired Flow (cfs)	Bypass Flow[2] (cfs)	Diversion Rate
June	132	~37	~71%
July	40	5	88%
August	17	5	71%
September	15	5	67%
October	64	~31	~52%

Between the Project dams there are 12 miles of mainstem spawning and rearing habitat for anadromous fish to rear to smolthood in a regulated system. The immediate area receives an average of 40 to 50 inches of rain per year. Tributary water temperatures and flows are suitable for anadromous salmonid fry rearing. Space for food and habitat are extremely limited in Eel River tributaries within the action area so that very few two to three year-old juvenile steelhead attain size to smoltify (Brown 1980). The mainstem between the dams provides early and late-rearing habitat for juvenile steelhead (SEC 1998) in habitat that is roughly 10 percent of that available prior to Project development in the Upper Eel River mainstem. Juvenile Chinook salmon originating from the mainstem Eel River above Cape Horn Dam experience an average delay of 19 days relative to the Tomki Creek outmigration, primarily due to cooler water temperatures in the stretch during April (SEC 1998). The delay in outmigration can increase the risk of encountering stressful conditions downstream (SEC 1998).

Lake Pillsbury is rapidly filling with sediment and by 2022 will be roughly 27 percent filled[3]. Active storage today is roughly 78,000 ac-ft of water with various recreational drawdown limits

[2] Bypass flows are the discharges released from the Project into the Eel River; measured immediately below Cape Horn Dam; gage E-11.

[3] PG&E filing with FERC on March 3, 2000.

by season that reduce this to 45,000 ac-ft most years. During hot, dry years if the storage pool is drafted to 15,000 ac-ft before fall rains, the remaining water is thermally polluted and is released as instream flow usually during September before the onset of cool weather. Lake Pillsbury is listed as water quality limited, due to temperature and mercury contamination, pursuant to section 303(d) of the Clean Water Act.

The Potter Valley Project has had significant impacts on fish habitat in the Upper Eel River (Week 1992). The Project is by far the largest diversion and damming of Eel River flows, and has damaged habitat by lowering summer and early fall flows to the remaining stream below the Project, and by blocking 50 to 150 miles of spawning and rearing habitats above the Project (Shapovalov 1939; CDFG 1965; USFS and BLM 1994; CDFG 1997).

(1) Upper Mainstem Eel River. Since construction of the Project, Upper Eel River flows have been controlled and reduced especially in spring, summer and fall. This departure from natural flows has likely resulted in adverse effects on salmonids, many of which are not fully understood. Important ecosystem linkages such as food-web interactions among salmon, their predators, their prey; nutrient cycles; and overall habitat diversity and quality are affected by stream flows (National Research Council 1996).

Project related discharge rates affect the migration rates of adult and juvenile salmonids (Shapovalov and Taft 1954; SEC 1996a). “Significant” flows in the winter and early spring are associated with strong migrations of adult steelhead (SEC 1998). Periods of low flows and extended droughts have impeded the upstream movement of adult coho salmon, Chinook salmon and steelhead in the Eel River in several years (SEC 1996a). Infrequent “spill flows” from Cape Horn Dam during Chinook salmon migration periods have “significant limiting influences” on Chinook salmon in the Eel River (SEC 1998). The rate of downstream migration of Chinook salmon fingerlings may also be related to river discharge.

Project diversion of Eel River flows during late summer and fall impedes upstream migration of adult coho salmon, Chinook salmon and steelhead. Upstream migration rates of fall Chinook salmon adults were reported as 10.2 km/day from the mouth to Dos Rios and 4.4 km/day from Dos Rios to VAFS (SEC 1998; p. 5.3-5). On average, the fish move upstream half as fast in the reach below the Project as they did in the lowest reach of the river. This slower migration rate is likely caused by lower flows in the upper mainstem Eel River. The Project also reduces baseflow below Dos Rios causing adverse passage and flow conditions, however, during late September the lower river cools and usually receives some rainfall that may temper poor migration conditions by accretion from the Middle Fork Eel and lower river tributaries.

Shapovalov (1941) noted reports that numerous salmonids have died below Cape Horn Dam in the summer due to low flows [approximately 3 cfs released from Cape Horn Dam] and high stream temperatures. Historical stream surveys conducted in 1969 by CDFG between Outlet Creek and Cape Horn Dam also indicated that over-summering juvenile steelhead populations were minimal (SEC 1998). The summer flow released at Cape Horn Dam at that time was only approximately 3 cfs, therefore it is expected that at 3 cfs, space and adequate temperature for summer rearing steelhead would be limited.

Kubicek (1977) classified summer water temperatures in the Eel River for salmonids as marginal from Cape Horn Dam to Tomki Creek and lethal from Tomki Creek to Outlet Creek. This study was conducted in the summer of 1973 when flows released from Cape Horn Dam were at approximately 3 cfs. VTN (1982) also noted that high water temperatures due to low flows severely limit steelhead populations below Cape Horn Dam in normal years [at 3 cfs flows]. However, in 1982 habitat conditions improved for summer rearing steelhead below the Project. Maximum daily temperatures were lower in 1982, compared to the previous two summers (VTN 1982). The difference in water temperatures between years was least below Scott Dam (2.0 EC) and was greatest above Outlet Creek (4.5EC) (VTN 1982). The reduction in water temperatures during the 1982 summer was probably in response to a combination of two factors: an exceptionally wet 1981/82 winter that recharged springs and tributaries and an unusually mild summer (VTN 1982). These lower maximum water temperatures in the mainstem Eel River near Outlet Creek, probably resulted in greater survival of steelhead due to less of a stimulus to seek cooler temperatures (VTN 1982). Station population estimates also indicated a more uniform distribution of juvenile steelhead in the Eel River below Cape Horn Dam to near Outlet Creek in 1982, even with maximum water temperatures reaching 28EC (VTN 1982). This demonstrates that the Eel River below Cape Horn Dam to Outlet Creek is capable of supporting summer rearing steelhead if the conditions are adequate.

During the ten-year study, SEC (1998) monitored temperatures in the Eel River above and below Cape Horn Dam. Despite the fact that Article 39 states, "The plan shall further provide for the monitoring of the temperature regime of the Eel River downstream of Scott Dam.", monitoring was terminated in early July of each year (SEC 1998) and is therefore incomplete data for the whole summer rearing period. Kubicek (1977) conducted a study to determine the effects of stream flow on the vertical stratification of temperature. This study was conducted in 1973 in the middle of summer from July 18 to August 8 which tested water temperatures for flows at 5.6, 22, 40 and 80 cfs (Kubicek 1977). This data was collected during unnatural flow conditions in the middle of summer when maximum water temperatures were the highest and is therefore an unreliable test of increased summer flows.

The ten-year study also had summer rearing monitoring sites in the Eel River below and above Cape Horn Dam, which were similar to the sites established and monitored by VTN. However, the sites below Cape Horn Dam were monitored by SEC in only five out of the ten years due to low numbers of rearing steelhead (SEC 1998). Combining the summer rearing data from the VTN (1982) study with the data from the SEC (1998) ten-year study, steelhead were present six out of seven years at the site below Cape Horn Dam and three out of seven years at the site below Emandel (Figure 2).

Although temperatures are marginal for steelhead survival, cool water refugia do exist in thermally stratified pools and cold water seeps and springs (Kubicek 1977; VTN 1982; Nielsen *et al.* 1994). Static low flow releases from Cape Horn Dam reduces and degrades available salmonid habitat by decreasing the amount of space and food available to rearing steelhead . Low summer flows may also increase water temperatures relative to unimpaired flows making conditions less conducive to steelhead rearing. Sacramento pikeminnow populations also displace and prey upon steelhead which limits the rearing success and survival of juvenile steelhead in the mainstem below the Project dams. Artificially low summer flows may influence ecosystem processes. Important ecosystem linkages such as food-web interactions among salmon, their predators, their prey; nutrient cycles; and overall habitat diversity and quality are affected by stream flows (National Research Council 1996).

(2) Lower Mainstem Eel River and the Estuary. Physical changes in the Eel River estuary occur seasonally. Low river flows during summer reduce the size of wetlands and increase salinity to the head of the Eel River estuary when Eel River flows are at 250 cfs (Boles 1988). Unfortunately, while there may be increasing reliance on the estuary for rearing due to warmer temperatures and exclusion from areas upstream, the estuary's carrying capacity is diminished due to sediment incursions and size reduction.

d. Introduced Predatory Species

An additional Project impact is the introduction of Sacramento pikeminnow into Lake Pillsbury, and subsequently into much of the remaining mainstem Eel River and major tributaries. It is thought that a fisherman using live bait in Lake Pillsbury introduced this predator (SEC 1998). This introduction of non-native Sacramento pikeminnow that occurred in the late 1970's has increased the risk of predation that lowers overall salmonid productivity. Since their introduction, the Sacramento pikeminnow have distributed between the dams, below Cape Horn Dam and now range throughout the basin (SEC 1998). Geary *et al.* (1992), state that their data suggests that the effect of pikeminnow on steelhead and Chinook salmon in the Upper Eel River has been serious, and the effect on rearing steelhead populations is most pronounced for marginal steelhead habitat (due to warm temperatures) downstream of Cape Horn Dam. The introduction of the Sacramento pikeminnow impacts salmonids by direct predation, and in the case of rearing steelhead, by displacing steelhead from pool habitat (Brown and Moyle 1991). Sacramento pikeminnow impacts are exacerbated by the presence of dam structures and reservoirs, and by summer thermal conditions and low flows that provide ideal conditions for Sacramento pikeminnow in the reservoir and mainstem Eel River below the Project. Reese and Harvey (2002) have also shown that there are more incidences of interspecific competition between young Sacramento pikeminnow and steelhead in warmer water compared to cooler water in laboratory streams. Due to predation and competition, Sacramento pikeminnow have decreased the capacity of the mainstem Eel River to grow juvenile steelhead (Moyle 2002). However, it is too late for a Sacramento pikeminnow eradication program in the Eel River (Moyle 2002).

Various pikeminnow subspecies co-evolved with salmonids across much of the western United States. Sacramento pikeminnow are native to much of California, living in sympatry with salmonids for thousands of years. Pikeminnow are likely to have significant impacts on salmonids only where humans have created conditions in which the natural ability of salmon to avoid predation is reduced, such as below dams (Brown and Moyle 1981) and/or in locations where pikeminnow have been introduced (Moyle 2002). Introduced and native fish assemblages in the Eel River are not yet stable following the introduction of pikeminnow, but are forming assemblages characteristic of other California streams (Brown and Moyle 1997).

In order to better understand how the operations of the Project affect the viability of Sacramento Pikeminnow populations in the Eel River and how these populations affect listed salmonids, NMFS has reviewed the life history and requirements of the Sacramento pikeminnow, as detailed in the scientific literature.

(1) Diet. Sacramento pikeminnow are probably the top fish predator in many streams; they feed throughout the water column (Moyle 1976). Younger, smaller Sacramento pikeminnow feed primarily on insects. As they grow larger (over 180 mm SL), Sacramento pikeminnow tend to switch diets and feed primarily on crayfish and fish, including salmonids (Moyle 1976). As adults, Sacramento pikeminnow tend to be lie-in-wait predators and ambush their prey from hiding locations such as rocks and logs (Moyle 1976). Large Sacramento pikeminnow actively forage for food in the evening (Dettman 1976; Moyle 1976). The streams where Sacramento pikeminnow prey on salmonids are generally of marginal quality for salmonids with high temperatures or changes in flow (Moyle 1976; Brown and Moyle 1981).

Sacramento pikeminnow have been reported as significant predators of salmonids (reviewed in Brown and Moyle 1981), however, under natural conditions pikeminnow feed largely on non-salmonid fishes such as sculpin (Tucker *et al.* 1998). While Sacramento pikeminnow are not likely to dramatically affect salmonid populations in free-flowing rivers, the effects may be significant in areas of altered streams or communities (dams, diversions, or fish releases) (Moyle 1976;Brown and Moyle 1981; Brown and Moyle 1991; Geary *et al.* 1992; Week 1992; CDFG 1997; Tucker *et al.* 1998). Brown and Brasher (1995) found that presence of large Sacramento pikeminnow (270-320 mm SL) altered selection of pool habitat by juvenile rainbow trout in artificial streams, though selection of riffle or edge habitat was not noted.

(2) Reproduction. Pikeminnow must reside year-round in freshwater habitats at least three to four years to achieve sexual maturity and over four years to achieve the greatest fecundity (Brown and Moyle 1991). At temperatures and flows found within most systems supporting anadromous salmonids (generally cooler water temperatures than the Eel River), pikeminnow growth rates are relatively slow to attain a large-enough size to prey upon salmonids and fecundities also remain relatively low until about four years of age.

Ripe fish migrate upstream during April and May to spawn in gravel riffles with increasing water temperatures (Moyle 1976; Grant and Maslin 1999). Specific spawning behavior was not described by Moyle (1976) or Grant and Maslin (1999); though Moyle (1976) assumed that it was similar to that of northern pikeminnow (*Ptychocheilus oregonensis*). Grant and Maslin (1999) concluded that in a Central Valley stream (Pine Creek, Tehama County) Sacramento pikeminnow likely spawned from early March through May when water temperatures ranged from 12Eto 20EC, and reported fecundity of ranged from 15,200 to 21,600 eggs per moderately-sized (314 and 347 mm fork length [FL]) female.

(3) Migration. Young Sacramento pikeminnow tend to school, whereas large Sacramento pikeminnow tend to be solitary (Moyle 1976). Sacramento pikeminnow are typically sedentary, though they do have regular migrations for spawning and feeding (Moyle 1976; Grant and Maslin 1999). Moyle (1976) reports that Sacramento pikeminnow tend to migrate upstream for spawning and feeding when stream flows are high and downstream in response to reduced summer flows. Grant and Maslin (1999) documented both upstream and downstream migrations associated with pre- and post-spawning behavior.

(4) Growth. Sacramento pikeminnow are large minnows that may reach more than 1 meter in length (Moyle 1976, Page and Burr 1991). In intermittent streams, growth can be interrupted as fish are crowded into pools of warm water; though growth in larger permanent streams is probably faster and the fish grow to a larger size (Moyle 1976).

(5) Habitat Preferences. Sacramento pikeminnow prefer deep, well-shaded, sand- or rock-bottomed pools (Moyle 1976;Moyle and Baltz 1985) and tend to do poorly in streams that do not rise above 15EC (Moyle 1976).

Ontogenetic shifts in habitat preference for Sacramento pikeminnow occur as adults use deeper, slower water than juveniles. Moyle and Baltz (1985) reported that adult Sacramento pikeminnow are typically found in deeper water than juveniles and exhibit strong preference to water depths greater than 70 cm deep. Moyle and Baltz (1985) found in typical flows (not extreme high or low flows) juvenile Sacramento pikeminnow have a moderate or high avoidance of water over 40cm/sec; whereas adult Sacramento pikeminnow have a moderate or high avoidance to water velocities greater than 70cm/sec. Juvenile Sacramento pikeminnow show strong preference for mean water column velocity of less than 20 cm/sec and adults about 20 cm/sec. Rainbow trout juveniles prefer about 20 cm/sec and adults 40 to 80 cm/sec. Although much overlap in preferences between Sacramento pikeminnow and juvenile trout occurs, Sacramento pikeminnow show strong preferences for water of lower velocity than do adult rainbow trout.

The introduction of Sacramento pikeminnow to the Eel River has adversely affected salmonid populations through competition, direct predation and predator-prey interactions that result in habitat partitioning and the exclusion of salmonids from pool habitats. Project induced changes to the summer flow regime relative to unimpaired flows, probably exacerbated these effects. Investigating the habitat use of steelhead and Sacramento pikeminnow in the Eel River, Brown and Moyle (1991) report segregation of these species, with steelhead abundant in cool headwater streams and Sacramento pikeminnow most abundant in downstream areas of tributaries and the mainstem that are too warm to provide good salmonid habitat. In the areas of overlap, they found that salmonids used the deeper parts of the stream much less often, either exhibiting microhabitat shifts within habitats or changes in the use of habitats. Brown and Moyle (1991) state,

> "Thus, the presence of squawfish [pikeminnow] does not affect the majority of the oversummering salmonid population. Production in the limited areas

> of overlap may be reduced due to direct predation, increased mortality due to heat stress because thermal refugia (thermal stratification and spring inflow) occurring in pools are no longer available, and decreased growth due to crowding in the limited riffle areas available."

Brown and Moyle (1997) characterize Sacramento pikeminnow as generalized predators that feed on a wide range of fish and invertebrate species. Brown and Moyle (1991) suggest that predation of salmonid smolts during outmigration may be important. However, predation risk for outmigrating salmonids in the early spring may be reduced by high turbidity and the availability of alternate prey (USFS Unpublished data). Brown and Moyle (1997) reported that salmonids were present in the stomach contents of 22 percent of sampled Sacramento pikeminnow 201-250 mm, standard length (SL), and in 50 percent of sampled Sacramento pikeminnow 251-300 mm SL. They also reported that salmonids were 100 percent of the diet of Sacramento pikeminnow >100 mm SL collected in the mainstem of the Eel River at the confluence of Outlet Creek in May 1989, near the peak of the outmigration.

e. 1955 and 1964 Floods

Major floods in 1955 and 1964 occurred during a period of intense land use, primarily related to timber harvest (CDFG 1997), which resulted in major adverse changes to the quantity and quality of salmonid habitat in much of the watershed. Changes to spawning and rearing habitat, as a result of the floods, in combination with overfishing and poor ocean conditions, caused a decline in the Chinook salmon population from which they never recovered (Moyle 2002).

f. Artificial Propagation Within the Eel River Basin

There are at least four salmonid production facilities in operation within the Eel River Basin: Van Arsdale Fisheries Station, Hollow Tree Creek Fish Hatchery, Yager Creek Hatchery, and Redwood Creek Fish Hatchery. The Van Arsdale Fisheries Station is operated by CDFG; the other facilities are operated by other entities under the guidance of CDFG through the CDFG Cooperative Fish Rearing Program. Hollow Tree Creek Fish Hatchery, Yager Creek Hatchery, and Redwood Creek Fish Hatchery are operated by the Salmon Restoration Association, PALCO, and the Pacific Coast Federation of Fishermen's Association, respectively.

(1) Van Arsdale Fisheries Station. Steelhead eggs were collected until 1997 at an egg-taking station located on the upper mainstem Eel River at Cape Horn Dam. This facility was established by Snow Mountain Light and Power Company in 1907; since the 1960s the egg taking station has been operated by CDFG under the name VAFS. Incorporation of Eel River steelhead into hatchery programs generally occurred prior to 1975; most eggs collected since then have been reared out of the basin, at either Mad River Hatchery or Don Clausen Hatchery(Russian River), then returned to the Eel River for release (Busby *et al*. 1996). Although most eggs taken at VAFS were from steelhead, some Chinook salmon and coho salmon eggs were taken as well.

CDFG conducts a "stock rescue" program which removes wild Chinook salmon and, until 1997, wild steelhead from the mainstem Eel River at the Cape Horn Dam fish ladder or in other upper mainstem locations (CDFG 1997). This program spawned and reared Chinook salmon and steelhead to smolt size prior to release to reduce predation by Sacramento pikeminnow. The program's assumption was that larger, emigrating juveniles are not as susceptible to predation as smaller, naturally-reared juveniles. This program was scheduled to continue until 1,000 adults of each species are counted annually at the VAFS, or until the year 2003. The CDFG has stopped spawning steelhead at the VAFS facility due to lack of funds. The last year that CDFG took eggs from steelhead at the VAFS was 1996-97 (Alan Grass, CDFG, personal communication).

(2) Hollow Tree Creek Hatchery. The Salmon Restoration Association has operated a Chinook salmon hatchery on Hollow Tree Creek (tributary to South Fork Eel River) since 1979. The project goal of the hatchery is to enhance the salmon fisheries in the Eel River Basin by rearing and releasing into Hollow Tree Creek system approximately 200,000 Chinook salmon fingerlings annually (CDFG 1999). From 1979 to 1997, 1,043,636 Chinook salmon fry were released into Hollow Tree Creek (Salmon Restoration Association 1997). In three separate years, small lots of coho salmon or steelhead eggs were also taken (CDFG 1997).

(3) Yager Creek Hatchery. The Pacific Lumber Company operates a small hatchery on Yager Creek (a tributary to the Van Duzen River, which is a tributary to the Eel River). Operations began in 1972, in rearing ponds constructed at Scotia. In 1976, the present facility at Yager Creek was constructed. Two satellite facilities were constructed in 1993 on the South Fork Yager Creek and Corner Creek. The CDFG allows the annual take of 100,000 Chinook salmon eggs and 30,000 steelhead eggs, though PALCO does not take that many eggs. During the 1999/2000 season, PALCO took 13,544 Chinook salmon eggs and 3,900 steelhead eggs (Robert Darby, PALCO, personal communication). Both Chinook salmon and steelhead are reared to be seeded into streams with improved or expanded habitat on PALCO property or for use in the "Classroom Incubation Program" (CDFG 1999).

(4) Redwood Creek Hatchery. The Eel River Salmon Restoration Project operates a Chinook salmon hatchery on Redwood Creek (tributary to South Fork Eel River). The goals of this hatchery are to enhance the salmon fisheries and fish habitat in several sub-basins of the Eel River Basin as well as provide salmon life cycle education to local schoolchildren (CDFG 1999). In 1999, they delivered 450 eggs to schools for the "salmon in the classroom" program and released 20,186 juvenile Chinook salmon into Redwood Creek (Eel River Salmon Restoration Project 1999).

g. Potential Effects of Hatchery-raised Fish on Naturally-produced Fish

Hatcheries on the Pacific Coast have been used for more than a hundred years in attempts to mitigate the effects of human activities on salmon and to replace declining and lost natural populations. These hatchery fish appear to have had substantial adverse effects on native fish populations. This major threat to the continuing existence of Eel River salmon and steelhead is a result of present and past hatchery practices. Artificial propagation threatens the genetic integrity, and diversity that protects overall productivity against changes in environment (61 FR 56138). The potential adverse impacts of artificial propagation programs are well documented (reviewed in Waples 1991, National Research Council 1995, National Research Council 1996, Waples 1999). These potential impacts have three broad categories: disease, genetic, and ecological.

(1) Disease Impacts. There are two important elements to consider in regard to the effects of disease as a result of artificial propagation: disease/pathogen amplification and disease/pathogen transmission. Amplification is simply the increase in disease (pathogens) from artificial propagation. Hatcheries may act as reservoirs of infection due to conditions (crowding or increased stress) or practices (handling) which increase the vulnerability of fish to infection and maintain pathogen populations at infective levels (Goede 1986). Disease problems may also persist in hatcheries because of contaminated water supplies and vertical transmission of pathogens. In addition, fish may carry latent disease from one generation to the next. Fish kept at high densities in hatcheries are prone to epidemics involving diseases that are uncommon in the natural environment, supplying strong selection for disease-resistant fish. These disease resistant fish subsequently can act as carriers for disease to the non-resistant wild population (National Research Council 1995).

(2) Genetic Impacts. The potential genetic impacts that result from artificial propagation programs are both the most serious and the hardest to detect. Potential genetic impacts from artificial propagation can be classified as: (1) extinction of native genetic stocks, (2) erosion of diversity among populations, (3) erosion of diversity within populations, and (4) domestication (Busack and Currens 1995). These impacts do not necessarily occur independently and may result either directly or indirectly from artificial propagation. Understanding and managing genetic impacts is imperative for both directing existing artificial propagation programs and for assessing the benefits and risks of new programs.

Myers *et al*. (1998) reported the transfer of non-native Chinook salmon into some watersheds of the action area has shifted the genetic profiles of some hatchery and natural populations so that the affected population is genetically more similar to distant hatchery populations than to local populations. They found that the Russian River, and to a lesser degree the Eel River system, have been the recipients of large numbers of out-of-basin (sometimes out of state) stocks: from 1973 through 1994, more than 625,000 (or 22 percent) of juvenile Chinook released salmon into the Eel River came from outside the ESU; and from 1956 through 1994 over 5,000,000 (or 76 percent) of juvenile Chinook salmon released into the Russian River came from outside the CC Chinook salmon ESU.

(3) Ecological Impacts. Ecological interactions between natural and hatchery fish are complex and may occur at different biological levels from individual to community (National Research Council 1995). As such, an understanding of ecological processes and the interactive, biophysical attributes necessary for Pacific salmon survival is necessary to assess interactions between natural and hatchery fish. The ecological impacts of hatchery programs on natural Pacific salmon and their ecosystems may be classified as: (1) carrying capacity impacts, (2) competition, (3) predation, and (4) altered migration behavior. When considering these impacts, it is important to consider not only fish biology, but also the processes that influence ecosystems; including human influences. If a wild population is small because of habitat loss or alteration, the increased population density that results from augmentation can increase competition for food, space, or other functions the habitat provides. That competition can further reduce the size of the wild population. The migration and spawning timing of hatchery stocks of steelhead in northern California has been truncated since hatchery operations began due to hatchery selection of breeding stock from only the early part of the run (Busby *et al*. 1996). This shortening of spawning time limits the ability of the population to respond to stochastic events such as late onset of rains, large storm events, or unusual low flow periods. It may also condense the population in spawning grounds, stressing the individuals.

The National Research Council (1995; 1996) concluded that hatcheries altered behavior of fish, caused ecological problems by eliminating the nutritive contributions of carcasses of spawning salmon from streams, and probably displaced the remnants of wild runs. Hatcheries have also increased the effects of mixed-population fisheries on depleted natural populations. If fisheries responds to apparent abundance without considering the mixture of population portions from different stock sources or hatchery contributions the natural population will be overfished. Many problems arise when the goal of hatcheries is to provide substitutes for natural populations lost or displaced because of human development activities, and from insufficient incorporation of basic genetic, evolutionary, and ecological principles into hatchery planning, operation, and monitoring (National Research Council 1995; 1996). For instance, a hatchery program with mandated mitigation goals may therein be constrained from applying both advancements in technology and alternative management theory. Because of their possible deleterious impacts hatcheries should no longer be viewed solely as factories for producing fish. To reduce potential deleterious impacts, hatchery management and operations should be changed so that their goals are to assist recovery of wild populations and to increase knowledge about salmon. Although hatcheries have many potential problems, they are a useful tool that may assist in the recovery of listed fish (Hard *et al*. 1992; NMFS 1999b; Waples 1999).

