ORIGINAL

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
525 NE Oregon Street
PORTLAND, OREGON 97232-2737

F/NWR5

May 28, 2004

Magalie Roman Salas, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

RE: Draft Biological Opinion for Endangered Species Act Section 7 Consultation for the Baker River Hydroelectric Project (FERC No. 2150). NOAA Fisheries Consultation No. 2002/01040.

Dear Secretary Salas:

Enclosed is a Draft Biological Opinion prepared by the National Marine Fisheries Service (NOAA Fisheries) on the Federal Energy Regulatory Commission's (FERC) proposed amendment to the current license for the operation of the Baker River Hydroelectric Project (FERC No. 2150). This document represents NOAA Fisheries' biological opinion of the effects of the proposed action on listed species in accordance with Section 7 of the Endangered Species Act of 1973 as amended (16 USC 1531 *et seq.*). This represents NOAA Fisheries' response to your August 14, 2002, letter and enclosed biological assessment requesting consultation.

In this Draft Biological Opinion, NOAA Fisheries has determined that the proposed action is not likely to jeopardize the continued existence of the Puget Sound chinook salmon.

Enclosed as Section 9 of the Draft Biological Opinion is a consultation regarding essential fish habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267). NOAA Fisheries finds that the proposed action will adversely affect EFH for chinook salmon, coho salmon, and pink salmon, and recommends that the terms and conditions of Section 8.4 of the biological opinion be adopted as EFH conservation measures.

NOAA Fisheries acknowledges Puget Sound Energy's (PSE) proposed adjustments to the "interim protection plan" contained in the amendment to the current Baker Hydroelectric Project operating license (FERC No. 2150). These adjustments were described in a letter from PSE to FERC dated March 14, 2004:

1. The dates for the Early Chinook Spawning Period (October 1-October 21) and the Late Chinook Spawning Period (October 21-November 15) are changed to September 15-October 15 and October 16-November 15, respectively.

2. During low flow conditions in both the Early and Late Chinook Spawning Periods (paragraph 2 in each respective section), the point where flow exceedence is measured is moved from the Baker River to the Skagit River. The new definitions of low flow conditions are: Flows in the Skagit River, as measured above the confluence of the Skagit River and the Baker River, less than 4,200 cfs during the Early Chinook Spawning Period, or less than 6,000 cfs during the Late Chinook Spawning Period. Under these conditions, low flow augmentation measures may be used.

NOAA Fisheries appreciates PSE's efforts to improve protection for salmon in the Baker and Skagit Rivers through adjustments to the proposed license amendment. NOAA Fisheries assumes that PSE's proposal of the adjustments indicates that they do not consider this to be a major change to their proposed action. The proposed adjustments are incorporated into the Draft Biological Opinion as a reasonable and prudent measure to reduce take of Puget Sound chinook salmon.

Comments on the draft biological opinion should be received within 30 days after receipt of this letter. If FERC needs additional time, please contact us to discuss further. Applicant comments on the draft biological opinion must be officially submitted to NOAA Fisheries via FERC, although the Applicant may send a copy of its comments directly to us [50 CFR 402.14 (g)(5)]. Please direct comments or questions regarding this biological opinion and MSA consultation to Blane Bellerud, Fish Biologist, at 503-231-2238 or email Blane.Bellerud@noaa.gov.

Sincerely,

Keith Kirkendall

for Brian J. Brown
Assistant Regional Administrator
Hydropower Division

Enclosure

cc. Original & 8 Copies to the Secretary
Service List

Endangered Species Act
Section 7 Consultation

Draft Biological Opinion

and

Magnuson-Stevens Fishery Conservation and Management Act Consultation

License Amendment for Operation of the
Baker River Hydroelectric Project (FERC No. 2150) through April 2006
Baker River, HUC 17110007
Skagit and Whatcom Counties, Washington

Action Agency:	Federal Energy Regulatory Commission
Consultation Conducted by:	NOAA Fisheries Northwest Region Hydropower Division
NOAA Fisheries Log Number:	2002/01040
Date:	May 28, 2004

TABLE OF CONTENTS

1. INTRODUCTION ... 1-1
1.1 Introduction ... 1-1
1.2 Description of the Action Area ... 1-2
1.3 Consultation History ... 1-2
1.4 Tribal Notification ... 1-4
1.5 USFWS Coordination ... 1-4
1.6 Evaluating Proposed Actions ... 1-4