3. <u>Salmonid Habitat in the Eel River</u>

Designated coho salmon critical habitat considerations are primarily related to water quality and quantity, availability of clean spawning gravel and spawning areas, and sites for juvenile rearing. Much of the mainstem Eel River channel and riparian habitats have been degraded from conditions known to support viable salmonid populations. CDFG (1997) summarized habitat conditions for salmonids within the Eel River using the following sub-basins: Estuary and Delta, Mainstem Eel River, Van Duzen River, South Fork Eel River, North Fork Eel River, and the Middle Fork Eel River.

a. Upper Mainstem Eel River

Since December 1922, discharges from Lake Pillsbury have artificially maintained summer flows and temperatures downstream to Cape Horn Dam at levels favorable to juvenile steelhead. Enhanced growth rates of juvenile steelhead in the mainstem between the dams have been reported by SEC (1998). Enhanced summer flow from Scott Dam has led to high production of macro-invertebrates for food and provides adequate water temperatures which have led to increased growth rates of juvenile steelhead. Upper mainstem tributary habitat also provides important spawning and rearing habitat for steelhead although growth rates are lower due to a natural hydrologic regime. Currently, winter steelhead have access to about 26 miles of spawning and rearing habitat within the Upper Eel River basin above Cape Horn Dam. However, due to the recent aggraded condition of Soda Creek, which makes spawning habitat unavailable to early returning Chinook, fall Chinook salmon appear to access only about 14 miles of habitat above Cape Horn Dam (USFS and BLM 1995). Spawning habitat for Chinook salmon is more abundant below the Project than above Cape Horn Dam due to the upstream barrier at Scott Dam.

The mainstem Eel River from (RM 21) to Cape Horn Dam (RM 157) is reported by CDFG (1997) to be generally too warm for salmonids during the summer due to low flows, but that some juvenile and adult use occurs during late spring and early summer. Major impacts to mainstem salmonid habitat, as a result of poor land-use practices and large flood events, have reduced the function and capacity of mainstem habitat. Filled pools, degraded gravel quality, and reduced macro-invertebrate production has occurred due to accelerated sediment delivery to the mainstem Eel River. These decreases in mainstem habitat quality have reduced habitat quality for juvenile rearing by reducing available food, space, and cover. Water quality and quantity is also limiting for juvenile salmonids. Spawning habitat and shelter for adult salmonids are also less than fully functional. Overall, low summer flows and lack of riparian vegetation in the mainstem Eel River produce poorly functioning critical habitat.

USFS and BLM (1995) reports that current conditions do not provide fully functional refugia habitat for stocks at risk. The lack of recruitment of riparian vegetation in some portions of the watershed will continue to affect fish habitat in the future due to the lack of recruitment of large trees which provide shelter for adult and juvenile salmonids to stream channels.

Under current conditions, habitat components for adult and juvenile salmonid migration are not properly functioning within the Eel River Basin. The Project impacts the quantity of water available during late spring, early summer, and fall causing migration delays for adult and juvenile salmon outmigrating to the ocean. Chinook salmon habitat in the reach between the dams is not functioning due to cold water releases from Scott Dam which results in slowed growth and delays juvenile Chinook salmon emigrations (SEC 1998). Salmonids are exposed to adverse thermal conditions, which reduce their survival and outmigration success, when they reach the lower mainstem river during the hot summer months. The mainstem Eel River is listed as water quality limited, due to temperature and sedimentation, pursuant to section 303(d) of the Clean Water Act.

b. Lower MainstemEel River

The lower reach of the Mainstem Eel River sub-basin extends from the Fort Seward area (RM 60) downstream to Rio Dell (RM 21)(Figure 1; CDFG 1997). CDFG (1997) reports that the lower Eel River is an important juvenile rearing area, where growth rates are superior to upstream nursery areas. During summer, water temperatures approach ambient air temperatures of the coastal fog-belt. The rain gage at Scotia recorded an average of 50 to 60 inches of rain per year (USGS 1969). Upland and riparian habitats are typically comprised of dense redwood forests. Mainstem flows range between 12 and 750,000 cfs in this reach. Channel habitat is deep pools separated by large, deep riffles.

The lower reach supports summer rearing for juvenile salmonids, especially steelhead yearlings and fall Chinook salmon subyearlings, and holding areas for adult summer steelhead. Mainstem spawning habitat is available in this reach, especially for fall Chinook salmon, but the radical fluctuation of flows and associated bedload movement during storm events makes this reach unstable for spawning use in most years (CDFG 1997).

Riffles in the lower river provide much more food-producing area and cover than upper river riffles. Lower river riffles are wider, deeper and temperatures are lower. Most were too large for Brown (1980) to sample well enough to estimate fish numbers, but sampling revealed large numbers of steelhead relative to similar areas sampled upstream. These riffles were concluded to provide vital rearing habitat and refuge for heat-stressed upstream populations.

Brown (1980) reported many more steelhead in lower river pools than in upper river pools. Twelve percent of the fish surveyed in lower river pools were steelhead in contrast to one percent in the upper river. Additionally, the majority of steelhead in lower river pools were of yearling size. These steelhead may prefer lower river pools because they are cooler and more frequently shaded by fog in summer than upper river pools. Steelhead may use lower river pools as rearing areas in their second year of life, before they migrate to the sea.

Smith and Elwell (1961) observed a large downstream migration of steelhead in early summer from the lower Middle Fork Eel River and concluded that the fish had moved downstream into the main Eel River or into the upper estuary to escape high water temperatures. Steelhead yearlings netted in the Eel River estuary in April, May, and June may have been moving from lethal water temperatures in upper river areas to cooler water in the lower river to complete their freshwater life history cycle. Brown's (1980) surveys revealed few yearling fish in tributaries and in Upper Eel River riffles. He hypothesized that many steelhead leave upper river and tributary areas as the water warms in spring and early summer and seek refuge in lower Eel River pools, riffles and estuary. The distribution of other fishes also seemed limited by habitat.

Steelhead biomass in lower Eel River tributaries was less than upper river tributaries, but the difference was not statistically significant. Young-of-the-year steelhead in the Upper Eel River tributaries were larger than their counterparts in lower river tributaries in June and August. Most yearling steelhead may leave their natal tributaries after their first summer and spend the rest of their freshwater lives in the lower Eel River and in the estuary. Relatively few steelhead remain in tributary streams and the upper main river through their second summer. The Eel River from the estuary to the South Fork provides part of the major rearing habitat for juvenile yearling steelhead in the Eel River System.

Historically, Chinook salmon showed a peak in abundance in the riverine subsystem in June and July (Puckett 1977) during out migration. A few juveniles were also sampled in the two fall samples taken in this reach. Fall out migration could possibly represent a few individuals with "stream type" [spring Chinook salmon] life histories (Murphy and DeWitt 1951) that spend the summer upstream in one of the few remaining cold water tributaries of the Eel River. A number of juvenile Chinook salmon reared throughout summer in the deep water habitat near the mouth and in the north bay (Puckett 1977).

Since the introduction and proliferation of Sacramento pikeminnow in the Eel River, as discussed earlier, juvenile salmonids are likely not using the lower river to the same extent as previously thought. Complete or partial exclusion of juvenile salmonids from the lower, cooler reaches of the river presumably plays a role in the overall reduced survival of salmonid year-classes in the Eel River.

c. Eel River Estuary and Delta
The Eel River estuary is the fourth largest estuary in California. It extends from the mouth of the river roughly seven miles upstream. Many sloughs and side channels add to the area of the estuary, calculated at 2,200 acres in 1973. The estuary provides spawning and nursery habitat for marine fishes and invertebrates, which are important for both sport and commercial fisheries. Freshwater flows reduce upper-estuary temperatures during late summer.

Due to it's low human population, intensive agricultural developments have been minor and has been concentrated in estuary and delta area of the Eel River Basin. However, livestock grazing remains a significant economic component in the basin (CDFG 1997). Livestock grazing has been identified by NMFS as an activity which can increase sediment, destabilize banks, reduce organic litter and woody debris, increase water temperatures, simplify stream channels, and increase peak flows leading to scouring (65 FR 7764). These adverse modifications reduce the value of habitat for salmonids, and may result in injury or mortality of fish.

The Eel River Estuary has been severely altered by many influences by both man and nature in recent times. Estuarine habitat has been degraded by poor land-use practices, animal waste from delta farming areas, and a depletion of riparian forests since the arrival of the European settlers. Presently, the estuary of the Eel River may only be 40 percent of its former size (USDA 1989). Reductions in estuarine surface acreage and habitat volume have limited this habitat for salmon and steelhead production. Unfortunately, while there may be increasing reliance on the estuary for rearing due to warmer temperatures and exclusion from areas upstream, the estuary's carrying capacity is diminished due to sediment incursions and size reduction. These impacts over time have reduced available habitat for salmonids to a fraction of historic levels. In the estuary, the water quality and quantity elements of critical habitat are in poor condition and functioning at a level below optimum. The Eel River Delta is also listed as water quality limited, due to temperature and sedimentation, pursuant to section 303(d) of the Clean Water Act.

4. <u>Factors That Limit Survival and Recovery of ESA-listed Salmonids in the Eel River Basin</u>

Factor 1
Mainstem Eel River flow needed for anadromous salmonid migrations, rearing, and spawning is critically reduced from conditions associated with self-sustaining and self-regulating salmonid

populations. The mainstem Eel River from Rio Dell (RM 21) to Cape Horn Dam (RM 157) is reported by CDFG (1997) to be generally too warm for salmonids during the summer due to low Project releases, but that some juvenile and adult use occurs during late spring and early summer. Wild runs of coho salmon, fall Chinook salmon and steelhead have drastically declined over the last 90 years to populations so low that resiliency may lag far behind and below other coastal rivers in the area. During spring, summer, and fall, biologically important baseflows and pulseflows are muted by Project storage and diversion. Project flow reductions limit survival of all anadromous salmonids during juvenile and adult migrations by blocking and delaying, and thereby eliminating, early segments of the run, increasing predation, reducing growth and increasing energy expenditures. Low flows redistribute spawning adults below the Project and potentially increase the incidence of mainstem spawning, which reduces population survival due to the increased likelihood of mainstem redd scour from high winter flows. Project flow reductions severely limit rearing habitat and degrade water quality (including temperature) during growing seasons for juvenile steelhead (especially for yearlings and older age-classes) and subyearling fall Chinook salmon.

Factor 2
Forestry practices have limited production of anadromous salmonids in the Eel River Basin. Habitat degradation by forestry activities has mostly occurred in tributaries, which affects spawning, incubation and rearing juvenile salmonids. The mainstem has also been severely aggraded as a result of post 1955 and 1964 flood sediment inputs from harvested slopes. Major impacts to salmonid habitat, as a result of poor land use practices and large flood events, have reduced the function and capacity of mainstem habitat. Filled pools, degraded gravel quality, and reduced macro-invertebrate production have occurred due to accelerated sediment delivery to the mainstem Eel River. These decreases in mainstem habitat quality have reduced juvenile rearing success by reducing available food, space, and cover. Spawning habitat and shelter for adult salmonids are also less than fully functional. Low flow and lack of riparian vegetation in the mainstem Eel River produce poorly functioning critical habitat. The lack of recruitment of riparian vegetation in some portions of the watershed will continue to have an effect on fish habitat in the future due to the lack of recruitment of large trees to stream channels that provides shelter for adult and juvenile salmonids. Tributary and mainstem habitats are limited by debris barriers, increased temperatures, massive siltation, loss of riparian cover diversity, loss of large woody debris, and road building and maintenance that causes increased sedimentation of fines and the filling of pools. USFS and BLM (1995) reports that current conditions do not provide fully functional refugia habitat for stocks at risk. These impacts limit population survival through reduced habitat quality and quantity.

Factor 3
Cyclically poor ocean conditions and resultant downward trends in anadromous salmonid survival, fecundity, and growth rates are universal and may reduce annual recruitment. However, analysis of hatchery returns and return trends in other rivers, indicate that poor ocean conditions are not a primary limiting factor of Eel River salmonids. A recent review by Hare *et al.* (1999) suggests that these conditions could be part of an alternating 20- to 30-year long pattern. These authors concluded that, while at-risk salmon stocks may benefit from a reversal in

the current climate/ocean regime, fisheries management should continue to focus on reducing impacts from harvest and artificial propagation, and improving freshwater and estuarine habitats.

Factor 4
The estuary and delta: CDFG (1997) reports that the lower Eel River is an important juvenile rearing area, and the estuary provides a nutrient-rich environment where growth rates are superior to upstream nursery areas. The Eel River Estuary has been severely altered by many influences of both man and nature in recent times. Estuarine habitat has been degraded by poor land use practices, animal waste from delta farming areas and a depletion of riparian forests since the arrival of the European settlers. These impacts over time have reduced available habitat for salmonids to a fraction of historic levels. In the estuary, the water quality and quantity elements of critical habitat are in poor condition and functioning at a level below optimum.

Factor 5
The introduction of Sacramento pikeminnow into the Eel River Basin in 1979, along with at least 15 other introduced species, have caused unstable fish assemblages (Brown and Moyle 1997). Sacramento pikeminnow displace and prey upon juvenile salmonids. Sacramento pikeminnow densities are relatively high within the lower sections of major tributaries and the mainstem Eel River (CDFG, unpublished data). Northern pikeminnow has been shown to be an important predator affecting the production of anadromous salmonids in the northwest United States (Friesen and Ward 1999), and Brown and Moyle (1997) document salmonids as a significant component of the diet of Sacramento pikeminnow in the Eel River, primarily during spring outmigrations. Geary *et al.* (1992), state that their data suggests that the effect of squawfish (pikeminnow) on steelhead and Chinook salmon in the Upper Eel River has been extreme, and the effect on rearing steelhead populations is most pronounced for marginal steelhead habitat (due to warm temperatures) downstream of Cape Horn Dam. Week (1992) also states that the spread of squawfish (pikeminnow) throughout the mainstem Eel River appears to have severely degraded salmonid production.

Factor 6
Hatchery produced steelhead directly compete with and prey upon wild salmonids. In the early 1900's as many as 20 million hatchery steelhead were produced and planted into the Eel River (SEC 1998). Hatchery plants to the South Fork Eel River and Upper Eel River have varied greatly since that time, but have likely had significant adverse impact upon wild salmonids over time. Whereas these efforts may increase the total population numbers, they also cause extensive impacts to natural populations of anadromous fish, by introducing diseases, reducing genetic diversity, preying on native salmonids, and outcompeting native salmonids for food and spawning sites. The relatively large steelhead smolts produced by hatcheries are known to prey upon and displace smaller wild salmonids.

Factor 7
Capture and retention of wild anadromous salmonids in mixed stock ocean and freshwater fisheries, and by poaching in freshwater, directly reduce the number of adults that can return to spawn.

Factor 8
Spawning and juvenile rearing habitats of anadromous salmonids in the mainstem and tributaries of the Eel River headwaters are blocked by Scott Dam. The construction and maintained operation of Scott Dam has eliminated access to the highest quality habitat from the Upper Eel River. Runs of summer steelhead and spring Chinook salmon were extirpated from the entire Upper Eel River Basin. Estimates vary between 50 and 150 miles of high-quality spawning and rearing habitat that were lost for winter steelhead, fall Chinook salmon, and possibly coho salmon. Very conservative estimates by VTN (1982) indicate that runs larger than the total production of fall Chinook salmon in the Upper Eel River sub-basin over the previous ten years were extirpated.

B. Russian River

The Russian River drains an area of 1,485 square miles within Mendocino County and Sonoma County. Basin elevations range from 4,344 feet to sea level, and mean annual precipitation is 44 inches per year (FERC 2000), though ranges from 25 to 80 inches per year depending upon elevation and year (SCWA 1996). Snow in the Russian River basin is a rare event and most precipitation falls as rain. From the headwaters north of Ukiah to the sea at Jenner is approximately 110 river miles. The climate in the Russian River can be described as Mediterranean, with over 90 percent of precipitation occurs between October and May (SEC 1996b).

In the geologically brief time span since the mid-1800s, the Russian River system has been transformed from its natural condition and balance to what is now essentially a heavily controlled urban water conveyance. Two major dams, interbasin water transfers, channelization, water diversions, resource harvest, agriculture and urban land use practices, and lack of foresight in management practices have all contributed to a significantly compromised function of the biological systems. The changes in the Russian River Basin present a classic case study of the modern anthropogenic impacts on interrelated ecological communities (SEC 1996b).

This section details factors effecting the abundance of Russian River salmonids. The extent to which there are species specific differences in population limiting factors is not clear; however, the freshwater ecosystem characteristics necessary for the maintenance of self-sustaining populations of all Russian River salmonids are quite similar.

For the Russian River Basin, NMFS cited many reasons for the decline of coho salmon (Weitkamp *et al.* 1995), Chinook salmon (Myers *et al.* 1998) and steelhead (Busby *et al.* 1996) including: gravel mining operations, summer diversions on important juvenile rearing tributaries, land use practices, degraded water quality, poor ocean conditions, commercial and sport fishing pressure, fish hatchery operations, and the construction of large water development projects (Lake Mendocino and Lake Sonoma). Logging, agricultural activities, urbanization, stream channelization, dams, wetland loss, and water withdrawals and unscreened diversions for irrigation have also been identified as causes contributing to the modification and curtailment of habitat for coho salmon (61 FR 56138), Chinook salmon (65 FR 7764), and steelhead (65 FR 7764) within the Russian River Basin. Individually, these factors may not be significant, but cumulatively they are formidable. Watersheds, for example, are affected by nearly all human endeavors. An impact of one area can manifest itself throughout a watershed.

1. Historic and Current Salmonid Fisheries

Although the Russian River Basin contained Chinook salmon, coho salmon, pink salmon (*Oncorhynchus gorbuscha*), and steelhead, likely only coho salmon have been harvested in in-river commercial fisheries (SEC 1996b). SEC (1996b) reported that since the settlement of the Russian River Basin in the 1850's, fish resources have suffered and concluded that pressure on the fisheries increased as human population expanded into the basin. As with other river basins on the west coast, the Russian River has seen salmonid populations plummet (Nehlsen *et al.* 1991).

There are few good historical accounts of the abundance of coho salmon harvested along the California coast (Jensen and Swartzell 1967). Early records did not contain quantitative data by species until the early 1950s. Anderson (1995) reported that annual catch of coho salmon in California's commercial troll fishery ranged from 100,000 to more than 650,000 fish in the early 1960s and 1970s, but had declined to an average of 54,300 fish (including a mixture of wild and hatchery fish) during the period 1980-1990. Anderson (1995) noted that there was considerable disagreement as to the role that commercial and recreational ocean fishing had played in the long term decline of coho salmon populations, as he found few records to indicate that curtailment of fishing had increased coho salmon spawner abundance.

An early commercial in-river coho salmon fishery was present in the Russian River Basin. Commercial cannery records from 1888 indicate that 183,597 pounds of salmon were caught near Duncan Mills for cannery and personal use (United States Bureau of Fish and Fisheries 1888). The cannery records do not identify the species of "salmon" captured, but mentions that the fish ranged in weight from 8 to 20 pounds. SEC (1996b) surmised - given the size of the reported fish - that the "salmon" from the cannery records were most likely coho salmon. SEC (1996b) further surmised that the average weight of coho salmon was 12 pounds and, therefore, about 15,300 coho salmon were taken in 1888. The United States Bureau of Fish and Fisheries (1888) reported that by 1888 the commercial fishery of the Russian River was ". . . rather unimportant as a commercial fishing center.", and while the Russian River had been renowned for its abundance of salmon, reductions in abundance were apparent. Snyder (1908) also reported a decline in abundance of Russian River salmon. Until recently, there was a recreational fishery for coho salmon on the Russian River.

Although currently no coho salmon may be legally retained in either marine or freshwater in California, CDFG port samplers routinely observe coho salmon retained from the ocean by recreational fisherman who either did not know the regulations or were not able to discern coho salmon from Chinook salmon. In 1999, it was estimated that 598 coho salmon were retained by recreational fisherman fishing in the ocean off California (Melodie Palmer, CDFG, personal communication). Also, over a three day period in mid-July 1999, CDFG wardens issued 55 citations for 57 coho salmon retained by recreational fisherman in Bodega Bay, which is located on the coast a few miles south of the mouth of the Russian River (Ed Magnuson, CDFG, personal communication). Additionally, there are incidental mortalities of coho salmon due to stress when captured and released by fisherman targeting other marine fish species. The confounding effects of habitat deterioration, drought, and poor ocean conditions on coho salmon survival make it difficult to assess the degree to which recreational and commercial harvest have contributed to the overall decline of coho salmon in west coast rivers.

Since 1992 the commercial salmon troll fishery of California has been designed to target Central Valley fall-run Chinook salmon. The April 2000 NMFS biological opinion on the effects of the Pacific Coast Salmon Plan on protected salmonids provided protections for CC Chinook salmon ESU by furnishing a Reasonable and Prudent Alternative which reduced harvest rates and improved monitoring and evaluation methods. The degree to which Chinook salmon derived from the Russian River were, and still are, captured in the ocean by fishermen is difficult to ascertain because river stocks do not segregate in the ocean. Although historically there was a recreational Chinook salmon fishery in the Russian River Basin, retention of Chinook salmon is currently prohibited.

Steelhead do not aggregate in the marine environment and therefore are not as susceptible to marine capture as are salmon. However, steelhead fishing in the Russian River was once praised as being some of the finest in California (SEC 1996b) and that a healthy economy thrived on the steelhead sport fishing activity (USACE 1982). SEC (1996b) reports two estimates of recreational harvest of steelhead from the Russian River: 15,000 from 1936 and 25,000 from 1956/57. Currently, only hatchery-produced steelhead may be retained from the Russian River Basin, and only those from a portion of the mainstem Russian River.

2. Land Use and Water Development Activities

The Russian River hydrology can be characterized as a rain-driven system with a substantial aquifer. Most water use is diverted from surface flow and underflow as provided by natural runoff, the diverted Eel River, and supplemented by reservoir storage from lakes Mendocino and Sonoma. In the Russian River mainstem, summer flows for irrigation and domestic use are already released from the storage reservoirs at levels which are much higher than natural, so that Project flows through the lower river exacerbate this divergence from natural conditions.

In the middle Russian River mainstem, unimpaired (or natural) average summer flow in a normal water years is 27 cfs. Current agricultural and domestic water supply needs during the summer months average 67 cfs (SCWA; Russian River unimpaired flow and water balance models). With additional water available from the Project, summer flows of 187 cfs (measured at Healdsburg) are common. Therefore, in the middle-mainstem Russian River, summer flows are often nearly three times the diversion need and seven times more than natural summer flows.

State Water Resources Control Board (SWRCB) Decision 1610 prescribes summer flows at nearly the same rate as Project diversions from June through September (SWRCB 1986). Without Project diverted flows the SWRCB would be unable to set Russian River summer flow regimes at such magnitude and pattern and therefore high summer flows in the Russian River are a Project impact.

Within the action area, the Sonoma County Water Agency (SCWA) and the Mendocino County Water Agency are the two major suppliers of water for urban, commercial, agricultural, and residential use. In addition to the two large reservoirs in the basin, there are an unknown number of permanent and temporary water withdrawal facilities that divert water for similar purposes. Using SWRCB records, SCWA estimated that there were over 600 diversions by various entities along the mainstem of the Russian River, and approximately 800 other diversions along the tributaries of the Russian River (SCWA 1996). Impacts from water withdrawals include entrapment and impingement of younger salmonid life stages, localized dewatering of reaches, and depleted flows necessary for migration, spawning, rearing, flushing of sediment from spawning gravels, reduced gravel recruitment, and transport of large woody debris. Unprotected water diversions in the Russian River can also impact young salmonids. Young fry are easily drawn into water pumps or become stuck against the pump's screened intakes. Unscreened or inadequately screened diversions predominate within the Russian River basin (SEC 1996b).

In the Russian River, extensive habitat degradation and decreased carrying capacity, a long history of artificial propagation with the use of non-native stocks, and recent droughts and poor ocean conditions are among explanations for the current low abundance of salmonids (Weitkamp *et al.* 1995). Logging, agriculture and mining activities, urbanization, stream channelization, dams, wetland loss, water withdrawals and unscreened diversions for irrigation have contributed to the decline of salmonids within the Russian River Basin. These land use activities have altered streambank and channel morphology, stream temperatures, spawning and rearing habitats, connectivity of habitats, and recruitment of large organic debris and spawning gravels.

Construction of Coyote Valley Dam on the East Fork Russian River in 1959 and Warm Springs Dam on Dry Creek in 1982, created absolute barriers to salmonid migration. The dams have blocked access to an estimated 86 to 169 miles of valuable spawning and rearing habitat within the Russian River Basin. It is estimated that the lost salmonid habitat would have the capability of supporting 8,000 to 14,000 steelhead and 100 to 300 coho salmon adults (SEC 1996b).

SEC (1996b) reported that changes in flow and temperature resulting from dams and diversions had significantly impacted Russian River salmonid populations. They reported that, prior to 1908, the Russian River flowed unimpaired, with high winter flows that cycled with storm events, and summer flows that were low or intermittent (SEC 1996b). Completed in 1922, Scott Dam allowed year-round diversion of Eel River water into the East Fork Russian River (SEC 1996b). Among other effects to the system, the average summer base discharges in the Russian River increased dramatically, with summer flows generally exceeding 125 cfs (SEC 1996b).

The construction of Coyote Dam in 1959 significantly altered downstream flows. During the rainy season, storage for water supply and flood control dampens or eliminates discharge peaks, particularly in fall and early winter as the water supply pool is filling (SEC 1996b). Summer flows also increased significantly after completion of Coyote Dam. Two hundred cfs is now the approximate mean summer flow at Healdsburg, compared with the historic unimpaired flow of 20 cfs or less. Coyote Dam's ability to further alter natural flows in the Russian River added to the growing problems of changed channel morphology, impeded migration, and compromised rearing habitat (SEC 1996b).

SEC (1996b) reported that increased summer base flows also eliminated the formation of stratified pool habitat in the mainstem Russian River. The augmented summer flow regime in the Russian River eliminated potential salmonid rearing habitat in marginal thermal reaches by maintaining flows at levels too high to allow pool stratification (SEC 1996b).

Cool water release from Coyote Dam was intended to benefit salmonids in summer, but the influence diminishes below Hopland due to ambient warming as the water moves downstream (SEC 1996b). Preferred temperatures for coho salmon are between 11.8° and 14.6°C (Laufle *et al.* 1986). At temperatures above 20°C, salmonids suffer stress (decreased metabolic activity and utilization of food, reduced competitive ability, and increased vulnerability to predation and disease). Between 23° and 26°C, salmonids suffer chronic physiological stress. Summer temperatures between Hopland and Cloverdale cause salmonid stress, and high temperatures prevent juvenile salmonids from utilizing the river below Cloverdale (SEC 1996b). Mean daily temperatures reach 20°C at Healdsburg in late April and exceed 23°C by June 1 (SEC 1996b). By June 1, even minimum temperatures at Healdsburg exceeded 20°C, creating thermally stressful conditions for salmonids (SEC 1996b).

In 1982, Warm Springs Dam was completed on Dry Creek, resulting in regulated flows and a loss of rearing habitat below the dam. Cool water released from Warm Springs Dam keeps temperatures below 16°C, limiting warmwater fish intrusion into Dry Creek and creating favorable temperatures for salmonids. This positive effect is offset, though, by impacts to channel morphology from regulated flows. Regulated flow coupled with gravel extraction has caused channel incision, channelization, diminished gravel recruitment, riparian encroachment, and habitat simplification.

Russian River water management and habitat disturbances have worked in concert with the introduction of exotic species to cause major shifts or declines in fish populations throughout the basin (SEC 1996b). SEC (1996b) cite USACE (1982) and Prolysts, Incorporated and Beak Consultants, Inc (1984) who found that since 1922 increased summer flows and temperatures in the mainstem Russian River not only decreased salmonid habitat, but actually created ideal warmwater habitat. SEC (1996b) reviewed sources which indicated that Sacramento pikeminnow , a native warmwater species in the Russian River which competes with or directly preys upon juvenile salmonids, dominate much of the mainstem and have become the most widespread predator in the basin.

There have also been introductions of exotic warmwater species that have contributed to the decline of salmon and steelhead. Of the 48 fish species (either present or extirpated) recorded from the Russian River, 29 were either intentionally or inadvertently introduced (SEC 1996b). SEC (1996b) cite EIP Associates (1994) who documented the following predatory species introduced in the Russian River: largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*), striped bass (*Morone saxatilis*), channel catfish (*Ictalurus punctatus*), and green sunfish (*Lepomis cyanellus*). SEC (1996b) concluded that the introduced predator species tend to occupy the warmer, lower reaches of the Russian River, with the heaviest predation upon salmonids likely occurring in association with structures that provide habitat for predators, e.g., bridges, bank armoring, dams, and diversions.

Historic gravel mining operations involved instream dredging (1940-1970) which channelized the river and forced it into a narrow and straight pattern (EIP Associates 1997). The dredging operations resulted in streambed elevation lowering of between 30 to 60 feet in some areas. Extraction was limited to bar skimming in 1980. EIP Associates (1997) also reported that isolated areas of thalweg lowering occurred between 1968 and 1991, where intensive mining coincided with highly erosive force. Areas of thalweg degradation recovered after 1995 and now exceed pre-mining topography in many areas. EIP Associates (1997) reports a loss of channel volume (aggradation) during the last decade. The Sonoma County Aggregate Resources Management Plan (EIP Associates1994) reports that between 1982 and 1989 channel volume decreased by approximately 4,988,000 ft^3 from RM 23.06 to 31.3. The trend towards channel aggradation in recent years has lead to more stable channel conditions. Stable channel conditions lead to increased salmonid habitat use for spawning and juvenile rearing.

Gravel mining, along with the barrier to sediment passage caused by Coyote and Warm Springs Dams has resulted in morphological changes to the Russian River. Decreased sediment load has caused the river to increase in depth, resulting in extensive bank erosion (Florsheim and Goodwin 1993). Over harvesting of gravel in the past has led to river incision, bank erosion, habitat simplification, and tributary downcutting. Degradation or downcutting of the channel due to past mining in the middle reach of the Russian River may have lead to impacts on ground water table adjacent to the river. Impacts such as the loss of water table elevation in the Middle Reach of the Russian River due to bed degradation has been attributed to gravel mining (EIP Associates1994).

3. <u>Artificial Propagation within the Russian River Basin</u>

Hatchery practices have also impacted the coho salmon and steelhead populations within the Russian River and Dry Creek. Since the1870's, millions of hatchery-reared salmonids have been released into the Russian River basin. The combination of planting out-of-basin stocks, hatchery selecting processes, and interbreeding have led to a decrease in salmonid genetic diversity and loss of local adaptations (SEC 1996b). There are two fish production facilities in operation within the Russian River Basin: Don Clausen Fish Hatchery (operational in 1980) and Coyote Valley Fish Facility. Both facilities are owned by the United States Army Corps of Engineers and operated under contract by CDFG.

The Don Clausen Fish Hatchery and Coyote Valley Fish Facility were created as mitigation for the effects of Warm Springs and Coyote Valley dams, located in the Russian River Basin. Facilities goals were to develop and maintain escapement of 6,000 steelhead, 1,100 coho salmon, and 1,750 Chinook salmon in the Dry Creek drainage of the Russian River (Don Clausen Hatchery) and 4,000 steelhead in the upper Russian River basin (Coyote Valley Fish Facility). Juvenile release goals for Don Clausen Hatchery are 300,000 steelhead, 110,000 coho salmon, and 1,400,000 Chinook salmon (Entrix 2000), though, recently, CDFG has implemented interim operations at Don Clausen Hatchery and will raise no Chinook salmon until long-term management strategies are developed. The juvenile release goal for Coyote Valley Fish Facility is 200,000 steelhead (Entrix 2000). In 2001, CDFG implemented a coho salmon captive broodstock program intended to aid in the recovery of coho salmon in the Russian River.

Out-of-basin stocks of coho salmon, Chinook salmon, and steelhead have been released into the Russian River basin both before and after creation of the Don Clausen Fish Hatchery and Coyote Valley Fish Facility. Information related to the production at the Don Clausen Fish Hatchery is from Entrix (2000). Out-of-basin coho salmon broodstock raised at the Don Clausen Fish Hatchery include: Eel River, Iron Gate, Noyo River, Alsea River (Oregon), and Soos Creek (Washington.) Out of basin Chinook salmon raised at the Don Clausen Fish Hatchery include: Sacramento River (winter-run), Eel River, Mad River, Klamath River, Silver King Creek, and Wisconsin strain (Green River, Washington.) Out-of-basin coho salmon broodstock raised at the Don Clausen Fish Hatchery include: Eel River, Prarie Creek, Mad River, San Lorenzo River, Scott Creek, and Washougal River (Washington.) From 1971 through 1994, the Russian River received about 140,000 steelhead per year of various stocks (Busby *et al.* 1996).

The genetic, physiological, and ecological consequences of artificial propagation programs on native salmonid populations are discussed in section 7.b. of the Environmental Baseline, above.

Russian River water management and habitat disturbances have worked in concert with the introduction of exotic species to cause major shifts or declines in fish populations throughout the basin (SEC 1996b). SEC (1996b) cite USACE (1982) and Prolysts, Incorporated and Beak Consultants, Inc (1984) who found that since 1922 increased summer flows and temperatures in the mainstem Russian River not only decreased salmonid habitat, but actually created ideal warmwater habitat.

4. Critical Habitat in the Russian River

Critical habitat considerations in the Russian River are primarily related to water quality and quantity, availability of clean spawning gravel and spawning areas, access to important spawning and rearing areas. Much of the mainstem Russian River channel and riparian habitats have been degraded by the effects of urbanization. Urbanization has degraded coho salmon habitat through stream channelization, floodplain drainage, and damage to riparian vegetation (Botkin *et al.* 1995).

The functioning of designated critical salmonid habitat within the mainstem Russian River has also been compromised by changes in flow and temperature resulting from dams and diversions since 1922 with the completion of Scott Dam on the Upper Eel River. Loss of cold water refugia in the mainstem continues to impact salmonid rearing conditions and survival.

Lake Mendocino provides cool water to the upper reach of the river between Ukiah and Hopland. Below Hopland the Russian River warms to temperatures stressful to salmonids. According to SEC (1996b) pool stratification in the mainstem is impacted by summer releases from Coyote Valley and Warm Springs Dam. Summer releases are 15-20 times the amount of pre-regulated flows in the mainstem Russian River with flows generally exceeding 125 cfs resulting in dysfunctional summer rearing habitat. Increased flows in the Russian River have created habitat conditions more favorable to introduced and native warmwater fish species such as Sacramento pikeminnow, bluegill, largemouth bass, smallmouth bass and striped bass. Sacramento pikeminnow have become the most widespread predator in the basin, frequently displacing salmonids from preferred habitat. Increased summer flows in the Russian River also decrease habitat availability for salmonids by inundating cover and increasing water velocities.

Riparian vegetation provides shelter and is a source for large woody debris and insects. The riparian corridor of the Russian River is functioning at a less than optimum level. Riparian vegetation along the mainstem Russian River in Mendocino County had been reduced by 30 percent. Other areas in lower reaches showed similar declines with the middle reach decreasing by 33 percent and the Alexander Valley reach declining by 53 percent (Beach 1996).

Migration of salmonids in the mainstem Russian River is impacted by a number of small seasonal dams that are located for the most part in the lower river. Recreational dams such as Vacation Beach and Johnson's Beach are currently equipped with denil-type fish ladders that pass adult salmonids in the late-summer and early-fall. The rubber dam at Wohler, operated by the Sonoma County Water Agency, is also equipped with denil fish ladders to pass adult salmonids in the fall and any late emigrating smolts in the late spring and early summer. The Healdsburg Memorial summer dam is only installed from early July to early September. Del Rio Woods summer dam is no longer permitted due to adverse effects and a denial of a permit from the North Coast Regional Water Quality Control Board. In addition, the Willow Water District Dam near Ukiah is primarily a grade control structure which impairs passage for migrating salmonids.

Winzler and Kelly Consulting Engineers (1978) evaluated spawning habitat condition in the Russian River. Their results suggest that the middle reach of the river from Cloverdale to Healdsburg provides suitable spawning habitat. The reach between Ukiah and Cloverdale is characterized by steeper gradients and has less suitable spawning habitat. The lower reach of the mainstem below Healdsburg had the least amount of suitable spawning habitat (Winzler and Kelly Consulting Engineers 1978).

C. Environmental Baseline Summary

NMFS has identified a number of factors that should be considered in evaluating the level of risk faced by an ESU, including: (1) absolute numbers of fish and their spatial and temporal distribution; (2) current abundance in relation to historical abundance and the current carrying capacity of the habitat; (3) trends in abundance; (4) natural and human-influenced factors that cause variability in survival and abundance; (5) possible threats to genetic integrity (e.g. from strays or outplants from hatchery programs); and (6) recent events (e.g, a drought or changes in harvest management) that have predictable short-term consequences for abundance of the ESU (65 FR 6960).

Within the action area, absolute numbers of fish show severe declines over several decades. The spatial and temporal distributions of salmonids in both the Eel and Russian rivers have been unequivocally and negatively affected by human-caused factors such as water diversions, migration barriers and increased sedimentation rates. Current estimates of abundance are far below historical records for both drainages. The carrying capacity of the habitat is substantially diminished due to sediment incursions and barriers to fish passage. Population trends in the Eel River reflect at least an 80 percent decline in salmon and steelhead from the early 1960's, and roughly a 97 percent decline over the last century. Variability in survival and abundance in the action area is affected by habitat degradation from various causes and habitat losses due to dams. Extensive hatchery programs have been instituted within the ranges of the ESUs, and within the action area, creating conditions for competition, loss of wild stock genetics, and disease transmission to native stocks.

Urbanization has degraded salmonid habitat mainly in the Russian River through stream channelization, floodplain drainage, and riparian damage. In the middle-mainstem Russian River, summer flows are often nearly three times the diversion need and seven times more than natural summer flows. In the Russian River, extensive habitat degradation and decreased carrying capacity, a long history of artificial propagation with the use of non-native stocks, and recent droughts and poor ocean conditions are among the causes for the current low abundance of salmonids. Logging, agriculture and mining activities, urbanization, stream channelization, dams, wetland loss, water withdrawals and unscreened diversions for irrigation have contributed to the decline of salmonids within the Russian River Basin by reducing the survival of all life stages.

The upper mainstem Eel River contains favorable spawning and rearing habitat. Since December 1922, discharges from Lake Pillsbury have artificially maintained summer flows and temperatures downstream to Cape Horn Dam at levels favorable to juvenile steelhead. Enhanced growth rates of juvenile steelhead in the mainstem between the dams have been reported by SEC (1998). Enhanced summer flow from Scott Dam has led to high production of macro-invertebrates for food and provided adequate water temperatures which have led to increased growth rates of juvenile steelhead. Upper mainstem tributaries provide important spawning and rearing habitat for steelhead although growth rates are lower due to a natural hydrologic regime. Currently, winter steelhead have access to about 26 miles of spawning and rearing habitat, including tributaries, above Cape Horn Dam. Fall Chinook salmon appear to be able to access only about 14 miles of habitat within the Upper Eel River basin above Cape Horn Dam (USFS and BLM 1995). Soda Creek has aggraded in the recent past, rendering spawning habitat unavailable to early returning Chinook salmon. Spawning habitat for Chinook salmon is more abundant below the Project than above Cape Horn Dam due to the upstream barrier at Scott Dam.

Under current conditions, critical habitat components for adult and juvenile salmonid migration are not fully functional. The Project impacts the quantity of water available during late spring, early summer, and fall causing migration delays for adult and juvenile salmon outmigrating to the ocean. Chinook salmon habitat in the reach between the dams is not functioning due to cold water releases from Scott Dam during late spring and early summer when water should be warming, which results in slowed growth and delays juvenile Chinook salmon emigrations. Then, when these fish reach the lower mainstem river during the hot summer months, they are exposed to adverse thermal conditions which reduce their survival and outmigration success.

VI. EFFECTS OF THE PROPOSED ACTION

The purpose of this section is to determine if it is reasonable to expect the proposed action to have direct or indirect effects on ESA-listed salmonids and their critical habitat that reduce appreciably the likelihood of their survival and recovery in the wild (i.e., the "jeopardy" standard identified in 50 CFR § 402.2).

The Final ESA Section 7 Consultation Handbook (USFWS and NMFS 1998) includes the following instructions for "Determining the effect of ongoing water projects." When analyzing the effects of
ongoing federal discretionary operations of water projects and water contracts, NMFS is to approach its analysis in the same way that it would analyze a new license or contract, thus considering:

> The total effects of all past activities, including effects of the past operation of the project, current non-federal activities, and Federal projects with completed section 7 consultations, form the environmental baseline;[emphasis in original]
>
> To this baseline, future direct and indirect impacts of the operation over the new license or contract period, including effects of any interrelated and interdependent activities, and any reasonably certain future non-Federal activities (cumulative effects), are added to determine the total effect on listed species and their habitat.

To determine a species' needs, NMFS often looks to historical (or unimpaired flow) conditions as a guide to conditions associated with self-sustaining and self-regulating populations. Where used, these conditions are not necessarily management goals. Instead, they serve as an important reference point for gauging the effects of a project on the species' ability to survive in the current ecosystem. In such cases, a project often has fewer impacts on a species where it minimizes or avoids changes to, and/or mimics the natural conditions to which the species have evolved and adapted to and are necessary for the species' long-term survival and recovery.

The approach used in this assessment is intended to determine if the proposed action is likely to degrade the quantity and quality of habitat necessary to support survival and recovery of the populations of listed salmonids in the action area. The assessment approach is intended to determine if the frequency, duration, and magnitude of impacts carried forward into the future by project operations are likely to impact the size, number, dynamics, or distribution of the salmonid populations in the action area in ways that can be reasonably expected to appreciably reduce their likelihood of both survival and recovery. The most current site specific information has been used where such information exists and reflects the best scientific and commercial data. In cases where information is lacking, NMFS has relied upon the scientific literature to judge likely effects and has provided the benefit of the doubt to the species.

The Final ESA Section 7 Consultation Handbook (USFWS and NMFS 1998) includes the following instructions for proceeding with consultation when there is an absence of conclusive scientific information:

> If the action agency...insists consultation be completed without the data or analyses requested, the biological opinion...should document that certain analyses or data were not provided and why the information would have been helpful in improving the data base for the consultation...The Services are then expected to provide the benefit of the doubt to the species concerned with respect to such gaps in the information base (H.R. Conf. Rep. No. 697, 96th Cong., 2nd Sess.12 (1979)).

By letter dated May 27, 1999, NMFS notified FERC that additional information, in addition to the submitted DEIS[4], would be needed to properly evaluate the effects of the proposed action on listed species and critical habitat pursuant to 50 CFR § 402.14 (g). NMFS informed FERC that proper evaluation of the effects of the proposed action can only be facilitated by a BA that contains reliable data and modeling results. To facilitate the evaluation, NMFS informed FERC that the BA must include the following information:

> 1) An analysis and assessment of the proposed action's impacts on coho salmon[5], including those Project mitigation and enhancement measures (PM&E) that will be implemented to aid in the recovery of coho salmon;

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[4]NMFS, DOI, EPA, SCWA, USFS, and several other agencies and the public provided comments to FERC on the DEIS (a major component of FERC's BA). These comments identified potentially serious flaws in modeling and other aspects of the analysis presented in the DEIS.

[5] Only coho salmon were listed as threatened pursuant to the ESA at the time of this letter. Shortly thereafter, Chinook salmon and steelhead in the Eel River became listed as threatened pursuant to the ESA.

2) An analysis and assessment of the proposed action's impacts to listed species as a result of the associated proliferation of the predatory Sacramento pikeminnow, including PM&E measures that will be implemented to control such predation; and

3) An analysis and assessment of the full range of objectives of, and alternatives to, the proposed project such that alternatives may be best adapted to a comprehensive plan for protection, mitigation, and enhancement (recovery) of anadromous fishery resources, including coho salmon.

On August 19, 1999, FERC maintained that its DEIS and other information available constituted a complete BA. FERC insisted that the requested information was contained in the BA sent on March 5, 1999. At that time, FERC requested that NMFS forward FERC, within 30 days either: 1)concurrence that the proposed action is not likely to adversely affect listed species or critical habitat; or 2) the biological opinion. On September 3,1999, noting that NMFS did not agree that FERC had supplied all the information that is readily available to facilitate review of the potential effects of the proposed action, NMFS initiated formal section 7 consultation.

The FEIS (FERC 2000) did not correct the significant modeling errors, nor did it include a full range of alternatives[6]. Since both the DEIS and FEIS contained significant modeling errors, NMFS relied on modeling of the proposed action conducted by Natural Resource Consulting Engineers, Incorporated (NRCE). A total of 90 years, water years 1910-1999, were simulated for both the proposed action and unimpaired flows using NRCE's model. Therefore, this data was utilized to evaluate the performance of the proposed action, season by season and year by year. It is important to note that the FEIS only modeled 21 years of data while the NRCE modeled 90 years of data.

The scope of the proposed action is a proposal for a flow regime in the Eel River designed to meet PG&E's hydropower needs while protecting and maintaining the fishery resources in the river. This proceeding is an extension of the re-licensing proceeding which concluded in 1983 with instructions to PG&E to operate under a specific flow regime (Article 38) while investigating whether a different flow regime would be necessary protect and maintain the fisheries (Article 39). When FERC considers whether to re-license a hydropower project, it must review the project to ensure it is best adapted to a comprehensive plan for, among other things, the adequate protection, mitigation and enhancement of fish and wildlife, including related spawning grounds and habitat. At the time of the re-licensing proceeding for the Project, there was considerable debate as to how the Project should operate to provide flows adequate to protect and maintain the fisheries in the Eel River. PG&E agreed to implement the flow regime of Article 38 while undertaking studies to determine what flow regime would protect and maintain the fisheries. It is important to note that had this information been available at the time of the re-licensing, the Article 38 flows, flow studies, and this proceeding to amend the flow

[6] NMFS, DOI, EPA, USFS, and several other agencies and the public provided comments to FERC on the FEIS (a major component of FERC's BA). These comments identified potentially serious flaws in modeling and other aspects of the analysis presented in the FEIS.

regime would have been unnecessary. It is also important to note that the license for the Project will be in effect for the next twenty years until 2022 when the license expires. Thus, adverse impacts to salmonids and salmonid habitat caused by the proposed action are expected to persist for the next twenty years or more.

A. Eel River

1. <u>Summer Flows (July through September)</u>

The proposed action would maintain flows in the Eel River below the Project at 5 cfs from July 7 to October 1 of each year. The licensee (PG&E) is not proposing an increase in the summer flow relative to Article 38 due to the assumption that an increase in summer flow will only provide more water and space for pikeminnow populations to survive and expand. However, there is no evidence as a result of the ten-year study or any other study on the Eel River that would indicate that the pikeminnow population is limited by space. The FEIS (FERC 2000) and ten-year study (SEC 1998) did not include a limiting factors analysis to determine if pikeminnow were limited by space. The FEIS also failed to critically examine pikeminnow population differences between flow enhanced and flow restricted areas within the Project. The data that is available suggests that pikeminnow numbers are actually lower and steelhead numbers are actually higher in the reach between Scott and Cape Horn dams where regulated summer flows are higher than the 5 cfs flow below Cape Horn Dam and water temperatures are lower (derived from data presented in SEC 1996a; SEC 1998).

NMFS believes that low summer flows below the Project historically and in recent years have limited salmonids, and at the same time have provided ideal conditions for Sacramento pikeminnow. The proposed action would continue these conditions to the detriment of protected salmonids. When compared to unimpaired flows, proposed low summer flows of 5 cfs, result in dampening within-year and between-year flow variability that is representative of the unimpaired flow patterns within the Eel River. This variability may provide important migration stimuli to salmonids (SEC 1998). On average, proposed flows will be three to seven times less than modeled unimpaired flows, indicating a significant reduction from actual unimpaired flows. Based on 90 years of modeled NRCE data, in some years, especially wet years, the ramp down to summer flows can have drastic effects to the hydrograph. Availability of steelhead summer rearing habitat is reduced from unimpaired flows, and late juvenile salmonid emigration and early adult im migrations may be impeded. The proposed action will have 5 cfs summer flows for the next twenty years which does not allow for more natural summer flows that have within-year and between-year flow variability which is representative of the unimpaired flow patterns within the Eel River. Wet cooler years may provide better emigration and rearing habitat in the mainstem Eel River, the proposed action does not recognize this because 5 cfs summer flows will occur independent of water year type. Also, low summer flows may not allow smooth transitions from spring flows into summer flows and from summer flows into fall flows. It is important to mimic natural flow patterns during both spring and fall migration periods to retain linkages to ecological functionality.

a. Steelhead Summer Rearing Habitat
Depending on water year type, in most years the 5 cfs summer flow would be significantly reduced from actual unimpaired flows. Based on modeled NRCE data for the proposed action from 1910 through 1999, flows would have been reduced from unimpaired flows in 80 out of 90 years, almost 90 percent of the time. Relative to conditions that would be provided for under unimpaired flows, low summer flow releases from Cape Horn Dam reduces and degrades available steelhead summer rearing habitat below the dam. Production of juvenile steelhead smolts in the Eel River from Cape Horn Dam to Outlet Creek appears low due to high summer water temperatures (VTN 1982), most likely resulting in low returns of adults to the reach. Summer water temperatures in the Eel River from Cape Horn Dam to Outlet Creek are greatly influenced by the reduction in flow that occurs at Cape Horn Dam, and generally, temperatures increase with distance from the dam (VTN 1982).

With the exception of the portion of the mainstem Eel River between Scott Dam and Van Arsdale Reservoir, water temperature conditions in the mainstem Eel River from Dos Rios to Cape Horn Dam are generally not favorable to salmonid rearing under historic, current and proposed conditions. Cooler-water releases from Scott Dam provides optimal rearing conditions for steelhead in the mainstem Eel River between the two dams. Releases from Cape Horn Dam reduce water temperatures immediately downstream of the dam to some extent, but not as much as the below Scott Dam (Friedrichson 1998).

Kubicek (1977) classified summer water temperatures in the Eel River for salmonids as marginal from Cape Horn Dam to Tomki Creek and lethal from Tomki Creek to Outlet Creek. This study was conducted in the summer of 1973 when flows released from Cape Horn Dam were at approximately three cfs. Steelhead summer rearing habitat value below the Project is limited by high water temperatures (FERC 2000), and low summer flows of 5 cfs exacerbates this effect. Low flows compound high water temperature problems because a smaller volume of water is more easily heated and cooled, causing larger diurnal changes in the water temperature and dissolved oxygen (Trihey and Associates 1996). Larger diurnal changes in water temperature can induce more stress on salmonids (Davis *et al.* 1963) and low dissolved oxygen levels decrease the rate of metabolism, swimming speed, growth rate, food consumption rate, efficiency of food utilization, behavior, and ultimately the survival of the juvenile steelhead (Reiser and Bjornn 1979).