2. DESCRIPTION OF PROPOSED ACTION ... 2-1
2.1 General Description of the Project ... 2-1
2.1.1 Upper Baker Project ... 2-3
2.1.1.1 Fish Passage Facilities ... 2-5
2.1.2 Lower Baker Project ... 2-6
2.1.2.1 Fish Passage Facilities ... 2-10
2.1.3 Operations and Maintenance of Project Structures ... 2-11
2.1.3.1 Power Scheduling and Generation ... 2-11
2.1.4 Fish Propagation and Release ... 2-12
2.2 Proposed Action ... 2-12
2.2.1 Down Ramping Rate ... 2-15
2.2.2 Research and Monitoring Activities ... 2-17
2.3 Term of this Biological Opinion ... 2-17

3. CRITICAL HABITAT ... 3-1

4. STATUS OF SPECIES ... 4-1
4.1 Biological Opinion ... 4-1
4.2 Biological Requirements ... 4-1
4.3 Status of Species ... 4-1
4.3.1 Puget Sound Chinook Salmon ... 4-2

5. ENVIRONMENTAL BASELINE ... 5-1
5.1 Status of Species within the Action Area ... 5-1
5.1.1 Puget Sound Chinook Salmon ... 5-1
5.1.1.1 Life History ... 5-1
5.1.1.2 Juvenile Rearing and Migration ... 5-2
5.1.1.3 Abundance ... 5-3
5.1.1.4 Productivity/Population Trajectory ... 5-3
5.1.1.5 Distribution ... 5-4
5.1.1.6 Diversity ... 5-4
5.1.1.7 Hatchery Effects ... 5-5

5.2 Physical Description and Status of Habitat Within the Action Area 5-6
5.3 Baseline Conditions 5-10
5.3.1 Water Quality 5-12
5.3.1.1 Water Quality: Temperature 5-12
5.3.1.2 Water Quality: Turbidity 5-12
5.3.1.3 Water Quality: Dissolved Substances 5-13
5.3.2 Habitat Access: Barriers 5-14
5.3.2.1 Habitat Access: Barriers - Upstream 5-14
5.3.2.2 Habitat Access: Barriers - Downstream 5-14
5.3.3 Habitat Elements 5-15
5.3.3.1 Habitat Element: Substrate 5-15
5.3.3.2 Habitat Element: Large Woody Debris 5-15
5.3.3.3 Habitat Element: Pool Frequency/Quality 5-16
5.3.3.4 Habitat Element: Refugia and Off-Channel Habitat 5-16
5.3.4 Channel Dynamics 5-17
5.3.4.1 Channel Dynamics: Channel Morphology 5-17
5.3.4.2 Channel Dynamics: Streambank Condition 5-17
5.3.4.3 Channel Dynamics: Floodplain Connectivity 5-18
5.3.4.4 Channel Dynamics: Altered Flows 5-18
5.3.5 Watershed Condition 5-21
5.3.5.1 Watershed Condition: Road Density/Drainage Network 5-21
5.3.5.2 Watershed Condition: Disturbance History 5-22
5.3.5.3 Watershed Condition: Riparian Reserves 5-23
5.4 Biotic Interactions 5-24
5.4.1 Increased Predation 5-24
5.4.2 Competition/Predation with Native Species or Hatchery Fish 5-24
5.4.3 Harvest 5-24
5.5 Historical Project Effects 5-24
5.5.1 Water Quality: Temperature 5-24
5.5.2 Habitat Access: Barriers - Upstream Migration 5-25
5.5.3 Habitat Access: Barriers - Downstream Migration 5-26
5.5.4 Habitat Element: Substrate 5-26
5.5.5 Habitat Element: Large Woody Debris 5-26
5.5.6 Habitat Element: Refugia and Off-Channel Habitat 5-26
5.5.7 Channel Morphology 5-27
5.5.8 Altered Flows - False Attraction Flows and Migration Delay 5-27
5.5.9 Altered Flows - High Flows 5-27
5.5.10 Altered Flows - Minimum Flows 5-27
5.5.11 Altered Flows - Flow Fluctuations 5-27
5.5.12 Altered Flows - Ramping 5-28
5.5.13 Routine Maintenance 5-30
5.6 Summary of Environmental Baseline 5-30

6. ANALYSIS OF EFFECTS OF THE PROPOSED ACTION 6-1
- 6.1 Effects of Proposed Action 6-1
- 6.2 Methods of Analysis 6-1
- 6.3 Direct Effects of the Project 6-2
  - 6.3.1 Effects of Continued Operations 6-2
  - 6.3.2 Effects of Modified Operations 6-2
- 6.4 Indirect Effects 6-3
- 6.5 Summary 6-3