Evidence suggests that this temperature regime has persisted for at least the last thirty years. Friedrichsen (1999) compared these recent results to similar data from 1973 (Kubicek 1977). The more contemporary temperature pattern was found not to differ significantly from that observed 26 years earlier. Flows from Cape Horn Dam have been regulated during the summer for almost 90 years. During the Kubicek (1977) study, summer flows averaged 3 cfs during summer months. Similarly, summer flows from Cape Horn Dam during the Freidrichsen (1998;1999) study averaged 5 cfs. Therefore, the proposed action would continue these low flow conditions in the mainstem Eel River below Cape Horn Dam for the next 20 years.

Summer low flows below those expected under unimpaired flow conditions artificially constrain available instream habitat, thus concentrating fish populations in smaller areas. The concentration of fish populations increases predation and competition for food and space. Under these crowded conditions, large Sacramento pikeminnow prey on all available food items, including juvenile salmonids, and displace juvenile steelhead from thermal refugia, primarily through predator-prey interactions. Reese and Harvey (2002) have also shown that there are more incidences of interspecific competition between young Sacramento pikeminnow and steelhead in warmer water compared to cooler water in laboratory streams. This low summer flow regime also provides favorable conditions for Sacramento pikeminnow populations by ensuring warm summer water temperatures and slow flowing stream conditions. The Project has two dams and two reservoirs, Sacramento pikeminnow impacts are exacerbated by the presence of dam structures and reservoirs, and by summer thermal conditions and low flows that provide ideal conditions for Sacramento pikeminnow in the reservoir and mainstem Eel River below the Project.

These effects would likely result in decreased survival and increased mortality of summer rearing steelhead below the Project for the next twenty years when compared to conditions that would be provided under unimpaired flows. Therefore, the proposed action would be expected to decrease the numbers and distribution of steelhead below the Project compared to if unimpaired flows were to occur. The effects would be greatest just below Cape Horn Dam and would be expected to decrease linearly with distance from the dam. In addition, the 5 cfs summer flow schedule provides minimal connectivity between areas of suitable salmonid rearing habitats and may impair important ecosystem processes. Important ecosystem linkages such as food-web interactions among salmon, their predators, their prey; nutrient cycles; and overall habitat diversity and quality are affected by stream flows (National Research Council 1996).

b. Adult Migration (summer steelhead and Chinook salmon)

Summer flows would have been reduced from unimpaired flows in 80 out of 90 years. The proposed action of 5 cfs summer flows impacts flows in the lower mainstem Eel River which can affect the immigration success of anadromous salmonids. Adult summer steelhead are immigrating in the mainstem Eel River to the Middle Fork Eel River during this time period, and in some years, Chinook salmon may begin their upstream migration in the Eel River as early as mid-August.

Adult summer steelhead immigrate in the Eel River from March through September (Fukushima and Lesh 1998); therefore, adequate summer flows are required during this time period to allow summer steelhead access to holding areas and natal streams such as the Middle Fork Eel River. Even after adult summer steelhead have reached holding areas, sufficient flows are required to allow for migration among pools as noted by Nielsen *et al*. (1994). The proposed action of 5 cfs summer flows would not provide optimum immigration conditions relative to unimpaired flows for adult summer steelhead migrating in the mainstem Eel River to the Middle Fork Eel River.

Although water temperature is an important factor affecting distribution of holding summer steelhead (Nielsen 1994; Baigun *et al*. 2000), temperature alone does not dictate distribution of summer steelhead (Reviewed in Nakamoto 1994; Nielsen 1994; Baigun *et al*. 2000). Nakamoto (1994) demonstrated that pool dimension, water velocity, and type and amount of cover affect summer steelhead, and that areas of low water velocities and shallow habitats limit the distribution of summer steelhead. Pool dimension, water velocity, and type and amount of cover available for salmonids in the mainstem Eel River are all affected by operation of the Project. Low summer flows of 5cfs release from Cape Horn Dam for the next twenty years would be expected to affect the immigration success and distribution of adult steelhead when compared to unimpaired flows.

The ten-year study (SEC 1998) and the FEIS (FERC 2000) present results and conclusions about Upper Eel River contributions to mainstem flows of Eel River at various downstream sites. The FEIS reports the relative contribution of average unimpaired runoff from above Van Arsdale Reservoir to flows at Scotia and Fort Seward (Figure 1). Gage data records Project flows at Scotia as 9 percent and at Fort Seward as 16 percent of total annual flow. The contribution of Project flows to critical summer flows is even more substantial. The FEIS reports reductions from unimpaired August flow conditions as a 10 percent reduction at Scotia and a 27 percent reduction at Fort Seward. These reductions in flows are directly attributable to Project storage and diversion.

Based on modeled NRCE data for the proposed action from 1910 through 1999, the ramp down to summer flows can have drastic effects to the hydrograph, especially in wet years. The drastic change in the hydrograph could have adverse effects on immigrating adult summer steelhead. In addition, low summer flow releases from Cape Horn Dam may delay adult summer steelhead immigrating to the Middle Fork Eel River in some years.

Late and early seasonal salmonid movements are dependant on flows originating from mainstem and tributary accretion. Chinook salmon may be staging in the ocean near the river mouth and in the estuary as early as mid-August, and are often in the lower river in September. September flows will be held at 5 cfs, and Tomki Creek gaging will not be in full effect until October 15. Early rain events may provide stimulus and water for upstream migrations, and they allow migrations into small natal streams (SEC 1996a). Chinook salmon typically move upstream on increased flows resulting from storm events, and hold in pools as they wait for increased discharges (SEC 1996a). California Department of Water Resources rainfall data for Potter Valley record early (prior to October 1) rain events of more than an inch of rain seven times between 1982 and 1996. Therefore, adult Chinook salmon passage may be impeded by the delay of flows in some years until after October 1, resulting in delayed migration and spawning and may truncate the run timing. Such delays are likely to reduce spawning success by forcing Chinook salmon to spawn lower in the river system in areas that will be subject to redd scour in subsequent high-flow events, or through the increased likelihood of pre-spawning mortality due to increased stress due to the delay. Early access to spawning areas is also important to Chinook salmon because broods from fish that spawn earlier are more likely to hatch and emigrate before the onset of thermally adverse conditions.

Even the FEIS (FERC 2000) identified that in some years low summer flows that persist into the fall could fail to provide enough water for upstream attraction, passage and spawning which could have serious adverse effects on an entire reproductive season. These effects would likely result in an increase in pre-spawning mortality, decrease in spawning success, decrease in fry emergence and thus a decrease in the numbers of Chinook salmon and summer steelhead that survive. This would be expected to decrease the numbers and distribution of salmonids, especially Chinook salmon throughout the mainstem Eel River.

c. Late Emigrating Smolts

During dry periods, contributions to stream flow in the lower river from Project releases could comprise a significant fraction (approximately 40 percent) of the total flow (FERC 2000). However, SEC (1998) asserts that the Project flows contribute little to flows in the lower river. This is true for the proposed action. For example, 20 cfs released from the Project would comprise 7, 15, and 19 percent of the median monthly flow at Scotia for July, August and September, respectively, during the period 1910 to 1997 (USGS, Gage Station 11477000). Therefore, the proposed 5 cfs flow during the summer months would likely contribute a small percentage of flow to the lower river.

During summers under the proposed action, juvenile salmonids that are rearing or migrating in the lower and upper mainstem Eel River will be subjected to 5 cfs releases which limit available habitat and increase migration times along the mainstem, below the Project, resulting in reduced survival of CC Chinook salmon, SONCC coho salmon, and NC steelhead by increasing their exposure to predation and delaying migrations to the lower river and/or to the ocean. However, the Project could contribute a larger proportion of flow, increase available habitat in portions of the river, and decrease migration times for salmonids.

The proposed action would impose summer flows that are regularly lower and annually less variable than unimpaired flows. Consistently low summer flow releases would occur earlier in the season under Project operations than would normally occur under a natural flow regime. Under such operations, the upper Eel River below Cape Horn Dam and mid-river reaches downstream can warm to a greater extent earlier in the season than under higher natural flows (VTN 1982). This accelerated attenuation of flow and warming of water temperatures during late spring/early summer most likely will restrict the period of suitable juvenile emigration conditions and opportunities for summer rearing. Under historic summer releases at Cape Horn Dam of 3 cfs, Article 38 release of 5 cfs and the current interim release of 5 cfs, excessive water temperatures in the Eel River near Fort Seward, may be reached as early as late May, during hot years with low flows, but more commonly occurs during late June and early July. A thermal barrier forms in late spring/early summer near Fort Seward (Kubicek 1977; Friedrichson 1998; SEC 1998) which negatively affects the success of anadromous salmonid emigrations. Current and proposed summer flow releases of 5 cfs from Cape Horn Dam do not represent and are independent of water year type. In some years, these low summer flow release s may influence water temperatures in the mainstem Eel River and may influence the timing of the formation of the thermal barrier. The proposed action would not be expected to improve the baseline condition for late emigrating salmonids and rearing steelhead in the mainstem Eel River.

Based on modeled NRCE data for the proposed action from 1910 through 1999, the ramp down to summer flows can have drastic effects to the hydrograph, especially in wet years. The drastic change in the hydrograph could have adverse effects on late emigrating juvenile salmonids. The importance of summer flows for emigration was illustrated by a case in 1999. Below is an example of how the proposed action would impose summer flows that are not reflective of the water year type and how the artificially low conditions in the mainstem can affect the success of emigrating salmonids from tributaries of the Upper Eel River. In 1999, CDFG found emigrating fall Chinook salmon young-of-the-year in Outlet Creek through June and into mid-July (CDFG unpublished data). This demonstrates that juvenile salmonids can outmigrate well into the summer season of some years and require flows in the mainstem Eel River that are sufficient to complete seaward migrations and provide summer-rearing in the lower river. Project flows, resulting from interim implementation of the proposed action, were reported by CDFG to be about 30 cfs on June 26, and ramping down toward 5 cfs for the summer season. An exceptional blockwater release[7] (not a provision of the proposed action) of 65 cfs ramping down to the Project summer minimum flow of 5 cfs was requested by CDFG and released from the evening of June 27 to July 9. The additional water directly and linearly increased flow at Fort Seward four days later, and at Scotia five days later, then decreased during and after the ramp down. This single Project release may also have decreased water temperatures in the middle mainstem as well, potentially allowing outmigrating salmonids to negotiate an alleviated thermal barrier in the middle mainstem.

Table 4 illustrates that an increase in flow at the Project during blockwater release directly increased flow, shown as percent of Project contribution to flow, at Fort Seward and at Scotia (Figure 1), four and five days after the initiation of the blockwater release. This blockwater release illustrates that Project releases can influence flows and salmonid habitat conditions throughout the Eel River, especially when accretion from tributaries is minimal such as in the summer and fall.

Table 4. Impact of Project blockwater release to the lower mainstem Eel River at Fort Seward and Scotia after initial Project release on June 27, 1999.

Date	Project Contribution at Fort Seward (percent)	Date	Project Contribution at Scotia (percent)
7/1/99	12	7/2/99	7
7/2/99	20	7/3/99	12
Net Increase	8		5

[7] This blockwater release was apparently conducted under provisions of Article 38, and not the interim flow schedule implemented in February 1999.

d. *Summary of Summer Flow Impacts*
NMFS' review indicates that Project releases affect mainstem flow and salmonid habitat in the mainstem Eel River below Cape Horn Dam. Reductions in flow reduce habitat quality and quantity adversely affecting outmigrating Chinook salmon juveniles from all tributaries, including Outlet and Tomki creeks. Project-released summer flows also may impact the mainstem flow below Cape Horn Dam for 117-157 miles in a direct and approximately linear fashion at a rate based upon water year and absence of basin wide rainfall at a much greater than the 10 percent contribution cited by SEC (1998). Project-released flow in this area affects migration conditions and rearing habitat for juveniles of all species in the lower river and estuary and staging, holding, and upstream migration conditions for adult summer steelhead and adult Chinook salmon in the late summer/early fall. These effects would likely result in decreased survival and increased mortality and would be expected to decrease the numbers and distribution of salmonids for the next twenty years. Important ecosystem linkages such as food-web interactions among salmon, their predators, their prey; nutrient cycles; and overall habitat diversity and quality are affected by stream flows (National Research Council 1996). In addition, low summer flows provided by the proposed action serve to support Sacramento pikeminnow populations by providing ideal low-flow, warm water conditions for this predator.

2. Adult Passage and Spawning (Fall/Winter)
Beginning October 1, and continuing to July 1, flows would be driven by the surrogate tributary, Tomki Creek (see section 3 below). The FEIS (FERC 2000) identified that in some years fall flows could fail to provide enough water for upstream attraction, passage and spawning which could have serious adverse effects on an entire reproductive season. Mainstem flows can directly affect mainstem and tributary salmonid populations by providing adequate flows to mainstem and tributary spawning grounds. Inadequate flows can delay and impede upstream migrations of adult coho salmon, Chinook salmon and steelhead. The potential adverse effects from mainstem passage conditions and tributary access are spawning migration delays or straying due to inaccessible natal streams. Since adult salmonids do not feed during their freshwater spawning migration, individuals have a finite amount of energy reserves. Therefore, migration to spawning areas, spawning site selection, redd construction, mate selection, defense of redds, and egg laying could be reduced in effectiveness if access to suitable mainstem or tributary spawning habitat is blocked or delayed. These effects could affect the overall population spawning success and depending on the severity could also negatively affect overall brood year strength.

The FEIS (FERC 2000) presents analysis of the effects of the proposed action on upstream passage of adult salmonids that indicate the proposed action provides three more "passage days" per month than current Article 38 flows. The proposed action is intended to allow for adequate passage flows at the critical riffle above Garcia Creek (SEC 1998), and by setting the cap at 140 cfs, the proposed action would improve on the current 100 cfs cap by allowing flows to exceed 100 cfs under certain circumstances. VTN (1982) had examined the relationship between passage and flows, and observed that a slot 4-ft wide and 0.6 ft deep was sufficient for fish passage over one critical riffle near Garcia Creek (SEC 1996a). Discussions within a Technical Review Committee during the Fishery Review Group process lead to acceptance of this criteria.

Changes in river morphology that may have altered the flows required to provide fish passage have not been checked since the 1982 study, possibly indicating that the criteria established for assessing migration flows may no longer be accurate. Low confidence in the adequacy of the passage flow criteria and the infrequency of attaining those flows during October and November leads NMFS to the conclusion that the proposed action may provide a slight, but probably insignificant improvement for adult passage over interim flows provided under the current Article 38.

Article 38 flows can "significantly delay an increase in minimum flows" and impede adult Chinook migration (SEC 1998). The FEIS (FERC 2000) also identifies that the proposed action may fail to provide sufficient fall migration pulses in some years, resulting in possible loss of reproductive success. Therefore, it follows that the proposed action will also result in delayed spawning migrations and reduced Chinook salmon survival and possibly reduced coho salmon survival in some years under the proposed action. Delayed spawning migrations could increase the incidence of pre-spawn mortality of adult salmonids. At the proposed September flow of 5 cfs, adult Chinook salmon passage will also be impeded in many years. Unable to reach their natal areas, Chinook salmon will spawn as far upriver as they can. Because low flow conditions may limit spawning to lower mainstem habitats, eggs and fry may be exposed to a greater risk of injury and mortality during high mainstem flows (SEC 1996a).

Based on modeled NRCE data of the proposed action, flows in some winters would have fluctuations and extremely low flows (even with the use of blockwater) which can affect the success of spawning, incubation and early rearing. The water years that illustrate this effect are as follows: 1911, 1912, 1918, 1920, 1924, 1976, 1977 and 1991. These fluctuation and low flows (compared to unimpaired) can delay migration, limit available mainstem spawning habitat, dewater redds, strand juveniles, and may crowd more fish together increasing competition and predation. These effects would be realized and more pronounced in some years, while in other years these effects would be limited or may not occur. Effects in some years could be detrimental to the year class.

a. Blockwater

The proposed action proposes that 5,000 ac-ft of blockwater be used for minimum flow augmentation purposes from December 1 to March 31 or until the 5,000 ac-ft is expended. This time period is crucial for the success of several salmonid life history stages: spawning, egg incubation; juvenile rearing and juvenile emigration.

The original blockwater target flow during the Fishery Review Group process was 100 cfs, but the blockwater size was not sufficient to meet this target in many years. The proposed action specifies a variable blockwater target flow of 1.4 times the average release below Cape Horn Dam during the last three weeks of November or 100 cfs, whichever is less. However, this method of flow augmentation is not adequate for the following reasons: (1) the blockwater target flow is inadequate to meet the needs of spawning and/or incubating salmonids in some years, (2) the blockwater size is insufficient to maintain the blockwater target flow in some years, and (3) if the blockwater is used for any other purpose (e.g. providing pulse flows), the remaining blockwater may not be sufficient to meet the minimum flow augmentation purposes. These unnecessary flow fluctuations have a greater potential to negatively affect redds and rearing habitats for young salmonids, which may result in premature dispersal of the young fry from the affected reaches. In some years, the minimum flow fluctuations can be of sufficient magnitude to cause dewatering of redds during the principal spawning and egg incubation season. The dewatering of redds has the potential to decrease the survival of the eggs and developing fry, and if severe enough could greatly influence the strength of the year class.

Since the use of blockwater is limited to 5,000 ac-ft and can only be used from December 1 through March 31, there is potential for the blockwater to be used up early in this time period. This may result in low flows and adverse impacts to salmonids during the crucial incubation and early rearing life history phase. It is also possible that since blockwater will be used under the discretion of the resource agencies, human error can occur which can negatively affect the actual provision of the blockwater. The uncertainties associated with the utilization of blockwater under real-time scenarios could ultimately reduce the intended benefits of blockwater. Therefore, the use of blockwater for flow augmentation purposes could result in adverse impacts to salmonids thereby reducing the biological performance of the proposed action. These effects would be expected to decrease the numbers and distribution of coho salmon, Chinook salmon and steelhead throughout the mainstem Eel River.

3. <u>Use of Tomki Creek Gaging as Eel River Flow Surrogate</u>
Under the proposed action, Eel River flows below Cape Horn Dam would be adjusted at least daily from October 1 through June 30 in response to natural flows in Tomki Creek based on a calculated relationship between Tomki Creek and unimpaired Eel River flows. Use of Tomki Creek gaging to trigger flows below Cape Horn Dam results in the muting of fall, winter, spring, and summer flows with attendant impacts on upstream migrating adult salmonids, spawning success, and rearing and emigrating juvenile salmonids. One intent of the Tomki-based flow schedule proposed by PVID and PG&E is to mimic important elements of the natural hydrograph of the Eel River below the Project. Upon review of available information, NMFS believes Tomki Creek gaging to be a poor surrogate for predicting the magnitude and timing of Upper Eel River natural unimpaired flow.

Flows in the Tomki Creek and Upper Eel River basins behave differently based on the significant size and hydrological differences between them (Figure 3). The headwaters of the Eel River receives an average of 70 inches of rain per year at and near the basin divide (USGS 1969). The Upper Eel River Basin above Scott Dam drains 288 square miles which is significantly larger than the Tomki Creek Basin which only drains 66 square miles (Figure 3). Approximately 92 percent of the 288 square mile drainage area above Scott Dam is in the Mendocino National Forest and Snow Mountain Wilderness (Figure 3). The range of elevations are also significantly different between the two basins. Elevations range from 1,760 to 7,000 feet in the Upper Eel River Basin, while in the Tomki Creek Basin, elevations only range from 1,400 to3,500 feet (Figure 3). In the Upper Eel River above Scott Dam, there are approximately 38 square miles (13 percent) of land at or over 5,000 feet in elevation (Figure 3). At 5,000 feet and above, snowpack is dependable and remains through May and into June many years, but is nearly always melted by mid-July. Average snow fall accounts for 17.1 inches of water on April 1 (DWR 1995). Tomki Creek is a rain driven system with no snow. The precipitation ranges from 37.5 to 75 inches per year in the Upper Eel River Basin above Scott Dam and from 45 to 55 inches per year in the Tomki Creek Basin (Figure 3). The average annual precipitation differs as well, at 54.2 inches per year for the Upper Eel River Basin above Scott Dam and 45.3 inches per year in the Tomki Creek Basin (Figure 3).

Although the average annual precipitation is not significantly different between the two basins, the ranges in precipitation clearly illustrate that there are differences in the hydrograph. These differences can be explained by differences in topography which influences the amount and duration of rain fall. There are two basic effects on precipitation caused by mountains, the "orographic" effect and the "rain shadow" effect (Satterland and Adams 1994). The orographic effect occurs when a moving air mass is forced over a topographic barrier which causes rainfall amounts to increase dramatically as you move farther up the mountain on the windward side (Satterland and Adams 1994). The rain shadow effect is where precipitation amounts drop significantly on the leeward side of a mountain (Satterland and Adams 1994). The Upper Eel River Basin above Scott Dam has higher elevations and a mountain range on the windward side which can increase the intensity and duration of individual storm events due to orographic effect. The Tomki Creek Basin, on the other hand, is on the leeward side of a mountain range and may be in the rain shadow decreasing duration and intensity of rain storms.

Therefore, the Upper Eel River hydrograph is not readily mimicked from Tomki Creek gage input because of the size difference between the two basins, different hydrograph and the fact that a substantial amount of winter precipitation in the Upper Eel River Basin falls in the form of snow. The proposed action does include a modifier to Tomki Creek flows which is intended to produce a flow similar to that of the Upper Eel River, but it does not reflect the different geology, topography or hydrographic patterns between the two basins.

During spring, the snow in the Upper Eel River basin melts and runs off, as does a greater percentage of spring rain (because the shallow aquifer is saturated). Then during the dry season (Table 5), continued snowmelt and baseflow from the aquifer would keep the Upper Eel River flowing an average of 132 cfs during June, 40 cfs during July, and 17 cfs throughout August and September at Cape Horn Dam gage E-11 (DWR 1976). In comparison, the proposed action would release 5 cfs from July 7 to October 1. NMFS has presented other “preliminary” analyses, that have been filed with FERC, examining the relationship between Tomki Creek and the Upper Eel River basins, and has been criticized by PG&E and others for its use of limited available data sets.

The assertion of NMFS that the hydrology of the two basins is significantly different, and would not be good surrogates for each other, remains valid. A significant component of precipitation in the Upper Eel River basin above Lake Pillsbury falls as snow, whereas the Tomki Creek discharge is strictly rain driven. These differences, and the vastly different basin areas, result in seasonal differences in hydrology. Differences between the two basins would be particularly troublesome in the fall before the ground is saturated (Balance Hydrologics, Inc. 1998) when run-off and high flow events will be unpredictable and flashy for both systems.

In some years, the proposed action would not provide adequate spring flows when compared to unimpaired flows. The spring flow ramping is linear and has artificial steps which can reduce emigration success. Based on modeled NRCE data for the proposed action, water years 1913, 1914 and 1916 have two artificial steps in the hydrograph, other years have a single less pronounced artificial step. Spring flows under the proposed action can also result in low flatline flows during the crucial emigration period. Water years, 1926, 1929, 1976, 1977, 1981, 1987 and 1992 illustrate that flows under the proposed action would be low and flatlined from the end of May through the end of June. Therefore, the proposed action, in some years would not provide optimum flows extending into summer to facilitate timely salmonid emigration. On average, the proposed action would result in lower flows than those expected under unimpaired conditions, reducing opportunities for juvenile salmonid emigration and rearing.

Table 5. Average monthly diversion rates of the Project under the Proposed Action; June through October (from FERC 2000; DWR 1976).

Month	Unimpaired Flow[8] (cfs)	Bypass Flow[9] (cfs)	Diversion Rate
June	132	~45	~65%
July	40	5	88%
August	17	5	71%
September	15	5	67%
October	64	~35	~45%

Adverse effects result from use of Tomki Creek as a surrogate in the spring and early summer as well as in the fal and winter. Upper and middle Tomki Creek may be dry or minimally accreting from June to October during many years. Model runs in SEC (1998 - appendices III-2 and IV-1) show that gaging Tomki Creek to predict Upper Eel River flow may identify pulses caused by large storm events, but migration conditions in the Eel River mainstem below the Project are too frequently reduced to low flow conditions that are far below modeled unimpaired flows. The

[8] PG&E has modeled unimpaired flows for the Eel River at the Project, however, in Table 3 unimpaired indicates flows that would occur if the Project were not in place. The values reported are from DWR, 1976 as reported by FERC.

[9] Bypass flows are the discharges released from the Project into the Eel River; measured immediately below Cape Horn Dam; gage E-11.

proposed action would release a minimum floor-flow of 35 cfs in the month of June at a much higher frequency than would occur naturally, which would be of some benefit to salmonids. The proposed minimum floor-flow of 35 cfs provides for less than 25 percent of the maximum potential physical habitat conditions for spawning/incubation steelhead and Chinook salmon based on the Instream Flow Incremental Methodology analysis conducted by DOI. The proposed action, including this minimum floor-flow, results in a modeled monthly average of approximately 80 cfs during June. However, modeled unimpaired flows from the Upper Eel River would average 132 cfs during June (Table 5), indicating that despite some gains in the lower flow ranges, the proposed action is not expected to provide the high flows that can occur in an unimpaired system.

Based on 90-years of modeled NRCE data for unimpaired flows, unimpaired Upper Eel River flows would sustain conditions suitable for migrating salmonids during spring and early summer and possibly mainstem rearing salmonids year-round, whereas Tomki Creek hydrology will not trigger the release of necessary flows. Using a Tomki Creek surrogate, and a 35 cfs floor will result in low flows during the month of June reducing survival of SONCC coho salmon, CC Chinook salmon, and steelhead during critical juvenile fish migration periods. Similarly, the effect on fall flows would be chronic and continuous year after year, and would result in delayed upstream migration and significant adverse impacts to CC Chinook salmon and early migrating SONCC coho salmon. Not only would these effects be expected to affect mainstem populations of Chinook salmon, tributary populations of coho salmon, Chinook salmon, and steelhead could also be affected. These effects would be expected to decrease the numbers and distribution of coho salmon, Chinook salmon and steelhead throughout the mainstem Eel River.

5. <u>Pikeminnow</u>

Sacramento pikeminnow were introduced into the Eel River system around 1979. Since that time, this introduced predator has colonized much of the mainstem, and has infested the Van Duzen River and the South Fork Eel (Brown and Moyle 1991), both major tributaries. CDFG (1999 unpublished data) has conducted snorkel surveys of various reaches of the Eel River and South Fork, and reports a prevailing trend that where large pikeminnow are found, steelhead are not found, and that the converse trend is also apparent. The implication is that Sacramento pikeminnow have displaced summer rearing steelhead, possibly aided by adverse habitat conditions for salmonids. Salmonids are known to be a component of the pikeminnow diet in the Eel River (Brown and Moyle 1997), and it is reasonable to assume that salmonids are preyed upon, and face competition from pikeminnow. In fact, it is widely held that pikeminnow constitute a major obstacle to the recovery of salmonids in the Eel River system.

The FEIS (FERC 2000) asserts that the introduction and invasion of pikeminnow into the Eel River represents the second-most causal factor for the decline of anadromous salmonids, but this assertion was not analyzed in the FEIS. All species of wild anadromous salmonids in the Upper Eel River were reduced to very low population numbers before 1979, when pikeminnow are thought to have been introduced. Of the 27 years of Chinook counts before 1979 at VAFS, fully 19 of those years had fewer than 20 adult returns. Estimated wild steelhead returns at VAFS averaged far less than 1,000 fish since 1960 and Upper Eel River coho salmon returns were already estimated to be reduced to 500 fish by 1964 (CDFG 1965).

Based upon effective predation size, habitat use, and life history differences, pikeminnow may prey extensively on young salmonids but primarily in a highly-localized and seasonal manner (Faler *et al.* 1988; Dettman 1976; Brown and Moyle 1997; reviewed by Brown and Moyle 1981). Studies in the Snake and Columbia rivers show predation rates are highest at mid-reservoir, dam forebays, and dam tailraces, which provide altered flow, temperature, habitat, and cover for pikeminnow and tend to disorient juvenile salmonids (Faler *et al.* 1988). Diet analysis of Sacramento pikeminnow in the Sacramento River around the Red Bluff Diversion Dam, showed that salmonids outweighed other food sources only in the summer months (Tucker *et al.* 1998). Recent unpublished research by the USFS found that salmonids comprised minute fractions of pikeminnow diets throughout the Eel Basin (even for large individuals during salmonid migration seasons) and that primary forage consisted of aquatic and terrestrial insects and decapods. Brown and Moyle (1997) found that Eel River pikeminnow preyed upon migrating salmonids opportunistically during spring migration periods, but sample sizes were small and growth rates of the recently introduced and expanding populations were not different from pikeminnow in other systems. Anadromous salmonid behaviors and life histories are adapted to avoid and confuse such resident predators by early-rearing in small tributaries, migrating in schools (especially coho salmon; Shapovalov and Taft 1954) at night, during high flows, at colder water temperatures, and in peaked runs. These behaviors of migrating juvenile salmonids quickly satiate pikeminnow and other potential predator guilds during salmonid migration while allowing most of the migrating school to escape predation.

Flow perturbations, especially reductions, increase the relative effectiveness and impact of pikeminnow predation on salmonids by grouping more juveniles in the mainstem for longer durations at migration and rearing times, redistributing spawning adult salmonids to the mainstem, narrowing and simplifying the migration corridor, and increasing temperatures (Faler *et al.* 1988). In the Eel River under present conditions, rearing wild steelhead are in proximity with pikeminnow for extended periods, and exposed to unnaturally high pressure from predation and competition reducing their numbers. The proposed action will not improve present conditions in summer months, therefore, these effects are expected to continue for the next 20 years.

B. Russian River

Effects of the proposed action to listed salmonids and critical habitat in the Russian River Basin are limited to the river reach below Coyote Dam. Although East Branch Russian River flows through Potter Valley will be altered from their pattern and volume under Article 38, there are no listed salmonids currently found in the reach between the powerhouse tailrace and Coyote Dam. Three species of listed salmonids are found below Coyote Dam: CC Chinook salmon, CCC coho salmon, and CCC steelhead.

Currently, high summer flows (generally exceeding 125 cfs) result in an adverse effect to juvenile salmonid habitat in the Russian River. It has been determined that flows higher than 83 cfs are likely to eliminate or completely mix stratified pools containing cold water refugia that rearing juveniles may best use to over-summer (DWR 1976; Nielsen *et al.* 1994; SEC 1996b). A range of flows that follow the natural flow regime is most beneficial to protect native fishes (Poff *et al.* 1997). The unnaturally-high flows provided as a result of Project releases into the East Branch Russian River adversely affect rearing juveniles by increasing water temperatures through the mixing of stratified pools, which increases vulnerability to disease, and proliferation of predatory and competing introduced species. High flows also alter invertebrate communities, channel morphology, and geomorphologic function, as well as negatively effecting critical habitat by reducing riparian vegetation by 30 percent and altering sediment transport (SEC 1996b; Poff *et al.* 1997).

Changes in the operation of Coyote Dam or deliveries of water to the lower Russian River may occur as an indirect result of the proposed action. State Water Resources Control Board (SWRCB) Decision 1610 prescribes summer flows at nearly the same rate as Project diversions from June through September (SWRCB 1986). Due to the proposed annual average fifteen percent decrease in the amount of water that is diverted annually, Decision 1610 may have to be reevaluated and new summer flows may have to be established. Also, NMFS is currently in section 7 consultation with the Army Corps of Engineers and the Sonoma County Water Agency which may also affect the operation of Coyote Dam. However, information detailing the likelihood and magnitude of these indirect effects is not available at this time. A reduction in flows necessitated by the reduction of Project diversions in the Russian River, particularly in summer months, may be viewed as somewhat beneficial to salmonids, especially juveniles.

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

A. Timber Harvest

Timber harvest activities are a major human activity in the Eel River Basin, but minor in the Russian River Basin. Future timber harvest levels in the action area cannot be precisely predicted, but it is assumed that harvest levels on private lands in Humboldt, Mendocino, and Lake counties will be within the approximate range of harvest levels considered in the Environmental Baseline of this biological opinion.

Reasonably foreseeable effects of timber harvest activities, including the direct, indirect, and cumulative effects of timber harvesting, may degrade habitat features identified as essential for designated coho salmon critical habitat. Improved watershed management by Private landowners, as discussed below, within the action area is expected to decrease sediment delivery to salmonid bearing streams. Restoration efforts to improve juvenile salmonid habitat quality and riparian habitat function should improve the success of juvenile rearing to smolt stage.

B. Road Construction and Maintenance

In the Eel River Basin, construction of private and county unsurfaced roads are a significant source of sediment input into streams that are habitat for listed salmonids. The level of new road construction cannot be anticipated, but it is expected to continue at a slightly lower level than has occurred in the recent past. Impacts from roads associated with timber harvest operations should decline due to the increased emphasis on protection of aquatic resources and implementation of higher standards for road construction, maintenance and use.

On March 15, 2000 the California Board of Forestry (BOF) adopted changes to the California Forest Practice Rules which are in effect until June 2001. The additional rules will provide slightly more protection for riparian zones, aquatic habitat, and put additional restrictions on roads and landings. Private landowners conducting timber operations within the Eel River basin will be required to follow the amended rules which have been temporarily adopted by the BOF.

C. Sacramento Pikeminnow Suppression Measures

A private group known as the Upper Eel Watershed Forum, has established a Sacramento pikeminnow fishing derby and offers anglers bounties for Sacramento pikeminnow turned in to receiving stations. The fishing derby is scheduled at times of the year, and conducted in areas such that impacts to anadromous salmonids are minimized. The effects of this proposed program are thought to be beneficial to listed species in the Eel River system.

D. Agriculture

Agricultural activities include grazing, dairy farming and the cultivation of crops. The recent upward trend in the value of dairy and wine related agricultural products is likely to continue as human populations increase, and these industries are expected to persist in the Eel and Russian river basins.

The impacts of this land use on aquatic species include decreased bank stability, loss of shade- and cover-producing riparian vegetation, increased sediment inputs, and elevated coliform bacteria levels.

In the Russian River Basin, where wine grape cultivation is most intense, there are six hydrologic subunits that are dependent on the river for water supply. Beach (1996) reports that all of the service area subunits will increase their water demands by the year 2015. In the Russian River basin, increasing water demand will likely continue the need for flows well above unimpaired in the mainstem which will continue to adversely impact salmonids, as described previously in the Environmental Baseline and Effects of the Action sections of this opinion. The rapid increase of vineyard development within the Russian River basin and possibly the Eel River basin will continue to impact salmonid habitat by increasing sediment delivery to streams, diverting stream flow, and encroaching on riparian habitat.

E. Urban Development

Impacts to salmonids from urban and suburban development include loss of riparian vegetation, changes in channel morphology and dynamics, altered watershed hydrology, increased sediment loading, and elevated water temperatures. Impacts in the Eel River Basin are not expected to increase substantially over current levels because relatively slow growth is anticipated. In the Russian River Basin, increasing water demand will likely continue the need for flows well above unimpaired in the mainstem which will continue to adversely impact salmonids. Suburban or rural development which relies on the development of private roads may cause the most impact due to problems with maintenance of these private roads.

F. Water Withdrawals

An unknown number of permanent and temporary water withdrawal facilities exist within the action area. These include diversions for urban, agriculture, commercial, and residential use. Impacts from water withdrawals include entrapment and impingement of younger salmonid life stages, localized dewatering of reaches, and depletion of flows necessary for migration, spawning, rearing, flushing of sediment from spawning gravels, reduced gravel recruitment, and transport of large woody debris. Water diversions are expected to be conducted under applicable State and Federal laws.

G. Chemical Use

It is anticipated that chemicals such as pesticides, herbicides, fertilizers, and fire retardants will continue to be used in the action area. Impacts to salmonids may include changes to riparian vegetation and associated organic input into aquatic systems, changes in aquatic invertebrate communities, and increased algae and phytoplankton. Due to the lack of specific information we are unable to determine the effects of chemical applications in the action area. Use of chemicals is expected to be conducted under applicable State and Federal laws.

H. California Stream Bed Alteration Agreements

The CDFG has recently strengthened the permitting process for activities taking place in, or in the vicinity of, rivers and streams by requiring environmental review. Henceforth, stream bed alteration agreements are now reviewed in accordance with the California Environmental Quality Act. The implementation of this new program is expected to result in lessened impacts to salmonids from projects such as temporary summer crossings, culvert installation, gravel extraction, and stream bank stabilization projects within the action area.

I. Habitat Restoration Projects

Restoration activities may cause temporary increases in turbidity and alter channel dynamics and stability (Habersack and Nachtnebel 1995; Hilderbrand *et al.* 1997; Powell 1997; Hilderbrand *et al.* 1998); these effects may temporarily stress salmonids. Misguided restoration efforts often fail to produce the intended benefits and can even result in further habitat degradation. Improperly constructed projects typically cause greater adverse effects than the pre-existing condition. The most common reason for this is improper identification of the design flow for the existing channel conditions. However, properly constructed stream restoration projects may increase available habitat, habitat complexity, stabilize channels and streambanks, increase spawning gravels, decrease sedimentation, and increase shade and cover for salmonids. The CDFG has produced a manual for stream restoration projects in California (see CDFG 1998b) providing guidance to maximize benefit to salmonids while minimizing risks. The negative effects of habitat restoration activities on anadromous salmonid populations within the action area are probably temporary and minor. Overall, habitat restoration projects are considered to be beneficial to the restoration and recovery of at risk populations. Multiple restoration projects have occurred within the Eel River Basin over the last decade. This has resulted in better habitat conditions for salmonids in the areas where restoration has occurred. The CDFG (CDFG 1997) has also produced a Draft Eel River Salmon and Steelhead Restoration Action Plan that identifies areas and types of restoration needed to improve habitat conditions for salmon and steelhead. Future restoration efforts are expected to be beneficial for salmonids and should aid in the recovery of Eel River salmonids.

VII. INTEGRATION AND SYNTHESIS OF EFFECTS

As noted above, NMFS often relies on historic, or unimpaired, conditions as a guide to the conditions under which a species best survives and which are therefore associated with self-sustaining and self-regulating populations. To complete their freshwater life cycle in the Eel River, Chinook salmon, coho salmon, and steelhead must first migrate as adults up river and tributaries to spawning habitat. Enough eggs and alevins must survive to become juvenile fish, many of which in turn must survive over at least one summer to become smolts during the next winter's rains. Enough smolts must survive migration and reach the ocean to ensure sufficient numbers of returning adults to repeat the cycle. In general, egg to smolt survival in salmonids ranges from 1 to 7 percent. Survival in the ocean has been estimated at 1-2 percent (Bradford 1995). These numbers are reported here to emphasize the importance of survival at each life stage especially in light of the small size and continuing decline of the Eel River salmonid populations and the SONCC coho salmon, CC Chinook salmon, and NC steelhead ESUs. Such a small population may also be characterized by a lack of genetic diversity which negatively impacts the species' fitness, including its adaptability, reducing the chances of the population's survival in the face of environmental changes (National Research Council 1996). For a population to survive it must produce sufficient numbers of individuals at all life stages and/or age classes to maintain itself into the future regardless of expected environmental and human impacts. Habitat must provide all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter. With populations existing close to the southernmost extent of their range and their environmental tolerance limits, relatively minor changes in key habitat characteristics can influence population viability (National Research Council 1996).

Chinook salmon populations in the Eel River have declined from 55,500 fish estimated in 1964 to an average of less than 5,000 fish over the past ten years. Results of surveys conducted since the mid-1960's in Sprowl Creek and Tomki Creek indicate both short- and long-term trends in abundance are severely declining. Shorter-term monitoring in other tributaries over the past 10 years also indicate precipitously declining abundance (NMFS 1999 unpublished data). In 1964, CDFG estimated Eel River Chinook salmon spawning escapement at 55,500, which represents 73 percent of the Chinook salmon production within the CC Chinook salmon ESU (CDFG 1965). These numbers indicate that the Eel River Chinook salmon population is important to the overall survival and recovery of the CC Chinook ESU.

Coho salmon are also in a precarious position having been extirpated from much of the Eel River system except for in the South Fork Eel River and a small remnant population in Outlet Creek (CDFG 2002). Recent population estimates of natural SONCC coho salmon of 10,000 (62 FR 24588), when compared to estimates by NMFS of Eel River coho salmon runs of less than 1,000 fish (approximately 10 percent of the ESU) indicate that the Eel River coho salmon population is important to the overall survival and recovery of the SONCC coho salmon ESU.

Steelhead have also suffered drastic declines in the Eel River through the last century. The most recent data show current abundance is well below estimates from the 1980s, and even further reduced from levels in the 1960s (65 FR 6960). Spawners in excess of one-half million steelhead where estimated for 1900 (FERC 2000), however NMFS estimates fewer than 9,000 in recent years. Eel River steelhead spawning escapement in 1964 was estimated at 82,000, about 41 percent of the overall production within the NC steelhead ESU (Busby *et al.* 1996). Again, these numbers indicate that the Eel River steelhead population is important to the overall survival and recovery of the NC steelhead ESU.

Therefore, the Eel River is important for the overall survival and recovery of the CC Chinook salmon ESU, SONCC coho salmon ESU and NC steelhead ESU. Eel River populations of Chinook salmon, coho salmon, and steelhead have likely lost much of the resiliency necessary for both survival and recovery. Self-sustaining and self-regulating Eel River populations will be necessary for the survival and recovery of these ESUs.

Operations of the Potter Valley Project can potentially affect several salmonid life history stages: migrating adults, spawning adults, incubating eggs, rearing fry and juveniles, and migrating smolts. Impacts to coho salmon, Chinook salmon, and steelhead populations stem from Project operations which diminish or destroy the quality of salmonid habitat in the Eel River through reduced flows and altered hydrographic patterns. Perturbations resulting from the proposed action, especially low 5 cfs flows in July, August, September, and depleted flows produced by Tomki Creek gaging in June and October would likely be accompanied by continued declines in salmonid abundance as high temperatures and predation would continue to take a toll on emigrating salmonids, and proposed low flows would also impede adult upstream immigrations and juvenile emigrations. Five cfs summer flows (July 7 through September 30) provided by proposed action will rule out, for the remaining life of the FERC license (20 years), any potential increase in steelhead summer rearing below the Project to possibly Outlet Creek by limiting wetted habitat, exacerbating marginal thermal conditions, and creating favorable conditions for Sacramento pikeminnow. Low flows also exacerbate thermal impacts downstream of the Project, and upset other important ecological linkages, such as riparian functions and river form and function which affect rearing and holding habitat, and fish passage.

In summary, the proposed action will directly affect mainstem and tributary populations of Chinook salmon, coho salmon and steelhead by muting natural flow events and providing inadequate spring, summer, and fall flows to river reaches below the Project. Adequate flows for emigrating Chinook salmon young-of-the-year, and coho salmon and steelhead smolts are not provided by the proposed action. The Project will divert 80 percent of the average unimpaired summer flow, which will cause significant and direct reductions to flow in the river below the Project. In addition, the Project will continue to provide nursery habitat and optimal habitat conditions for juvenile and adult pikeminnow, allowing benefits to the pikeminnow population to the detriment of juvenile salmonids. As a result, the survival and abundance of several freshwater life history stages of Chinook salmon, coho salmon, and steelhead would be expected to decrease and appreciably reduce the likelihood of survival and recovery.

Continuing Project impacts to these small populations can be expected to prevent them from increasing, thereby reducing the likelihood they would persist into the foreseeable future in the face of natural and human-caused environmental variability. To re-establish self-sustaining populations of Eel River salmonids, Project impacts that impede spawning and rearing success rates would have to be avoided or minimized to the maximum extent possible. Summer flows that more closely mimic the natural hydrograph, including inter-annual variability, would benefit steelhead and possibly Chinook in some years, and would also support important ecosystem linkages that will further benefit all Eel River salmonids.

Due to the proposed action's adverse effects on the quality and functioning of critical habitat in the Eel River, it is reasonable to expect the proposed action to appreciably reduce the likelihood of survival and recovery of the SONCC coho salmon, CC Chinook salmon, and the NC steelhead ESUs by reducing their numbers, reproduction, and distribution, and would serve to keep these populations at low levels, increasing their vulnerability to demographic, genetic, and environmental extinction factors.

VIII. CONCLUSION

After reviewing the current status of listed species in the action area including the SONCC coho salmon, CCC coho salmon, CC Chinook salmon, NC steelhead, and CCC steelhead; the environmental baseline for the action area; the effects of the proposed action; and the cumulative effects, it is NMFS' biological opinion that the action, as proposed, is likely to jeopardize the continued existence of the SONCC coho salmon, CC Chinook salmon and NC steelhead; and is likely to adversely modify designated SONCC coho salmon critical habitat. With respect to salmonids in the Russian River, it is NMFS' biological opinion that the action, as proposed, is not likely to jeopardize CCC coho salmon or CCC steelhead, or result in the destruction or adverse modification of designated CCC coho salmon critical habitat.

IX. REASONABLE AND PRUDENT ALTERNATIVE

Regulations (50 CFR § 402.02) implementing section 7 of the Act define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that: (1) can be implemented in a manner consistent with the intended purpose of the action; (2) can be implemented consistent with the scope of the agency's legal authority and jurisdiction; (3) are economically and technologically feasible; and (4) would, NMFS believes, avoid the likelihood of jeopardizing the continued existence of listed species or the destruction or adverse modification of critical habitat.

DOI and NMFS filed extensive comments on the original PG&E proposal to FERC in 1999 prior to completion of the DEIS. These comments addressed a number concerns regarding the PG&E's proposed flow schedule and implementation/compliance plan. Although PG&E responded to the these comments, they were not adequately addressed. Similarly, the DEIS issued by FERC did not address or attempt to resolve any of these concerns either. Since PG&E and FERC did not address these comments, DOI and NMFS conducted additional technical studies based on modeling and analyzing PG&E's proposal for water years 1929 through 1995. On the basis of these studies, DOI and NMFS developed an alternative proposal which was designed to provide optimal protection to salmonids in the Eel River and thus, satisfy objectives of Article 39. DOI and NMFS submitted this proposal to FERC in April 1999 (DOI/NMFS proposal) for their consideration and for inclusion in the FEIS as an alternative. The FERC included and analyzed the DOI/NMFS proposal in the FEIS, however, a major modeling error occurred in the FEIS that affected the analysis of the DOI/NMFS proposal.

NMFS along with various other parties (DOI, Round Valley Indian Tribe (RVIT), SCWA, USFS, EPA, Cal Trout and various private citizens) provided comments to FERC regarding the analyses of the various alternatives in the FEIS. Many of the comments focused on the modeling errors, concerns involving the long-term sustainability of the Project, the range of alternatives analyzed, data gaps in the environmental impacts analysis, and the relative weight given to various balancing factors. Specifically, in FERC's analysis of the DOI/NMFS proposal, the cumulative flows into Lake Pillsbury were erroneously calculated based on the PG&E unimpaired flow data set, rather than based on the raw United States Geological Survey (USGS) data as specified in the DOI/NMFS proposal. Due to a significant and unjustified discrepancy between PG&E's unimpaired data set and the USGS-based unimpaired data set, the Exceptionally Dry Year criteria and the PVID curtailment criteria were not implemented in the modeling performed for the FEIS. As a result, FEIS modeled runs of the DOI/NMFS proposal show minimum Lake Pillsbury storage at 652 ac-ft in sediment-year 2000 conditions, and zero storage in sediment-year 2020 conditions in a water year similar to water year 1977. By using nominal cumulative inflow derived from USGS data, minimum Lake Pillsbury storage levels are actually much higher than what was presented in the FEIS; 14,000 ac-ft for sediment-year 2000 conditions and 13,000 ac-ft for sediment-year 2020 conditions. Therefore, if the DOI/NMFS proposal was analyzed correctly in the FEIS, it would have clearly shown that the proposal would not result in the dewatering of Lake Pillsbury in a water year such as 1977.

The FEIS evaluated each alternative in terms of the benefit that would accrue to fish resources in the Upper Eel River and the Upper Russian River, and the costs each action would impose on other water users, especially in the Russian River Basin (FERC 2000). Although there are modeling and technical errors in the FEIS, it did conclude that the DOI/NMFS proposal would improve the physical habitat for andromous salmonids in the Upper Eel River, and would be more beneficial over all the other alternatives (except the RVIT proposal), especially in drought years and in summer months (FERC 2000). However, due to the modeling errors mentioned above that suggested that the DOI/NMFS proposal would dewater Lake Pillsbury in an extremely dry year and due to economic impacts to water users in the Russian River, the PVID proposal was chosen as the proposed action.

The purpose of the proposed action is to modify the temporary Article 38 flow regime and Project structures "for the protection and maintenance of salmonid fishery resources in the Eel and Russian rivers" (Article 39) to achieve a flow regime and operational system which meets the Project's purposes and complies with Section 10 of the Federal Power Act. The DOI/NMFS proposal was developed through step-by-step modifications of the original PG&E proposal that was analyzed in the DEIS (FERC 1999). The key feature of both the original PG&E proposal and the PVID proposal analyzed in the FEIS (FERC 2000), namely the concept of mimicking the natural hydrograph between the floor and cap envelopes, has been retained and improved upon with some modifications. It is NMFS' position that the proposal submitted to FERC by DOI and NMFS dated April 27, 1999[10], with certain modifications introduced below, constitutes a reasonable and prudent alternative (RPA) to the proposed action that will achieve Project purposes, avoid jeopardy to listed species and avoid the destruction or adverse modification of critical habitat.

The RPA is a modification of the proposed action designed to provide improved conditions for various salmonid life cycles in the Eel River. The RPA is comparable to the proposed action in its impacts to hydropower generation at the Potter Valley powerhouse and at the Lake Mendocino powerhouse under current sediment conditions and under 2020 sediment conditions (Table 6). The differences in impacts to power generation between implementing the RPA and implementing the proposed action are not significant; under current sediment conditions losses would be slightly less and under 2020 sediment conditions losses would be slightly more (Table 6). The RPA would also result in an approximate average 15 percent reduction (relative to Article 38 diversions) in the annual diversion of water from the Eel River Basin to the Russian River Basin, which is comparable to the proposed action impacts to the diversion (FERC 2000).

Due to the dire condition of coho salmon, Chinook salmon and steelhead runs in the Eel River, and in view of the environmental baseline and cumulative effects analysis, flows that more closely resemble the natural hydrograph are necessary to suppress further declines and to aid in

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[10] Some details of the DOI/NMFS proposal have been modified for this reasonable and prudent alternative. This reasonable and prudent alternative reflects those modifications, but as of this writing the modifications have not been filed with FERC. Specific modifications are discussed in Section H.9. of the reasonable and prudent alternative section.

the recovery of salmonid populations in the Eel River. NMFS believes that the hydrograph produced with implementation of the RPA will more closely resemble the natural hydrograph of the Upper Eel River Basin which should provide improved habitat conditions for listed salmonids more frequently. Of particular importance is the superior response to hydrologic events in the Upper Eel River Basin and the provision of summer flows that allow for more realistic within-year and between-year flow variability that is representative of the unimpaired flow patterns within the Eel River. These features should provide improved habitat conditions and better survival rates for several salmonid life history phases and thus avoid jeopardy to listed salmonid species.