7. CUMULATIVE EFFECTS 7-1

8. CONCLUSION 8-1

9. INCIDENTAL TAKE STATEMENT 9-1
- 9.1 Amount and Extent of Anticipated Take 9-1
- 9.2 Effect of Anticipated Take 9-1
- 9.3 Reasonable and Prudent Measures 9-1
- 9.4 Terms and Conditions 9-2

10. CONSERVATION RECOMMENDATIONS 10-1

11. REINITIATION OF CONSULTATION 11-1

12. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT 12-1
- 12.1 Background 12-1
- 12.2 Identification of EFH 12-2
- 12.3 Proposed Action 12-2
- 12.4 Effects of Proposed Action 12-2
- 12.5 Conclusion 12-2
- 12.6 EFH Conservation Recommendations 12-2
- 12.7 Statutory Response Requirement 12-3
- 12.8 Supplemental Consultation 12-3

13. LITERATURE CITED 13-1

LIST OF TABLES

Table 1. ESA status of listed anadromous salmonids in the Skagit River Basin. 4-2
Table 2. Estimated brood-year harvest rates on PSTRT-defined populations of Skagit River Basin chinook salmon 5-3
Table 3. Estimates of historical capacity, recent spawning counts, and lambda (rate of population change) estimates for Skagit Basin populations of Puget Sound chinook salmon 5-4
Table 4. Estimates of hatchery fish in natural escapements, estimated returns of hatchery-born chinook salmon, and most recent releases in the Skagit River Basin ... 5-5
Table 5. Pool frequency for properly functioning condition 5-16
Table 6. Washington State ramping rate standards 5-29
Table 7. Matrix of Pathways and Indicators for the environmental baseline 5-31
Table 8. Analysis of project effects 6-5
Table 9. Studies described in Appendix D of the Biological Assessment 9-3

LIST OF FIGURES

Figure 1. The Baker River Hydroelectric Project in Concrete, Washington 2-2
Figure 2. Diagram of downramping curve at Lower Baker Dam 2-16
Figure 3. Map of Baker River before and after construction of the Baker River Hydroelectric Project 5-8
Figure 4. Average monthly flows of Skagit River at Mount Vernon, Washington, 1941-2002 5-9
Figure 5. Peak flows in the Skagit River, 1910-2002 5-10

ACRONYMS AND ABBREVIATIONS

AR	at risk
BA	biological assessment
Baker Project	Baker River Hydroelectric Project, FERC No. 2150
cfs	cubic feet per second
ECA	equivalent clear-cut area
EDT	Ecosystem Diagnostic Tool
EFH	essential fish habitat
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FCE	fish collection efficiency
FERC	Federal Energy Regulatory Commission
fmsl	feet above mean sea level
ft	foot, feet
LSOG	late successional old growth [timber]
LWD	large woody debris
m	meter
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MW	megawatt
NOAA Fisheries	National Oceanic and Atmospheric Administration Fisheries (National Marine Fisheries Service)
NPF	not properly functioning
NWFP	Northwest Forest Plan
PFC	properly functioning condition
PSE	Puget Sound Energy
PSTRT	Puget Sound Technical Recovery Team
RM	river mile
RPM	reasonable and prudent measure
Skagit Project	Skagit River Hydroelectric Project, FERC No. 553
USC	United States Code
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WCC	Washington Conservation Commission
WDFW	Washington Department of Fish and Wildlife
WLCTRT	Willamette/Lower Columbia Technical Recovery Team

1. INTRODUCTION AND CONSULTATION HISTORY

The Endangered Species Act (ESA) of 1973 (16 USC 1531-1544), as amended, establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the National Marine Fisheries Service (NOAA Fisheries) and the U.S. Fish and Wildlife Service (USFWS), as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species. The Skagit River Basin is inhabited by one protected salmonid evolutionarily significant unit (ESU): Puget Sound chinook salmon.

The Federal Energy Regulatory Commission (FERC) proposes to amend the hydroelectric license of Puget Sound Energy, Inc. (PSE) for the operation of the Baker River Hydroelectric Project (FERC No. 2150), located near Concrete, Washington. The purpose of this license is to generate and sell electricity, as well as to promote comprehensive development of the waterway. FERC is proposing to amend the license amendment according to its authority under the Federal Power Act.