Table 6. Hydropower Generation Losses (Compared to Article 38) as a Result of Implementing the Proposed Action vs RPA (based on 21 years of simulated data presented in FERC 2000).

Potter Valley Powerhouse		
	2000 Sediment Conditions	2020 Sediment Conditions
proposed action	$193,300	$183,300
RPA	$192,000	$187,000
Difference	+$1,300	-$3,700
Lake Mendocino Powerhouse		
	2000 Sediment Conditions	2020 Sediment Conditions
proposed action	$33,600	$33,500
RPA	$32,000	$34,000
Difference	+$1,600	-$500

Flows under the RPA during July, August, and September will provide enhanced conditions for emigrating salmonids and enhanced habitat conditions for steelhead rearing below the Project, especially in wet years. In dry years, water temperature will limit steelhead rearing below the Project. The summer flows of the RPA will also benefit the aquatic ecosystem in general, and will provide improved salmonid habitat conditions in many years. Higher summer flows that are representative of the water year type will increase wetted habitat and should result in increased productivity of aquatic invertebrate species. Increased flows result in increased river underflow and higher water table adjacent to the river that should promote the growth of riparian vegetation. Maintaining a wetted subchannel is critical for riparian ecosystem support;

especially for invertebrate communities. For salmonids, the benefits come from increased availability of forage and increased habitat complexity and function.

NMFS expects that implementation of the RPA will avoid jeopardy to Eel River salmonids. When fully implemented, the RPA should provide Eel River salmonids with a quasi-natural hydrograph with sufficient flows for fall and winter migrations, spring emigrations, and in some years will provide improved summer rearing habitat in the mainstem Eel River below Cape Horn Dam. Project flows under the RPA will support salmonid recovery efforts by providing improved salmonid habitat conditions that will benefit multiple salmonid life stages. All three listed salmonids would be expected to benefit from better habitat conditions, especially Chinook salmon and steelhead.

The following RPA is described as various components. Each component described below must be implemented to ensure compliance with the RPA and to avoid jeopardizing SONCC coho salmon, CC Chinook salmon, and NC steelhead, and adverse modification of designated SONCC coho salmon critical habitat. The RPA modifies the proposed action's flows in the following specific ways:

The abbreviations that are used in the RPA are presented below.

MF11	=	minimum flow of the Eel River below Cape Horn Dam (cfs)
MF02	=	minimum flow of the Eel River below Scott Dam (cfs)
MF16	=	minimum flow of the East Branch Russian River (cfs)
Index	=	index flow (cfs)
Cap	=	cap on the index flow (cfs)
Floor	=	floor on the index flow (cfs)
SF	=	summer flow (cfs)
CLP(date)	=	cumulative inflow into Lake Pillsbury as of the given date (ac-ft)
EXCL(date)	=	exceptionally low inflow into Lake Pillsbury as of the given date (ac-ft)
CRIT(date)	=	critically dry inflow into Lake Pillsbury as of the given date (ac-ft)
DRY(date)	=	dry inflow into Lake Pillsbury as of the given date (ac-ft)
Bom	=	beginning-of-month
Day	=	day-of-month

A. Minimum Flows of the Eel River Below Cape Horn Dam

C Minimum flows of the Eel River below Cape Horn Dam, *MF11*, measured at the PG&E gage E-11, shall be computed as an index flow subject to the floor and cap limitations. If the index flow is between the cap and the floor, the minimum flow is equal to the index flow. If the index flow is less than the floor, the minimum flow is equal to the floor. If the index flow is greater than the cap, the minimum flow is equal to the cap. Mathematically, this can be expressed as:

MF11=min(max(*Index*,*Floor*),*Cap*).

C The cap and the floor are specified in sections A.1 through A.8 below.

A.1. <u>October 1 - October 15</u>

C *Cap = SF+(140-SF)*Day/15*
C If *SF < 25 cfs, Floor* = *SF*+(25-*SF*)**Day*/15. Otherwise, *Floor=SF*

A.2. <u>October 16 - November 30</u>

C *Cap* = 140 cfs
C If *SF<25 cfs, Floor* = 25 cfs. Otherwise, *Floor=SF*

A.3. <u>December 1 - March 31</u>

C *Cap* = 140 cfs
C *Floor*=100 cfs, but if *CLP(Bom)* is less than *EXCL(Bom)* and if the previous month's *Floor* was not equal to 100 cfs, Floor=25 cfs.

A.4. <u>April 1 - May 15</u>

C *Cap* =200 cfs
C *Floor*=100 cfs, but if *CLP(Bom)* is less than *EXCL(Bom)* and if the previous month's *Floor* was not equal to 100 cfs, Floor=25 cfs.

A.5. <u>May 16 - May 30</u>

C Cap = 200 cfs
C *Floor*=*SF*+(*FM*-*SF*)*exp(-*(Day-15)/7*), where *FM* is the May 1-15 floor defined in A.4

A.6. <u>June 1 - June 30</u>

C *Cap*=*SF*+(200-*SF*)*exp(-*Day/7*)
C *Floor*=*SF*+(*FM*-*SF*)*exp(-*(Day+15)/7*), where *FM* is the May 1 floor defined in A.4.

A.7. <u>July 1 - July 30</u>

C *Cap*=*SF*+(200-*SF*)*exp(-*(Day+30)/7*)
C *Floor*=*SF*+(*FM*-*SF*)*exp(-*(Day+45)/7*), where *FM* is the May floor defined in A.4.

A.8. <u>August 1 - September 30</u>

C *Cap* and *Floor* are both equal to the summer flow *SF*

C Summer flow value depends on classification of both current and previous water years based on the cumulative inflow into Lake Pillsbury as of May 15. If the previous water year was not classified as “very wet”, summer flow shall be equal to the singular summer flow. If the previous water year was classified as “very wet”, summer flow shall be equal to the serial summer flow. Values of singular and serial summer flows are selected according to the classification of the current water year.

C Water year classification criteria and values of singular and serial summer flows are shown in the following table:

Classification			Summer Flow *SF*	
Water Year Classification	Probability Range	CLP as of May 15 (ac-ft)	Singular	Serial
Very Dry	0-20%	Less than 171,600	3 cfs	5 cfs
Dry	20-50%	171,600 to 309,400	9 cfs	20 cfs
Wet	50-80%	309,400 to 598,400	15 cfs	25 cfs
Very Wet	80-100%	More than 598,400	30 cfs	35 cfs

A.9. *CLP* computation

C *CLP* on a given day is defined as the cumulative unimpaired inflow into Lake Pillsbury from the beginning of the current water year to the end of the previous day, ignoring the net evaporation. *CLP* shall be computed as:

*CLP=delta(E01)+cfs2af*sum(E02)*,

where *E01* is the Lake Pillsbury storage in ac-ft, *delta* indicates the change from the beginning of the current water year to the end of the previous day, *cfs2af*=1.98347, *E02* is the measured flow of the Eel River below Scott Dam in cfs, and *sum* indicates the summation of all daily flows from the beginning of the current water year to the end of the previous day.

A. 10. <u>Exceptionally low inflows</u>

C Exceptionally low inflows into Lake Pillsbury, *EXCL*, are defined in the following table:

Date	Dec 1	Jan 1	Feb 1	Mar 1	Apr 1	May 1
EXCL (ac-ft)	2,000	4,000	7,000	12,000	25,000	40,000

A.11. <u>Index flow computation</u>

C The following index flow equation defines the distribution of the overall water supply between the downstream Eel River and the Potter Valley Project diversion:

*Index=0.7*Eel*,

where *Eel* is the unimpaired flow of the Eel River below Cape Horn Dam.

C The index flow variable *Eel* is estimated as:

*Eel=avg[af2cfs*delta(E01)+E11+E16],*

where *avg* indicates the average over the last seven days, *af2cfs*=0.50417, *delta(E01)* is the daily change in storage of Lake Pillsbury in ac-ft, *E11* is the measured release below Cape Horn Dam in cfs, and *E16* is the measured Potter Valley Project diversion in cfs.

B. Minimum Flows of the Eel River Below Scott Dam

B.1. Minimum flows of the Eel River below Scott Dam, *MF02*, measured at the PG&E gage E-02, shall be computed as shown in the following table:

Minimum Flow of the Eel River below Scott Dam *MF02*				
Period		Classification		
From	Through	Normal	Dry	Critical
Dec 1	May 31	100 cfs	40 cfs	20 cfs
Jun 1	Nov 30	60 cfs	40 cfs	20 cfs

B.2. <u>Classification</u>

C January through June are classified as normal if *CLP(Bom) > DRY(Bom)*
C January through June are classified as dry if *CRIT(Bom) < CLP(Bom) < DRY(Bom)*
C January through June are classified as critical if *CLP(Bom) < CRIT(Bom)*

C July through December are classified based on the classification of the previous June
C *DRY(Bom)* and *CRIT(Bom)* are shown in the following table:

Date	Jan 1	Feb 1	Mar 1	Apr 1	May 1	Jun 1
DRY (ac-ft)	19,975	39,200	65,700	114,500	145,600	160,000
CRIT (ac-ft)	3,400	19,500	40,000	45,000	50,000	55,000

B.3. PG&E shall continue to cooperate in releasing warm water from the spillway of Scott Dam in the late winter/early spring period to promote the timely downstream migration of juvenile Chinook salmon from the Eel River between Scott and Cape Horn dams.

C. Minimum Flows to the East Branch Russian River

C.1. Minimum flows of the East Branch Russian River, *MF16*, measured at the PG&E gage E-16, but excluding flows released for the Potter Valley Irrigation District, shall be computed as shown in the following table:

Minimum Flow of the East Branch Russian River *MF16*				
Period		Classification		
From	Through	Normal	Dry	Critical
Sep 16	Apr 14	35 cfs	35 cfs	5 cfs
Apr 15	May 14	35 cfs	25 cfs	5 cfs
May 15	Sep 15	75 cfs	25 cfs	5 cfs

C.2. Classification

C Classification is the same as described in section B.2

C.3. Dry spring exception

C From June 1 through September 15, if the month is classified as normal and the inflow into Lake Pillsbury during the preceding April and May is less than 20,000 ac-ft, *MF16*=40 cfs.

D. Blockwater

D.1. 2,500 ac-ft are reserved for release at the discretion of resource agencies each water year.

E. Operating Rules

E.1. Release to the Eel River below Cape Horn Dam shall be greater than or equal to the minimum flow *MF11* specified in section A.

E.2. Release to the Eel River below Scott Dam shall be greater than or equal to the minimum flow *MF02* specified in section B.

E.3. Release to the East Branch Russian River shall be greater than or equal to the minimum flow *MF16* specified in section C plus the release for the Potter Valley Irrigation District.

E.4. Release for the Potter Valley Irrigation District shall not exceed 5 cfs from October 16-April 14 and 50 cfs from April 15 to October 15. If *CLP*(April 1) is less than 25,000 ac-ft, this release shall not exceed 25 cfs during the following period from April 15 through October 15.

E.5. Diversions in excess of the sum of the minimum flow *MF16* specified in section C and the release to the Potter Valley Irrigation District specified in section E.4 can only be made when the Lake Pillsbury Storage is above the Target Storage Curve. Exceptions to this rule can occur only due to rare and brief emergency power and water demands.

E.6. Different Target Storage Curves shall be used depending on the water year classification as of May 15 for the purpose of the summer flow specification.

C If a water year is classified as “Very Wet”, i.e. if the *CLP* on May 15 is more than 598,400 ac-ft, the Target Storage Curve during the following 12-month period starting on August 1 shall be Target Storage Curve A defined in the following table:

Target Storage Curve A (PG&E "3%" "Low Envelope)

If a water year is classified as "Very Wet" on May 15 for the purpose of the summer flow specification,
Target Storage Curve A shall be used in the following 12-month period starting on August 1.

Day	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1	69184	55901	41089	28997	23363	22758	30383	49507	70555	80640	82313	78353
2	68806	55431	40574	28709	23263	22805	30793	50400	71058	80830	82255	78157
3	68429	54960	40060	28422	23163	22852	31203	51292	71561	81020	82197	77960
4	68052	54490	39546	28134	23063	22899	31613	52184	72065	81210	82139	77763
5	67674	54019	39032	27846	22962	22946	32023	53077	72568	81400	82081	77567
6	67297	53549	38518	27558	22862	22993	32433	53969	73071	81590	82023	77370
7	66919	53078	38004	27270	22762	23040	32843	54861	73574	81780	81965	77173
8	66542	52608	37490	26982	22662	23087	33253	55754	74077	81970	81906	76977
9	66165	52137	36976	26694	22562	23133	33663	56646	74581	82160	81848	76780
10	65787	51667	36462	26406	22461	23180	34073	57538	75084	82350	81790	76583
11	65410	51196	35948	26119	22361	23227	34482	58431	75587	82540	81732	76387
12	65032	50726	35433	25831	22261	23274	34892	59323	76090	82730	81674	76190
13	64655	50255	34919	25543	22161	23321	35302	60215	76594	82920	81616	75993
14	64277	49785	34405	25255	22060	23368	35712	61108	77097	83110	81558	75797
15	63900	49314	33891	24967	21960	23415	36122	62000	77600	83300	81500	75600
16	63429	48800	33603	24867	22007	23825	37014	62503	77790	83242	81303	75223
17	62959	48286	33315	24767	22054	24235	37907	63006	77980	83184	81107	74845
18	62488	47772	33027	24666	22101	24645	38799	63510	78170	83126	80910	74468
19	62018	47258	32740	24566	22148	25055	39691	64013	78360	83068	80713	74090
20	61547	46744	32452	24466	22195	25465	40584	64516	78550	83010	80517	73713
21	61077	46230	32164	24366	22242	25875	41476	65019	78740	82952	80320	73335
22	60606	45715	31876	24265	22289	26284	42368	65523	78930	82894	80123	72958
23	60136	45201	31588	24165	22336	26694	43261	66026	79120	82835	79927	72581
24	59665	44687	31300	24065	22383	27104	44153	66529	79310	82777	79730	72203
25	59195	44173	31012	23965	22429	27514	45046	67032	79500	82719	79533	71826
26	58724	43659	30725	23865	22476	27924	45938	67535	79690	82661	79337	71448
27	58254	43145	30437	23764	22523	28334	46830	68039	79880	82603	79140	71071
28	57783	42631	30149	23664	22570	28744	47723	68542	80070	82545	78943	70694
29	57313	42117	29861	23564	22617	29154	47723	69045	80260	82487	78747	70316
30	56842	41603	29573	23464	22664	29564		69548	80450	82429	78550	69939
31	56372		29285		22711	29974		70052		82371		69561

C If a water year is classified as either “Wet” or “Dry”, i.e. if the *CLP* on May 15 is between 171,600 ac-ft and 598,400 ac-ft, the Target Storage Curve during the following 12-month period starting on August 1 shall be Target Storage Curve B defined in the following table:

Target Storage Curve B (PG&E "15%" "Low Envelope)

If a water year is classified as either "Wet" or "Dry" on May 15 for the purpose of the summer flow specification,

Target Storage Curve B shall be used in the following 12-month period starting on August 1.

Day	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1	69184	56590	43363	32767	27830	27300	33982	50902	70555	80640	82313	78353
2	68806	56160	42912	32515	27742	27341	34341	51694	71058	80830	82255	78157
3	68429	55730	42462	32263	27655	27382	34700	52487	71561	81020	82197	77960
4	68052	55300	42011	32010	27567	27423	35059	53280	72065	81210	82139	77763
5	67674	54870	41561	31758	27479	27464	35419	54073	72568	81400	82081	77567
6	67297	54440	41110	31506	27391	27505	35778	54865	73071	81590	82023	77370
7	66919	54010	40660	31254	27303	27546	36137	55658	73574	81780	81965	77173
8	66542	53580	40209	31001	27215	27588	36496	56451	74077	81970	81906	76977
9	66165	53150	39759	30749	27128	27629	36855	57244	74581	82160	81848	76780
10	65787	52720	39308	30497	27040	27670	37215	58036	75084	82350	81790	76583
11	65410	52290	38858	30245	26952	27711	37574	58829	75587	82540	81732	76387
12	65032	51860	38407	29992	26864	27752	37933	59622	76090	82730	81674	76190
13	64655	51430	37957	29740	26776	27793	38292	60415	76594	82920	81616	75993
14	64277	51000	37506	29488	26688	27834	38651	61207	77097	83110	81558	75797
15	63900	50571	37056	29236	26601	27876	39011	62000	77600	83300	81500	75600
16	63470	50120	36803	29148	26642	28235	39803	62503	77790	83242	81303	75223
17	63040	49670	36551	29060	26683	28594	40596	63006	77980	83184	81107	74845
18	62610	49219	36299	28972	26724	28953	41389	63510	78170	83126	80910	74468
19	62180	48769	36046	28884	26765	29312	42181	64013	78360	83068	80713	74090
20	61750	48318	35794	28796	26806	29671	42974	64516	78550	83010	80517	73713
21	61320	47868	35542	28709	26847	30031	43767	65019	78740	82952	80320	73335
22	60890	47417	35290	28621	26888	30390	44560	65523	78930	82894	80123	72958
23	60460	46967	35037	28533	26930	30749	45352	66026	79120	82835	79927	72581
24	60030	46516	34785	28445	26971	31108	46145	66529	79310	82777	79730	72203
25	59600	46066	34533	28357	27012	31467	46938	67032	79500	82719	79533	71826
26	59170	45615	34281	28269	27053	31827	47731	67535	79690	82661	79337	71448
27	58740	45165	34028	28182	27094	32186	48523	68039	79880	82603	79140	71071
28	58310	44714	33776	28094	27135	32545	49316	68542	80070	82545	78943	70694
29	57880	44264	33524	28006	27176	32904	49316	69045	80260	82487	78747	70316
30	57450	43813	33272	27918	27217	33263		69548	80450	82429	78550	69939
31	57020		33019		27259	33623		70052		82371		69561

C If a water year is classified as “Very Dry”, i.e. if the *CLP* on May 15 is less than 171,600 ac-ft, the Target Storage Curve during the following 12-month period starting on August 1 shall be Target Storage Curve C defined in the following table:

Target Storage Curve C (PG&E "25%" "Low Envelope)

If a water year is classified as either "Very Dry" on May 15 for the purpose of the summer flow specification,

Target Storage Curve C shall be used in the following 12-month period starting on August 1.

Day	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1	69184	57164	45258	35909	31553	31084	36980	52064	70555	80640	82313	78353
2	68806	56768	44860	35686	31475	31121	37297	52773	71058	80830	82255	78157
3	68429	56372	44463	35463	31398	31157	37614	53483	71561	81020	82197	77960
4	68052	55976	44065	35241	31320	31193	37931	54193	72065	81210	82139	77763
5	67674	55580	43668	35018	31243	31230	38248	54903	72568	81400	82081	77567
6	67297	55183	43270	34796	31165	31266	38565	55612	73071	81590	82023	77370
7	66919	54787	42873	34573	31088	31302	38882	56322	73574	81780	81965	77173
8	66542	54391	42475	34351	31010	31338	39199	57032	74077	81970	81906	76977
9	66165	53995	42078	34128	30933	31375	39516	57742	74581	82160	81848	76780
10	65787	53599	41680	33905	30855	31411	39833	58451	75084	82350	81790	76583
11	65410	53202	41283	33683	30778	31447	40150	59161	75587	82540	81732	76387
12	65032	52806	40885	33460	30700	31484	40467	59871	76090	82730	81674	76190
13	64655	52410	40488	33238	30623	31520	40784	60581	76594	82920	81616	75993
14	64277	52014	40090	33015	30545	31556	41101	61290	77097	83110	81558	75797
15	63900	51618	39693	32793	30468	31593	41418	62000	77600	83300	81500	75600
16	63504	51220	39470	32715	30504	31909	42127	62503	77790	83242	81303	75223
17	63108	50823	39247	32638	30540	32226	42837	63006	77980	83184	81107	74845
18	62711	50425	39025	32560	30576	32543	43547	63510	78170	83126	80910	74468
19	62315	50028	38802	32483	30613	32860	44256	64013	78360	83068	80713	74090
20	61919	49630	38580	32405	30649	33177	44966	64516	78550	83010	80517	73713
21	61523	49233	38357	32328	30685	33494	45676	65019	78740	82952	80320	73335
22	61127	48835	38134	32250	30722	33811	46386	65523	78930	82894	80123	72958
23	60730	48438	37912	32173	30758	34128	47095	66026	79120	82835	79927	72581
24	60334	48040	37689	32095	30794	34445	47805	66529	79310	82777	79730	72203
25	59938	47643	37467	32018	30830	34762	48515	67032	79500	82719	79533	71826
26	59542	47245	37244	31940	30867	35079	49225	67535	79690	82661	79337	71448
27	59145	46848	37022	31863	30903	35396	49934	68039	79880	82603	79140	71071
28	58749	46450	36799	31785	30939	35713	50644	68542	80070	82545	78943	70694
29	58353	46053	36576	31708	30976	36030	50644	69045	80260	82487	78747	70316
30	57957	45655	36354	31630	31012	36347		69548	80450	82429	78550	69939
31	57561		36131		31048	36663		70052		82371		69561

F. Non-Flow Improvements

C In addition to flow provisions, this proposal also calls for the following non-flow measures:

F.1. Cape Horn Dam will be modified to allow accurate regulation of the required minimum flows.

F.2. PG&E shall provide $60,000 annually in order to fund the costs of implementing the pikeminnow suppression program and monitoring requirements of this RPA and Incidental Take Statement. PG&E shall credit an additional $60,000 to the Fund on January 1 of each year after the first year for the remaining term of the license, including any annual license(s) which may be issued after license expiration or license surrender. The unspent balance of the Fund shall accrue interest at the 90-day commercial paper rate as determined by the Federal Reserve Bank of New York, credited on a quarterly basis. The account can be used for the evaluation of the impacts of higher summer flows on salmonid and pikeminnow abundance and related predation impacts, pikeminnow suppression efforts, chinook salmon hatchery supplementation, or funding for a scientific aide at Van Arsdale Fishery Station. Decisions on the expenditures to be charged to the Fund will be made by NMFS in consultation with PG&E in consultation with the resource agencies and RVIT. PG&E shall distribute an accounting statement to NMFS within 30 days after January 1 of each year after the Fund is established, summarizing the Fund balance, accrued interest, and previously charged amounts.

G. Implementation and Compliance Issues

G.1. PG&E shall develop and maintain a World Wide Web site on which the relevant flow measurements and the calculated minimum flow requirements can be reviewed by the fisheries resource agencies and general public.

G.2. FERC shall ensure that PG&E, in coordination with the resource agencies develop a five year adaptive management plan for the suppression of Sacramento pikeminnow. The plan should concentrate on efforts to suppress pikeminnow in the reach of Eel River between Scott Dam and Van Arsdale Reservoir, in Van Arsdale Reservoir and around and below both dams. The adaptive management plan should accomplish the following objectives:

- C Quantify pikeminnow and steelhead distribution, abundance, and size-class structure in the Eel River between Scott and Cape Horn Dams

- C Employ and evaluate various techniques for pikeminnow suppression

- C Monitor immediate effects of suppression efforts on rearing steelhead, pikeminnow, and other species

- C Monitor the response of pikeminnow and rearing juvenile steelhead at the end of the summer following suppression efforts

H. Discussion of the Reasonable and Prudent Alternative Components

1. Curtailments to the Potter Valley Irrigation District Demand in Extremely Dry Years

Modeling of the simulated flows and storages indicates that a 50 percent curtailment to the PVID demand is needed in order to protect Lake Pillsbury storage during a water year like 1977, the driest water year on record. However, no curtailments to the PVID demand are needed in any other simulated year. Therefore, the RPA specifies that the PVID delivery be curtailed by 50 percent during the entire irrigation season in a drought-of-record type year, as indicated by an extremely low cumulative inflow into Lake Pillsbury of 25,000 ac-ft or less as of April 1. In the event that an extremely dry year similar to water year 1977 were to occur, NMFS shall consult with PG&E and PVID as early in the irrigation season as possible before implementing any such curtailment. Curtailment to PVID will be minimized to the extent possible.

2. Modification of Floor Flows

This modification is designed to ensure biologically adequate minimum flows from December 1 through May 15. In the proposed action, the normal floor flow of 35 cfs provides for less than 25 percent of the maximum potential physical habitat conditions for spawning/incubation steelhead and Chinook salmon based on the Instream Flow Incremental Methodology analysis conducted by DOI. In the proposed action, it is proposed that the 5,000 ac-ft blockwater be used for minimum flow augmentation purposes. The original blockwater target flow during the Fishery Review Group process was 100 cfs, but the blockwater size was not sufficient to meet this target in many years. The current PVID proposal specifies a variable blockwater target flow of 1.4 times the average release below Cape Horn Dam during the last three weeks of November or 100 cfs, whichever is less. However, this method of flow augmentation is not adequate for the following reasons: (1) the blockwater target flow is inadequate to meet the needs of spawning and/or incubating salmonids in some years, (2) the blockwater size is insufficient to maintain the blockwater target flow in some years, and (3) if the blockwater is used for any other purpose (e.g. providing pulse flows), the remaining blockwater may not be sufficient to meet the minimum flow augmentation purposes. For these reasons, the RPA introduces a fixed minimum flow floor which is generally equal to 100 cfs from December 1 through May 15, with some exceptions. The 100 cfs floor corresponds to ensuring availability of about 80 percent of the maximum potential physical habitat conditions for spawning and incubation of steelhead and Chinook salmon.