This Biological Opinion (hereinafter, the Opinion) is the product of an interagency consultation pursuant to Section 7(a)(2) of the ESA and implementing regulations found at 50 CFR §402. The objective of this Opinion is for NOAA Fisheries to determine whether the FERC-proposed authorization of the license amendment is likely to jeopardize the continued existence of ESA-listed species. The analysis also fulfills requirements under Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), which requested Federal agencies to consult with NOAA Fisheries if their actions may adversely affect essential fish habitat (EFH). The administrative record for this consultation is on file with the Hydropower Division, NOAA Fisheries, Northwest Region.

1.1 Introduction

The Baker River Hydroelectric Project, FERC No. 2150 (hereinafter, the Baker Project), is owned and operated by PSE. The Baker Project consists of two hydroelectric generating developments, both located on the Baker River in Washington State. Construction of the Lower Baker Development, including the Lower Baker Dam at river mile (RM) 1.1, was completed in 1925 prior to the enactment of the Federal Power Act. In 1927, the Federal Power Commission, now the FERC, issued a license to Puget Sound Power & Light Company (now known as PSE) to operate the Lower Baker Development. The Federal Power Commission subsequently issued a license in 1956 to construct the Upper Baker Development. The 1956 license, which remains in effect today, combined the operations of both developments into a single Federal license for the Baker Project. Construction of the Upper Baker Development, including the Upper Baker Dam at RM 9.2, was completed in 1959.

1.2 Description of the Action Area

An action area is defined by NOAA Fisheries' regulations (50 CFR §402) as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action."

The action area for the proposed action extends from the upstream limits of Baker Lake reservoir, downstream on the Baker River to the confluence of the Baker and Skagit Rivers, and downstream from the confluence to the mouth of the Skagit River. The entire delta area of the Skagit River mouth (between the North and South Forks of the Skagit River) is included in the action area. The Baker River, from the head of Baker Lake reservoir to its confluence, is dominated, indeed almost totally inundated, by the two dams and reservoirs of the Baker Project. The Baker River provides 18% of flows to the Lower Skagit River, and ramping and other flow modifications of the Baker River have a strong influence on Lower Skagit River levels, connectivity with off-channel habitat, and channel-forming processes. Consequently, many of the direct and indirect effects of operation of the Baker Project, discussed below, are experienced throughout the Lower Skagit River, as well as in the Baker River.

1.3 Consultation History

The Baker Project license expires in 2006. PSE filed a notice of intent to relicense the Project in April 2001 and file an application to relicense the Project on or before April 30, 2004. In advance of that filing, PSE (as the prospective license applicant) initiated informal consultation as the non-Federal designee under Section 7 of the ESA with respect to relicensing of the Baker Project.

By letter dated March 5, 2001, FERC authorized PSE to act as its non-Federal designee in consultation with NOAA Fisheries and the USFWS, subject to limitations described in FERC's order.

On August 14, 2002, NOAA Fisheries received a copy of a biological assessment (BA) from FERC addressing the effects of Baker Project operations and the proposed interim protection plan on Puget Sound chinook salmon. The interim protection plan describes operation and actions that will be implemented prior to expiration of the current license on April 30, 2006. Modifications to the current license will be implemented during the interim period through an amendment to the license.

Based on the analysis and conclusion of the BA, FERC concluded that the operation of the Baker Project and its proposed interim conservation measure are likely to adversely affect listed Puget Sound chinook salmon in the Baker and Skagit Rivers, and requested initiation of formal consultation under Section 7 of the ESA. The letter further noted that the coordinated flow management plan, proposed as an alternative in the proposed license amendment, was eliminated from consideration as PSE and Seattle City Light had not reached an agreement regarding coordinating load-following operations.

In a reply letter to FERC dated January 29, 2003, NOAA Fisheries determined that the BA did not include all of the information necessary to initiate formal consultation as outlined in the regulations governing interagency consultations (50 CFR §402.14). NOAA Fisheries requested the following additional information to properly analyze the proposed action:

1. An analysis of the proposed action based upon the correct spawning period (September 15 through November 15) specifically related to the percentage of chinook salmon escapement using the Middle Skagit River that could potentially benefit from the proposed action.

2. An analysis of the proposed action as it affects pink and coho salmon (for which EFH has been designated under the MSA).

3. An analysis (including examples and hydrologic data) of the proposed flow management plan as it would affect flows in the Skagit River and provide redd protection and incubation flows during typical low and average water years, focusing on the percentage of chinook salmon escapement using the Middle Skagit River that could potentially benefit from the proposed action.