Exceptions to the 100 cfs floor are needed since such a floor would be generally higher than the unimpaired flow in a drought-of-record type of water year, and maintaining such a floor could result in low Lake Pillsbury levels. The criteria for exceptions to the 100 cfs floor are based on the cumulative inflow into Lake Pillsbury as of the first day of each month from December through May. Specifically, if the CLP on December 1 is less than 2,000 ac-ft, the fall floor is maintained at 25 cfs. Similarly, if the CLP on January 1 is less than 4,000 ac-ft, if the CLP on February 1 is less than 7,000 ac-ft, if the CLP on March 1 is less than 12,000 ac-ft, if the CLP on

April 1 is less than 25,000 ac-ft, or if the CLP on May 1 is less than 40,000 ac-ft, the floor is continued to be maintained at 25 cfs. The objective of these criteria is to ensure that the floor flow is not set at 100 cfs in years which are so extremely dry that the total annual minimum flow requirement (with a 100 cfs floor) would exceed the total annual unimpaired flow. In order to meet this objective, the floor flow is maintained at the fall floor level until it is reasonably certain that the current water year is not extremely dry. The floor flow would never be set at 100 cfs and later decreased to 25 cfs due to the exceptions criteria. This modification to the minimum flow floor of the proposed action ensures biologically adequate flows during the spawning/incubation period, while taking into account the possibility that the current water year may be extremely dry. This modification also eliminates the need to utilize the blockwater for the minimum flow augmentation purposes, which also greatly simplifies the implementation. Since the blockwater is no longer needed for augmentation purposes, the blockwater size is specified as 2,500 ac-ft in this RPA and is still available for the pulse flow implementation at the discretion of the resource agencies.

This element of the RPA is also anticipated to address potential deleterious effects of flow fluctuations under the proposed action for mainstem spawning, incubation and rearing habitat below Cape Horn Dam. The unnecessary flow fluctuations in the proposed action have a greater potential to negatively affect spawning, incubation and rearing habitats for young salmonids, which may result in increased mortality or result in premature dispersal of the young from the affected reaches. The flows provided by the RPA are similar to that of the DOI/NMFS proposal and simulations of the DOI/NMFS proposal conducted by DOI clearly show a more stable flow pattern during this period compared to other proposals which will reduce the environmental risk associated with flow fluctuations inherent in the proposed action.

Increasing the floor from 35 cfs to 100 cfs in December through May 15 will increase flows for Chinook salmon and steelhead migration and incubation in all but critically dry years and will provide outmigrating salmonids additional flow to migrate farther downstream in the spring. An increase of flow from 35 cfs to 100 cfs will likely result in increased adult Chinook salmon spawning and incubation by allowing adult salmonids more access to the upper reaches of the main river and tributaries. Additional flow in the spring will increase the survival of smolting coho salmon, Chinook salmon and steelhead by allowing them to take advantage of increased flows that will likely decrease emigration time, decrease predation due to turbidity and increased habitat volume, and move fish farther downstream where they are less likely to be impacted by thermal stress in the mainstem.

3. Summer Flows

Summer flows in the RPA allow for more realistic within-year and between-year flow variability that is representative of the unimpaired flow patterns within the Eel River. This is considered important to mimic natural flow patterns during both spring and fall migration periods. This desire to retain linkages to ecological functionality within the summer flow regime underpins the modification to the summer flow regime. This variability in summer flows under various water year types provides an improved potential for mimicking the ecological processes within the Eel River below Cape Horn Dam. A range of flows that follow the natural flow regime is most beneficial to protect native fishes (Poff *et al.* 1997). The summer flow schedule under the RPA parallels the range of flow magnitudes observed in the unimpaired flow records by water year type. This increase in summer rearing habitat below the Project in some years will help provide an incremental improvement to the potential biological productivity of salmonid stocks, which is essential given the status of the stocks. In years where 15 to 35 cfs is released during the summer months, river conditions will be caused to be more lotic which should favor salmonids. The summer flow schedule also provides increased benefits for other ecological processes such as connectivity between suitable rearing habitats, maintains a flow magnitude linkage with the unimpaired flows from the Upper Eel River tributary systems, may benefit early and late migrants, and allows for expanded physical habitat in water years with higher flows which may reduce direct competition and/or predation by pikeminnow.

Summer flow value depends on classification of both current and previous water years based on the cumulative inflow into Lake Pillsbury as of May 15 (Table 7). If the previous water year was not classified as “very wet”, summer flow shall be equal to the singular summer flow. If the previous water year was classified as “very wet,” summer flow shall be equal to the serial summer flow. Values of singular and serial summer flows are selected according to the classification of the current water year. Higher summer flows in years following wet years are designed to support the increased salmonid production expected the previous year.

Sacramento pikeminnow have enjoyed a competitive advantage over Eel River salmonids since their introduction as a result of Project operations. Low flows below the Project in recent years have limited salmonids, and at the same time have provided ideal conditions for Sacramento pikeminnow. It is NMFS’ biological opinion that improved flows, particularly in the summer months, in conjunction with a Sacramento pikeminnow suppression program, are absolutely necessary to decrease the decline of Eel River salmonids. It is acknowledged that summer rearing habitat is limited and marginal below the Project. However, suitable thermal conditions for steelhead rearing occur in some years as is evident by results reported by VTN (1982), and even infrequent and small gains for steelhead rearing must be preserved in order to decrease further declines.

The summer flow component of the RPA will be monitored annually through temperature and monitoring of pikeminnow and steelhead rearing in the Eel River below Cape Horn Dam to below Outlet Creek. After ten years of monitoring, the summer flow component of the RPA will be re-evaluated based on results provided in annual reports. If NMFS determines that the summer flow component of the RPA is not providing the anticipated benefits to salmonids, then NMFS will re-evaluate this component of the RPA to determine if additional measures or changes in flows are necessary.

Table 7. Water year classification criteria and values of singular and serial summer flows.

Water Year Classification	Probability Range	CLP as of May 15 (ac-ft)	Singular Summer Flow	Serial Summer Flow
Very Dry	0-20%	Less than 171,600	3 cfs	5 cfs
Dry	20-50%	171,600 to 309,400	9 cfs	20 cfs
Wet	50-80%	309,400 to 598,400	15 cfs	25 cfs
Very Wet	80-100%	More than 598,400	30 cfs	35 cfs

4. Modifications to Flow Ramping

This element of the RPA eliminates several artificial step-like reductions in the minimum flow patterns during the descending limb of the hydrograph of the proposed action by applying an exponential equation, specified in detail in the April 27, 1999 DOI/NMFS proposal and summarized below. Step-like reductions in flow are known to cause stranding of young salmonids and this modification to the proposed action reduces the potential of stranding of listed Eel River salmonids.

The exponential equation is as follows:

> Cap=SF+(200-SF)*exp(-(Day+30)/7)
> Floor=SF+(FM-SF)*exp(-(Day+45)/7), where SF is summer flow and FM is the May floor.

5. Summary of Minimum Flow Requirements Prescribed by the RPA

Minimum flows of the Eel River below Cape Horn Dam are determined based on an index flow subjected to the cap and floor limitations. If the index flow is between the cap and the floor, the minimum flow is equal to the index flow. If the index flow is less than the floor, the minimum flow is equal to the floor. If the index flow is greater than the cap, the minimum flow is equal to the cap. The cap and the floor are specified as follows and in Table 8:

- October 1 - November 30: From October 1 to October 15, the cap is linearly increasing from a value equal to the previous summer flow on September 30 to 140 cfs on October 15. The floor is linearly increasing from a value equal to the previous summer flow on September 30 to the fall floor flow on October 15. The fall floor flow is equal to 25 cfs or the previous summer flow on September 30, whichever is greater. From October 16 - November 30, the cap is 140 cfs, and the floor is equal to the fall floor defined above.

C December 1 - March 30: The cap is 140 cfs. The floor is 100 cfs, except when the cumulative inflow into Lake Pillsbury is exceptionally low and the previous month's floor was not equal to 100 cfs, in which case the floor is 25 cfs.

C April 1 - May 15: The cap is 200 cfs. The floor is 100 cfs, except when the cumulative inflow into Lake Pillsbury is exceptionally low and the previous month's floor was not equal to 100 cfs, in which case the floor is 25 cfs.

C May 16 - July 30: The floor is exponentially decreasing from its value on May 15 to the summer flow on August 1. The cap remains constant at 200 cfs from May 16 through May 31 and then exponentially decreases from 200 cfs to the summer flow on August 1.

C August 1 - September 30: The cap and the floor are both equal to the summer flow.

Table 8. Summary of the RPA Minimum Flow Schedule. Minimum Flow of the Eel River below Cape Horn Dam = *min (max (Index, Floor) , Cap)* . Summer flow = SF, beginning of month = BOM, and exceptionally low inflow into Lake Pillsbury = EXCL.

From	Through	Cap	Floor	Exception
Oct 1	Oct 15	linearly increasing from SF to 140 cfs	linearly increasing from SF to 25 cfs	if SF>25 cfs, floor=SF
Oct 16	Nov 30	140 cfs	25 cfs	if SF>25 cfs, floor=SF
Dec 1	Mar 31	140 cfs	100 cfs	if CLP(Bom)<EXCL(Bom), floor=25 cfs
Apr 1	May 15	200 cfs	100 cfs	if CLP(Bom)<EXCL(Bom), floor=25 cfs
May 16	May 31	200 cfs	exponentially decreasing from May 15 floor to SF	
Jun 1	Jul 31	exponentially decreasing from 200 cfs to SF		
Aug 1	Sep 30	SF	SF	

The RPA specifies an index flow equation *Index=0.7*Eel,* where *Eel* is the unimpaired flow of the Eel River below Cape Horn Dam. This equation defines the distribution of the overall water supply between the downstream Eel River and the Project diversion.

Minimum flows of the Eel River below Scott Dam are specified in the same way as in the PG&E and PVID proposals, while the minimum flows to the East Branch Russian River are specified in the same way as in the PVID and Sonoma County proposals.

6. Pikeminnow Suppression Plan

Sacramento pikeminnow are not likely to dramatically affect salmonid populations in free-flowing rivers, however, the effects may be significant in areas of altered streams or communities (dams, diversions, or fish releases) (Brown and Moyle 1981; Brown and Moyle 1991; CDFG 1997; Geary *et al.* 1992; Moyle 1976; Moyle 2002; Tucker *et al.* 1998; Week 1992). Therefore, in order to reduce predation impacts, suppression efforts should focus on suppressing pikeminnow in the reach of Eel River between Scott Dam and the Van Arsdale Reservoir, in the Van Arsdale Reservoir and around and below both dams. Pikeminnow suppression measures between Scott Dam and Cape Horn Dam can be conducted during the period of July through September. Actual suppression efforts might include angling, seining, gill netting, explosives, and electrofishing techniques, and will be carried out by ground crews. Details of the pikeminnow suppression plan will be developed by PG&E and the resource agencies and will be filed with NMFS no later than April 15, 2003. After five years, the pikeminnow population and its interactions with salmonids will be reassessed as a part of the adaptive management plan, and the plan may be revised as deemed necessary by the resource agencies.

7. Impacts of the RPA on Lake Pillsbury Storage Levels

NMFS and DOI have performed detailed analyses of the water levels in Lake Pillsbury under the DOI/NMFS proposal, which are described in the report entitled *Response to Sonoma's Comments on Hydrologic Issues in the DOI/NMFS proposal* ("DOI/NMFS Hydrologic Report"), filed with FERC on December 2, 1999.

In the judgment of NMFS, the RPA is not expected to cause adverse impacts to recreation, water quality (including temperature and mercury contamination), or the Federally listed bald eagle. It should also be noted that the DOI/NMFS proposal fully met all 4(e) conditions regarding the reservoir levels proposed by the USFS, as filed with FERC on September 25, 2000, and the RPA is expected to impact lake levels to an even lesser degree.

8. Impacts of the RPA on Water Supply in the Russian River Basin

The DOI/NMFS Hydrologic Report (filed with FERC on December 2, 1999) shows that the curtailments in the upper Russian River Basin under the RPA in sediment-year 2000 conditions would be zero, and that curtailments under sediment-year 2022 conditions would average 1,198 ac-ft. Curtailments under the proposed action under sediment-year 2022 conditions would average 976 ac-ft, only slightly less than the RPA.

Eel River summer flows provided by the RPA do not have "attendant significant impact on water supply." The RPA uses a system of three different rule curves dependent on water supply conditions. This system was designed specifically to reduce the impacts of summer flows on water supply. The average difference in the amount of water diverted into the East Branch Russian River between the RPA summer flows and PVID summer flows is only 528 ac-ft per year (0.40 percent). The impacts to water supply due to RPA summer flows have been minimized by use of a more efficient system of three different rule curves that are dependent on the water supply conditions.

9. Differences Between the RPA and the DOI/NMFS Proposal

The RPA constitutes a slight modification of the DOI/NMFS proposal that was filed with FERC in April 1999 and evaluated in the FEIS. However, the simulated performance over the historical period of record is nearly identical to that of the DOI/NMFS proposal. The modifications to the DOI/NMFS proposal and simulated results of the DOI/NMFS and RPA are discussed below:

C The minimum summer flow values are changed from 2 cfs to 3 cfs only for singular summer flows under very dry water year classification (cumulative inflow into Lake Pillsbury as of May 15 less than 171,600 ac-ft). Over the 67-year period from 1929-1995, summer flows fall into this category in 11 years (1931, 1933, 1934, 1944, 1955, 1964, 1976, 1977, 1990, 1991, and 1994). By increasing the summer flow in these years from 2 cfs to 3 cfs, releases to the Eel River below Cape Horn Dam are increased by the amount between 200 and 250 ac-ft during the period from June through September. This translates into Lake Pillsbury storage being lower by approximately this amount on September 30 in these water years, and into reductions in Potter Valley diversions during subsequent fall periods (in the following water year) because of smaller differences between the September 30 storage and target storage curve. Because these effects are only between 200 and 250 ac-ft, they are essentially negligible with respect to water balances, environmental benefits, and socioeconomic impacts of the RPA.

C The Exceptionally Low Inflow criteria for the original DOI/NMFS proposal and for the RPA are shown in the following table:

EXCL (ac-ft)	Dec 1	Jan 1	Feb 1	Mar 1	Apr 1	May 1
DOI/NMFS	2,000	5,000	8,000	11,000	15,000	20,000
RPA	2,000	4,000	7,000	12,000	25,000	40,000

C The criteria for the 50% curtailment to the PVID are different between the DOI/NMFS proposal and the RPA. These criteria are based on the cumulative inflow into Lake Pillsbury as of April 1 being less than 15,000 ac-ft under the DOI/NMFS proposal and less than 25,000 ac-ft under the RPA. While these numbers are different, the performances of the DOI/NMFS proposal and the RPA would be identical over the historical period of record. Analysis of these inflows shows that the set of months in which the inflows are lower than the original values of EXCL is the same as the set of months in which the inflows are lower than the RPA values of EXCL. This means that if the historical inflows were to recur, the same months would be classified as Exceptionally Low Inflow under the original DOI/NMFS proposal and under the RPA, and the resulting minimum flows would be identical. Similarly, the PVID curtailment criteria would be applied only in 1977 under both the original DOI/NMFS proposal and under the RPA. However, if the normalized smoothed unimpaired flow data set that was developed by PG&E's consultant Steiner Environmental Consulting (SEC) ("SEC data set") is used for the purpose of calculating the cumulative unimpaired inflows into Lake Pillsbury, as was erroneously done in the FEIS, the simulated performances of the original DOI/NMFS alternative and the RPA would be different in water years 1977 and 1991. This crucial error in the FEIS modeling of the DOI/NMFS alternative was discussed in detail in the DOI and NMFS comments on the FEIS.

C Inflows in April and May of 1977 and February 1991 would be classified as Exceptionally Low Inflows under the RPA, but not under the original DOI/NMFS proposal. Similarly, the PVID curtailment criteria would be applied in 1977 under the RPA, but not under the original DOI/NMFS proposal. Therefore, the floor flow in the RPA would not increase to 100 cfs during water year 1977 and the PVID curtailments would be applied even if the modeling were performed using the SEC data set as was done in the FEIS.

C While it is true that the RPA would perform differently from the DOI/NMFS proposal if it were evaluated under the incorrect assumptions used in the FEIS, there would be no differences in the performance if the modeling were performed correctly. Furthermore, if the RPA were modeled under the incorrect assumptions used in the FEIS, the revised Exceptionally Low Inflow criteria and the revised PVID curtailment criteria would ensure that the outcome of such a modeling would not cause such dramatic errors in the simulated Lake Pillsbury storage as for the original DOI/NMFS proposal in the FEIS.

C An additional modification is that installation of additional flow gages will not be required. Instead, the surrogate index equation will be adopted permanently. If PG&E elects to install gages, an evaluation of the index equation will be performed for two years after installation of the Tomki Creek gage. The index equation could be developed with respect to the correlation between Tomki Creek and the Upper Eel River. However, NMFS would determine the adequacy of the correlation and of any new index equation.

I. Summary of the RPA and Avoidance of Jeopardy

Although the RPA is comparable to the proposed action's impact on the diversion because they both would result in an approximate average 15 percent reduction (relative to Article 38 diversions) in the annual diversion of water from the Eel River Basin to the Russian River Basin, annual averages are not a meaningful way to compare the biological performance of different flow regimes because biologically significant differences can be masked by the averaging procedures. Year-by-year and season-by-season comparisons of the proposed action and the RPA, based on 90 years of modeled NRCE data, illustrate that there are significant and biologically important differences between the proposed action and the RPA. The RPA will provide a more responsive flow regime that provides high frequency of adequate flows for salmonid immigration, spawning, rearing and emigration. The better habitat conditions provided by the RPA flows should result in increased survival rates of multiple salmonid life history phases, which would be expected to increase numbers of salmonids and increase the distribution of salmonids and ultimately will aid in the recovery of listed salmonids in the Eel River. Flows that mimic unimpaired flows, especially spring and summer flows may also aid in the suppression of pikeminnow by providing less conducive habitat conditions for pikeminnow, especially in wet years.

Modeled flows under the RPA ramp up earlier in the fall, or are extended by the previous summer levels in many modeled years where the proposed action does not. Early access to spawning areas is important to Chinook salmon productivity. Broods from fish that spawn earlier are more likely to hatch and emigrate before the onset of thermally adverse conditions. It is also important to the survival of the brood of mainstem spawning Chinook salmon and steelhead, that once the redd is established, water levels are maintained to prevent the dessication of eggs. Fluctuating water levels can adversely affect redds by dewatering redds having a pernicious effect on egg survival. The RPA provides more consistent flows in the month of December which coincides with peak Chinook salmon spawning, and coho salmon and steelhead immigration. The RPA has sufficient flows built into the flow regime during this time period that does not rely on blockwater to augment minimum flows. The RPA's minimum flow schedule provides minimum flow limits that would maintain adequate conditions for migration, spawning and incubation of fry until emergence is complete. This would be expected to increase spawning success, incubation success and fry emergence success and thus increase survival of salmonids in the mainstem Eel River.

Timely access to tributaries during fall and winter is important for tributary populations of coho salmon, Chinook salmon and steelhead. The RPA provides better conditions in the fall and winter by mimicking unimpaired flows more closely which should provide better salmonid passage conditions in the mainstem Eel River and improve access to natal tributaries. This should result in improved spawning success and thus, improved survival of salmonids in tributaries.

Spring flows that are important for salmonid emigration and adult summer steelhead immigration are provided much more frequently under the RPA. NMFS judges the spring flows under the RPA to be superior to the proposed action in 12 out of 21 years because the RPA provides conditions comparable to the unimpaired flows the listed salmonids once thrived on. Higher spring flows, ramping down to high summer flows have the effect of extending spring flows for salmonid smolt emigration and adult summer steelhead immigration through the month of July which will improve survival of coho salmon smolts, Chinook salmon smolts, and steelhead smolts and adults which is not provided by the proposed action. The higher spring flows and the effect of extending spring flows into the summer in wet years may aid in the suppression of pikeminnow by decreasing reproductive success. This may also result in improved thermal conditions in the mainstem Eel River during salmonid smolt emigration, adult summer steelhead immigration, steelhead rearing, and adult Chinook salmon immigration. The formation of the thermal barrier in the Eel River near Fort Seward may also be delayed due to the increased summer flows in wet years. Flows of 9, 15, 20, 25, 30, and 35 cfs would also provide additional mainstem habitat for rearing steelhead, a benefit that will be amplified in wet years with later and cooler than average springs as was experienced in 1982.

Pikeminnow impacts are exacerbated by the presence of dam structures and reservoirs, and by summer thermal conditions and low flows that provide ideal conditions for Sacramento pikeminnow. The proposed action would have 5 cfs summer flow releases from Cape Horn Dam for the next twenty years. The RPA would have summer flows that would range from 3 cfs to 35 cfs depending on water year type. The inter-annual variation in summer flows should provide conditions less favorable to pikeminnow in wet years, which should help suppress pikeminnow populations in the mainstem below the Project. Another element of the RPA is the development and implementation of a pikeminnow suppression program in and around the Project area. Pikeminnow suppression will improve salmonid survival by reducing predation, and by making mainstem pool habitat more available to salmonids. Larger pikeminnow, over 200 mm FL, are predators of salmonids and displace summer rearing steelhead from pool habitat. Successful pikeminnow suppression should decrease predation rates of Eel River salmonids, and allow steelhead more access to summer rearing habitat.

Because this biological opinion has found jeopardy to listed species and adverse modification of critical habitat, the FERC is required to notify NMFS of its final decision on the implementation of the reasonable and prudent alternative.

X. INCIDENTAL TAKE STATEMENT

"Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Section 7 (b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA, and the proposed action may incidentally take individuals of a listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. It also states that reasonable and prudent measures, and terms and conditions to implement the measures, be provided that are necessary to minimize such impacts. Under the terms and conditions of section 7(o)(2) and 7(b)(4), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are nondiscretionary, and must be undertaken by the FERC so that they become binding conditions of the license issued to PG&E, for the exemption in section 7(o)(2) to apply. The FERC has a continuing duty to regulate the activity covered by this incidental take statement. If the FERC (1) fails to assume and implement the terms and conditions or (2) fails to require a permittee or contractor to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms added to the grant, permit, or contract, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the FERC must report the progress of the action and its impact on the species to NMFS as specified in the incidental take statement (50 CFR §402.14(I)(3)).

This incidental take statement is applicable to all activities related to the PG&E Potter Valley Project (P-77-110) pursuant to the RPA described in this opinion. Unless modified, this incidental take statement does not cover activities that are not described and assessed within this opinion.

A. Amount or Extent of Take

NMFS anticipates that incidental take of Southern Oregon Northern California coho salmon, Central California Coast coho salmon, California Coastal Chinook salmon, Northern California steelhead, and Central California Coast steelhead may occur as a result of implementation of the identified reasonable and prudent alternative for the remaining life of the FERC license. However, NMFS anticipates that incidental take of individual coho salmon, Chinook salmon, and steelhead will be difficult to detect. Evidence of incidental take in the form of dead or injured fish is unlikely to be found and measured because incidental take is likely to occur in the form of delayed or blocked migration, dewatering of redds, reduced survival due to unfavorable habitat conditions, and predation on juvenile fish.

NMFS has determined that incidental take of listed species may be measured through successful compliance with the reasonable and prudent alternative. NMFS has also determined that any take resulting from the reasonable and prudent alternative is not likely to result in jeopardy to the species or destruction or adverse modification of designated or proposed critical habitat. Operation in compliance with the reasonable and prudent alternative is evidenced by environmental conditions in the Eel River that more closely resemble the natural hydrograph of the Upper Eel River and will more frequently provide improved conditions, including adequate habitat conditions and summer low flows, for rearing and migrating salmonids. Any action that is not in compliance with the reasonable and prudent alternative will be considered to have exceeded anticipated take levels, triggering a requirement that FERC reinitiate consultation on the Project. In addition, reinitiation is triggered if information indicates that the Project is not providing the conditions anticipated to result from the reasonable and prudent alternative in the biological opinion or that, despite compliance with the reasonable and prudent alternative, the

Project may affect listed species in a manner or to an extent not analyzed or anticipated in the biological opinion.[11]

B. Reasonable and Prudent Measures

The NMFS believes that the following reasonable and prudent measures are necessary and appropriate to minimize the likelihood of take of Southern Oregon Northern California coho salmon, Central California Coast coho salmon, California Coast Chinook salmon, Northern California steelhead and Central California Coast steelhead resulting from the operation of the Project under the Reasonable and Prudent Alternative.

FERC shall:

1. Ensure that PG&E develop with NMFS, USFWS, USFS, RVIT, and CDFG, an adaptive management plan for the suppression of pikeminnow in and around the Project area as specified in the RPA. The plan will specify details of activities to suppress pikeminnow, including methods, the establishment of index pools, and define success criteria.

2. Ensure that each year for the remaining term of the license, including any extensions or annual licenses which may be issued by the FERC, PG&E file a pikeminnow suppression operations plan with NMFS. The operations plan shall be filed for NMFS approval and shall include at a minimum: 1) specific activities planned, and provisions for funding and monitoring; 2) the status of ongoing activities and results of any salmonid or pikeminnow related monitoring studies; 3) the success of pikeminnow suppression efforts; 4) any recommended modifications to Project facilities or operations and other recommended actions to minimize pikeminnow predation on listed salmonids in the Eel River system.

3. Require the licensee to develop a system to allow for the verification of flows below the Project in the Eel River and compliance with the RPA.

4. Direct PG&E to provide $60,000 annually in order to fund the implementation of the pikeminnow suppression program and monitoring requirements of this RPA and Incidental Take Statement. In addition, PG&E must report to NMFS annually the numbers of anadromous salmonids counted at VAFS, Coyote Dam and Warm Springs Dam, and the findings of all fishery surveys conducted by PG&E or others.

5. Direct PG&E to provide accurate regulation of flows as called for in the RPA.

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[11] A measure of population status in the Eel River is available from counts of fish arriving at the VAFS. Counts of Chinook salmon are a direct indicator of Chinook salmon escapement, and an index of coho salmon escapement in the Eel River. In the Russian River Basin, numbers of wild anadromous fish returning to Warm Springs and Coyote dams can provide an index of overall escapements. By monitoring escapements, FERC, NMFS, and the licensee will be able to detect overall trends in salmonid abundance and variability. Information concerning compliance with the reasonable and prudent alternative may be developed from PG&E surveys or other sources.

6. Direct PG&E to notify the State Water Resources Control Board so that the board can assess the efficacy of Decision 1610 that concerns Russian River flows.

7. Ensure that PG&E operations of the fish screen at Van Arsdale diversion dam are reviewed and approved by NMFS prior to implementation of the RPA.

8. Ensure that PG&E develop with the resource agencies, a suitable annual monitoring program in order to monitor and assess the summer flow component of the RPA with respect to the anticipated biological benefits to salmonids. This will include a temperature monitoring component and a summer rearing monitoring component in order to provide biological information on the performance of the RPA under different summer flow regimes.

C. Terms and Conditions

The following term and condition implements Reasonable and Prudent Measure 1:

1. By April 15, 2003, PG&E shall file a pikeminnow adaptive management plan for the suppression of pikeminnow for NMFS approval. Prior to filing its plan with NMFS, PG&E shall consult with NMFS, USFWS, USFS, RVIT, and CDFG on the proposed pikeminnow adaptive management plan. PG&E shall include with the plan, documentation of any consultation with the RVIT and agencies, copies of comments and recommendations on the completed plan after it has been prepared and provided to the RVIT and agencies, and specific descriptions of how the RVIT's and agencies' comments and recommendations are accommodated by the plan. PG&E shall allow a minimum of 30 days for the agencies to comment and make recommendations before filing the plan with NMFS. If PG&E does not adopt a recommendation, the filing shall include PG&E's reasons, based upon site specific information. The NMFS shall reserve the right to require changes in the plan. The plan shall be delivered to:

   Northern California Supervisor
   Protected Resources Division
   777 Sonoma Avenue, Room 325
   Santa Rosa, California 95404-4731

The following terms and conditions implement Reasonable and Prudent Measure 2:

2. Annually, PG&E shall file a pikeminnow suppression operations plan with NMFS. The plan shall be filed for NMFS approval and shall include details of specific activities planned for pikeminnow suppression, specify flow manipulations, and specify areas to be treated. Suppression efforts should focus on suppressing pikeminnow in the reach of Eel River between Scott Dam and the Van Arsdale Reservoir, in the Van Arsdale Reservoir and around and below both dams. Also, each annual operations plan shall consider the results of previous year plans in justification of the current year operations. The operations plan for the current year shall be filed with NMFS by June 1 of each year.

The NMFS shall reserve the right to require changes in the plan. The plan shall be delivered to:

Northern California Supervisor
Protected Resources Division
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404-4731

3. Annually, PG&E shall file results of salmonid or pikeminnow related monitoring studies, and report on the success of pikeminnow suppression efforts. In addition, PG&E may make recommendations for modifications to Project facilities or operations and other recommended actions to minimize pikeminnow predation on listed salmonids in the Eel River system. Results shall be filed with NMFS by April 15 of each year. Results shall be delivered to:

Northern California Supervisor
Protected Resources Division
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404-4731

The following term and condition implements Reasonable and Prudent Measure 3:

4. PG&E shall develop and implement a system to enable NMFS and the other resource agencies to monitor Eel River flows immediately below the Project on a real-time basis. Gage E-11 below Cape Horn Dam, for example, may be equipped to provide real-time flow data, or another system shall be developed to provide Eel River flow data below the Project and accessible by the resource agencies 24 hours a day.

The following terms and conditions implement Reasonable and Prudent Measure 4:

5. Ensure that PG&E, within six (6) months of the license amendment issuance, establishes a tracking account (the Fund) for the purpose of financing Project-related activities and monitoring. Such activities include implementing the pikeminnow suppression program and monitoring requirements of this RPA and Incidental Take Statement. PG&E shall initially establish the Fund in the amount of $60,000. On January 1 of each year thereafter PG&E shall credit an additional $60,000 to the Fund for the remaining term of the license, including any annual license(s) which may be issued after license expiration or license surrender. The unspent balance of the Fund shall accrue interest at the 90-day commercial paper rate as determined by the Federal Reserve Bank of New York, credited on a quarterly basis. PG&E shall administer the Fund and decisions on the expenditures to be charged to the Fund will be made by NMFS in consultation with PG&E, the resource agencies and RVIT. PG&E shall distribute an accounting statement to NMFS within 30 days after January 1 of each year after the Fund is established, summarizing the Fund balance, accrued interest, and previously charged amounts.

6. PG&E shall compile all fish count data from the Eel and Russian rivers annually, including the results of surveys conducted by PG&E or other parties. These data will be presented in report form to NMFS by May 1 of each year, and will be used to assess the level of Project impacts. This report shall be delivered to:

Northern California Supervisor
Protected Resources Division
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404-4731

The following term and condition implements Reasonable and Prudent Measure 5:

7. Direct PG&E to modify Cape Horn Dam to allow accurate regulation of the higher minimum flows, up to 200 cfs, provided under the Reasonable and Prudent Alternative.

The following term and condition implements Reasonable and Prudent Measure 6:

8. Notify the California State Water Resources Control Board how minimum flow requirements are modified so the Board may consider modification of Decision 1610 and specify new minimum flows in the Russian River.

The following term and condition implements Reasonable and Prudent Measure 7:

9. Direct PG&E to submit to a screen operations plan and its biological rationale to NMFS for approval within 90 days of implementation of the RPA. The screen operations plan shall be delivered to:

Northern California Supervisor
Protected Resources Division
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404-4731

The following terms and conditions implement Reasonable and Prudent Measure 8:

10. By April 15, 2003, PG&E shall file a temperature monitoring plan for NMFS approval. This plan should include annual water temperature monitoring from May to October in the mainstem Eel River from above Scott Dam to below the confluence with the South Fork Eel River. Monitoring sites that were established by the Humboldt County Resource Conservation District for the Eel River Water Quality Monitoring Project should be utilized. If the Eel River Water Quality Monitoring Project continues, then PG&E can rely on that project to fulfill this water temperature monitoring plan requirement. The plan must include annual water temperature monitoring from spring to fall for the mainstem Eel River above Scott Dam to the mainstem Eel River below the

confluence with the South Fork Eel River. This will provide useful information on how various summer flow releases from Cape Horn Dam affect water temperatures in the mainstem Eel River. Prior to filing its plan with NMFS, PG&E shall consult with the resource agencies and RVIT on the proposed plan. The NMFS shall reserve the right to require changes in the plan. The plan shall be delivered to:

Northern California Supervisor
Protected Resources Division
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404-4731

11. By April 15, 2003, PG&E shall file a summer rearing monitoring plan for NMFS approval. This plan should include the provisions of annual monitoring of rearing steelhead and pikeminnow in the mainstem Eel River below Cape Horn Dam to below the confluence with Outlet Creek. Previously established sites (VTN and ten-year study) with additional sites shall be monitored annually. This will provide useful information on how various summer flow releases from Cape Horn Dam affect steelhead and pikeminnow populations. Prior to filing its plan with NMFS, PG&E shall consult with the resource agencies and RVIT on the proposed plan. The NMFS shall reserve the right to require changes in the plan. The plan shall be delivered to:

    Northern California Supervisor
    Protected Resources Division
    777 Sonoma Avenue, Room 325
    Santa Rosa, California 95404-4731

12. Annually, PG&E shall file results of the temperature and summer rearing monitoring program in report form. Results shall be filed with NMFS by May 1 of each year and shall be delivered to:

    Northern California Supervisor
    Protected Resources Division
    777 Sonoma Avenue, Room 325
    Santa Rosa, California 95404-4731

13. After ten years of monitoring, the summer flow component of the RPA will be re-evaluated based on results provided in the annual reports. If NMFS determines that the summer flow component of the RPA is not providing the anticipated benefits to salmonids, then NMFS will re-evaluate this component of the RPA to determine if additional measures or changes in flows are necessary.

XI. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitat, or develop additional information.

NMFS believes the following conservation recommendations are consistent with these obligations, and therefore recommends that the following conservation measures be implemented:

1. FERC should require PG&E to use its resources to widely disseminate information relating to Sacramento pikeminnow suppression efforts that might rely on public participation for implementation.

2. FERC should require PG&E to fund annual salmon carcass surveys in index sections of the Eel River, Tomki Creek, Outlet Creek and any other stream reach deemed significant by fishery biologists.

3. FERC should require PG&E to install gages above Lake Pillsbury and on Tomki Creek as described in the original DOI/NMFS proposal and discussed below. The DOI and NMFS have concluded that additional gages above Lake Pillsbury would be beneficial in developing an indexing equation capable of providing a more direct measure of the unimpaired flow of the Eel River. This may be especially important for implementation of more natural pulse flows as a part of the flow schedule. The DOI/NMFS proposal calls for installation of three flow gages: (1) gage E-20 on the Tomki Creek, (2) gage E-21 on the Eel River above Lake Pillsbury, and (3) gage E-22 on the Rice Fork of the Eel River above Lake Pillsbury. The two gages above Lake Pillsbury are expected to measure flows that are representative of the unimpaired inflow into Lake Pillsbury, while the Tomki Creek gage is expected to measure flows that are representative of accretion flows from Lake Pillsbury to Garcia Riffle. A weighted sum of the flows at the three gages could provide a more direct measure of the unimpaired flows targeted for release by the flow schedule, provide a better means to index pulse flow timing, and build a form of redundancy into the unimpaired flow estimation procedure as opposed to reliance on a single gage for this critical purpose. It is also believed that measurement of flow conditions at the two gages above Lake Pillsbury would be more effective given the higher discharge rates within each of these systems as opposed to measurement of the lower flows in Tomki Creek.

   An evaluation study shall be performed after the gages are installed and operating for a period of two years of data collection at the three proposed flow gages. In this study the data will be evaluated for accuracy, reliability, and suitability for use in the indexing flow equation. Provided that all data is suitable for use in the index flow equation, the index flow will be calculated as a weighted sum of the flows measured at the three gages. The weighting coefficients will be developed in a way that optimizes biological benefits, but is subject to the constraint that the new indexing equation should match the RPA's index flow equation in terms of distribution of the overall water supply between the downstream Eel River and the Potter Valley diversion.

4. FERC should study the feasibility and develop a schedule for decommissioning and removing the Potter Valley Project in order to restore unimpaired flows and restore access to historical salmonid spawning and rearing habitats to aid in the recovery of listed salmonids in the Eel Basin.

In order for the NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

XII. REINITIATION NOTICE

This concludes formal consultation on the actions outlined in this opinion. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in this opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, consultation shall be reinitiated immediately.

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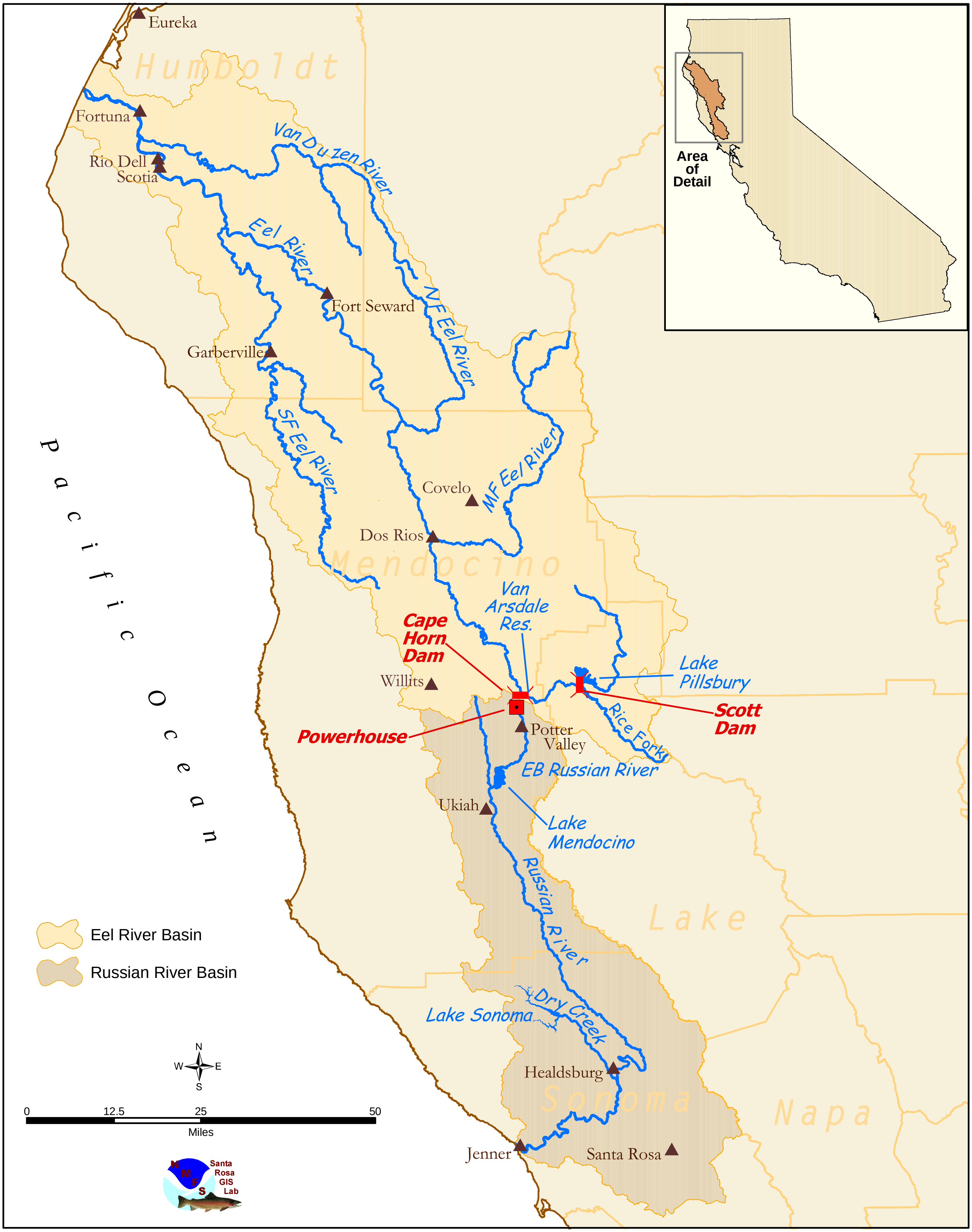

Figure 1. Location of the Potter Valley Project

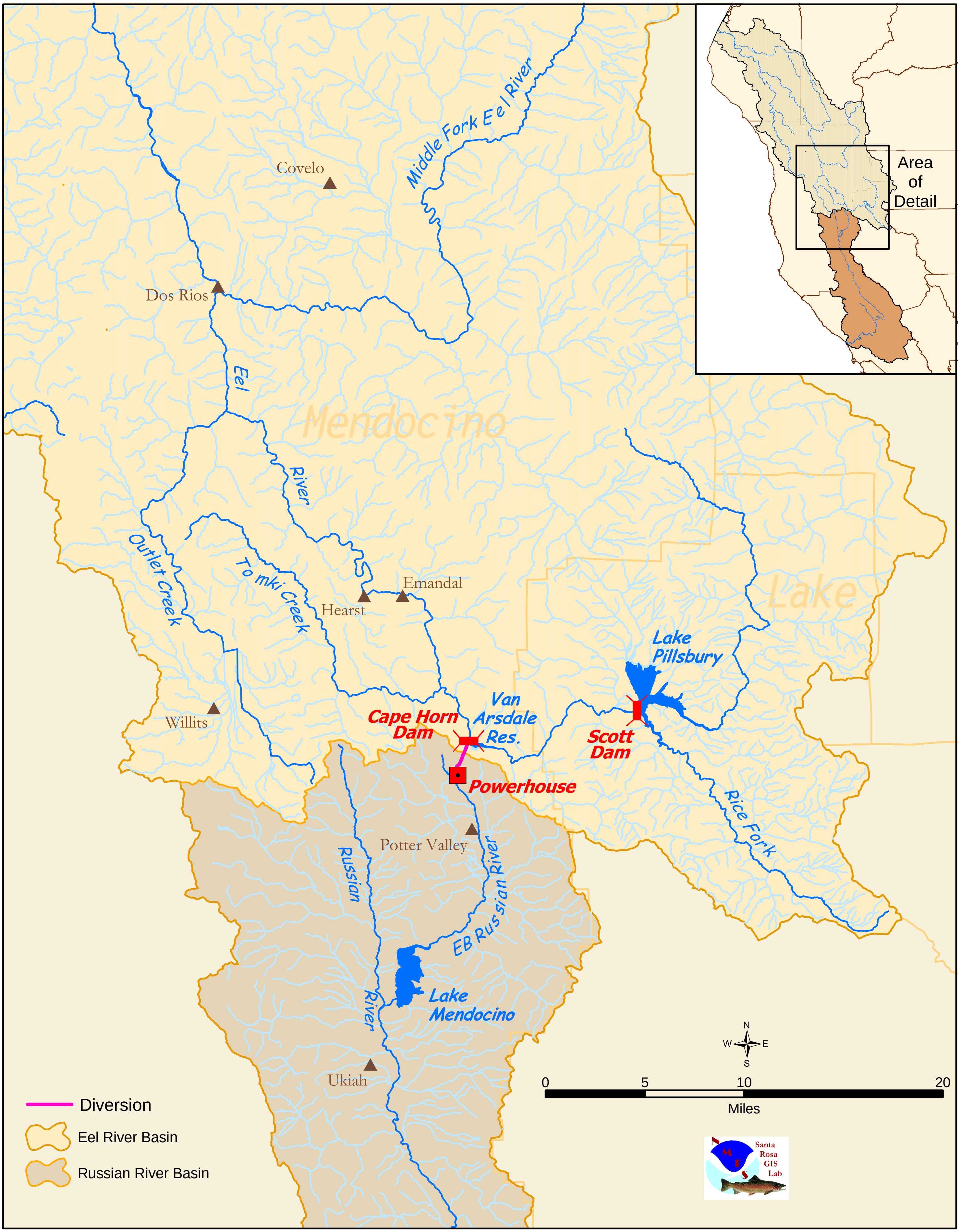

Figure 2. Potter Valley Project, Eel-Russian River Diversion

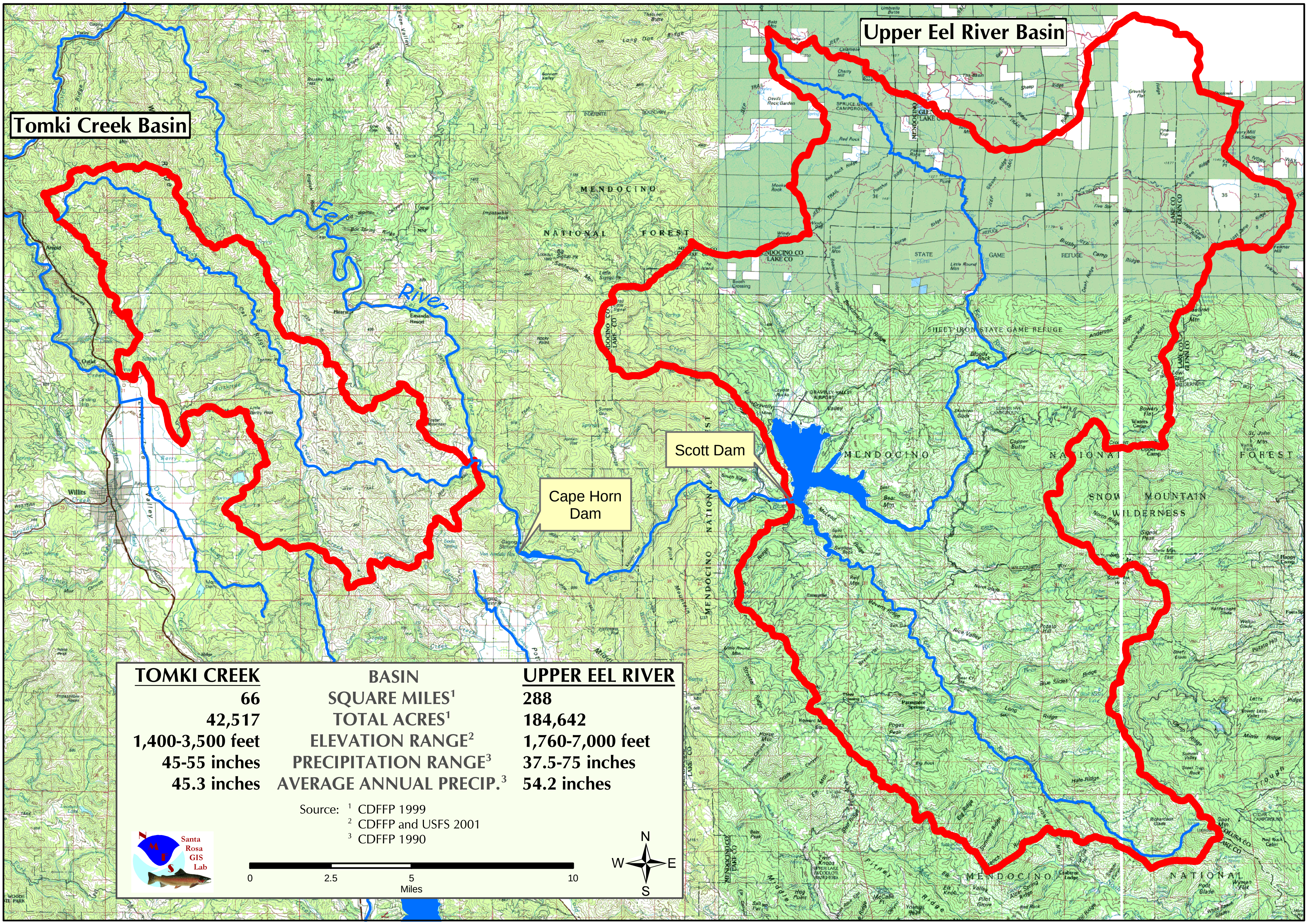

Figure 3. Comparison of Tomki Creek Basin and Upper Eel River Basin above Scott Dam

APPENDIX A -- Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Conservation Recommendations

I. INTRODUCTION

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established new requirements for "Essential Fish Habitat" (EFH) descriptions in Federal fishery management plans and to require Federal agencies to consult with the National Marine Fisheries Service (NMFS) on activities that may adversely affect EFH. EFH for Pacific Coast salmon has been described in Appendix A, Amendment 14 to the Pacific Coast Salmon Fishery Management Plan. The Potter Valley Project (Project) affects two watersheds that have been designated EFH for salmon, the Eel River and the Russian River.

Only species managed under a Federal fishery management plan are covered under the MSFCMA. Coho salmon and Chinook salmon are managed under Federal fishery management plans, whereas steelhead are not managed. Therefore, these Essential Fish Habitat Conservation Recommendations address only coho salmon and Chinook salmon and do not address steelhead.

II. LIFE HISTORY AND HABITAT REQUIREMENTS

General life history information for Chinook salmon and coho salmon is summarized in the preceding biological opinion. Additional detailed information on Chinook salmon ESUs is available in the NMFS status review of Chinook salmon from Washington, Idaho, Oregon, and California (Myers *et al.* 1998), and the NMFS proposed rule for listing several ESUs of Chinook salmon (63 FR 11482). Further detailed information on coho salmon ESUs is available in the NMFS status review of coho salmon from Washington, Oregon, and California (Weitkamp *et al.* 1995).

III. PROPOSED ACTION

The proposed action is described in the preceding Biological Opinion.

IV. EFFECTS OF THE PROJECT ACTION

Effects of the proposed project on salmon EFH are those associated with streamflow diversion, significantly reducing water flows in the Eel River and increasing water flow in the Russian River. In the Eel River, salmon EFH is adversely affected by these reduced flows due to loss of habitat, increased water temperature, and reduced water quality, as well as providing competitive advantages to the Sacramento pikeminnow, a known predator of juvenile salmonids.

Effects of the Project on salmon EFH in the Russian River result from the increased flows caused by the diversion of water from the Eel River. The effects include: increased agriculture and development resulting in increased pollution and other human impacts; and, unnaturally-high flows adversely affect rearing juveniles by increasing water temperatures through the mixing of stratified pools, thereby increasing vulnerability to disease, proliferation of predatory and competing introduced species, altered invertebrate communities, and geomorphologic function.

V. CONCLUSION AND EFH CONSERVATION RECOMMENDATIONS

After reviewing the effects of the Project, NMFS believes that the project action, as proposed, will adversely affect the EFH of Chinook and coho salmon in both the Eel River and the Russian River.

Section 305(b)(4)(A) of the MSFCMA authorizes NMFS to provide EFH Conservation Recommendations that will minimize adverse effects of an activity on EFH. For this project, NMFS recommends that the terms and conditions and conservation recommendations of the preceding Biological Opinion be adopted as EFH Conservation Recommendations for Pacific coast salmon. Additionally, NMFS recommends that the Diversion plan as proposed in the Project not be implemented, but that the Reasonable and Prudent Alternative be implemented instead.

VI. FEDERAL AGENCY STATUTORY REQUIREMENTS

The MSFCMA (Section 305(b)(4)(B)) and Federal regulations (50 CFR Section 600.920(j)) to implement the EFH provisions of the MSFCMA require Federal action agencies to provide a written response to EFH Conservation Recommendations within 30 Days of its receipt. A preliminary response is acceptable if final action cannot be completed within 30 days. The final response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity on EFH. If your response is inconsistent with our EFH Conservation Recommendations, you must provide an explanation for not implementing those recommendations.

VII. LITERATURE CITED

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grand, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. United States Department of Commerce, National Oceanic and Atmospheric Administration Technical Memorandum NMFS-NWFSC-35.

Weitkamp, L.A., T.C. Wainwright, G.J. Bryant, G.B. Milner, D.J. Teel, R.G. Kope, and R.S. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California.

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