   This analysis may benefit from an instream flow incremental methodology study to delineate and determine the amount of affected habitat in the Middle Skagit River. Thus NOAA Fisheries requested any information on flow levels in the Middle Skagit River which generate redd scour and how often these flows can be expected to occur during spawning incubation periods during low and average water years.

4. An analysis of the benefits of improved ramping rates to the survival of chinook salmon in the Middle Skagit River. The effect on project storage and flood control would also have to be determined.

In a letter received by NOAA Fisheries on March 14, 2003, FERC indicated that it believed that all of the best available scientific and commercial information had been incorporated in the BA.

In a letter to FERC dated April 23, 2003, NOAA Fisheries acknowledged receipt of the March 14, 2003, letter, and indicated that, while some of the requested information was not required to initiate consultation, the following critical information needs remained: Item 1 - Reanalysis of the spawning period, and Item 3 - Analysis of the flow management plan. NOAA Fisheries agreed to proceed with formal ESA consultation and stated that it would make efforts to fill in information gaps during consultation. The letter further indicated that an initial meeting with PSE to discuss the requested analyses and other information was set for April 29, 2003.

After discussions with PSE and FERC, on August 26, 2003, NOAA Fisheries requested an 180-day extension of consultation to allow sufficient time for the analysis of the proposed action based upon the revised spawning dates, to allow sufficient time for PSE to gather and present the additional information requested, and to coordinate with the USFWS. The 180-day extension was granted by FERC in a letter dated October 9, 2003, with the new date for delivery of the biological opinion set as March 29, 2004. Following the initial meeting held on April 29, 2003, through February 4, 2004, a total of six meetings and two conference calls were held with PSE and FERC to discuss information requests and further analysis. During the course of the consultation the remaining issues were addressed.

During a phone conference held between NOAA Fisheries and PSE on February 4, 2004, PSE presented an analysis of modified start and end dates for the proposed flow plan and a change in the location of monitoring. In a letter to FERC dated March 16, 2004, PSE expressed its desire to adjust the proposed action to include those changes. NOAA Fisheries incorporated the proposed adjustments into the reasonable and prudent measures of the incidental take permit (Section 9.3) of this Opinion.

1.4 Tribal Notification

On February 11, 2004, in accordance with the Secretarial Order concerning American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the ESA (June 5, 1997), NOAA Fisheries sent letters to the Upper Skagit Tribe, the Swinomish Tribe, the Sauk-Suiattle Tribe, and the Nooksack Tribe. The letters notified these Tribes that NOAA Fisheries was initiating an ESA consultation that may affect Indian lands, tribal trust resources, or the exercise of American Indian tribal rights, and solicited any information, traditional knowledge, or comments the Tribes wished to provide to help in this consultation. NOAA Fisheries did not receive responses from any of the Tribes contacted.

1.5 USFWS Coordination

The listed species of concern for USFWS in this consultation is bull trout (*Salvelinus confluentus*). NOAA Fisheries has maintained contact with USFWS personnel during the consultation portion of this Opinion to avoid conflict and identify areas of potential cooperation.

1.6 Evaluating Proposed Actions

This section reviews the approach used in this Opinion in order to apply the standards for determining jeopardy and destruction or adverse modification of critical habitat as set forth in Section 7(a)(2) of the ESA and as defined by 50 CFR §402.02 (the consultation regulations). Additional guidance for this analysis is provided by the Endangered Species Consultation Handbook, March 1998, issued jointly by NOAA Fisheries and the USFWS. In conducting analyses of actions under Section 7 of the ESA, NOAA Fisheries uses the following steps of the consultation regulations:

1. Evaluate biological requirements and current status of the species at the ESU level and within the particular action area (Section 4).

2. Evaluate the relevance of the environmental baseline in the action area to action-area biological requirements and the species' current rangewide and action-area status (Section 5).

3. Determine the direct and indirect effects of the proposed or continuing action on the species and on any designated critical habitat (Section 6).

4. Determine and evaluate any cumulative effects within the action area (Section 7).

5. Evaluate whether the effects of the proposed action, taken together with any cumulative effects and added to the environmental baseline, can be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the affected species, or is likely to destroy or adversely affect their designated critical habitat (Section 8). (See CFR §402.14(g).)

If NOAA Fisheries determines the action under consultation is likely to jeopardize the ESA-listed species or adversely modify critical habitat, NOAA Fisheries must identify any reasonable and prudent alternatives for the action that avoid jeopardy or adverse modification of critical habitat and meet the other regulatory requirements for reasonable and prudent alternatives. (See CFR §402.02.)

2. DESCRIPTION OF PROPOSED ACTION

2.1 General Description of the Project

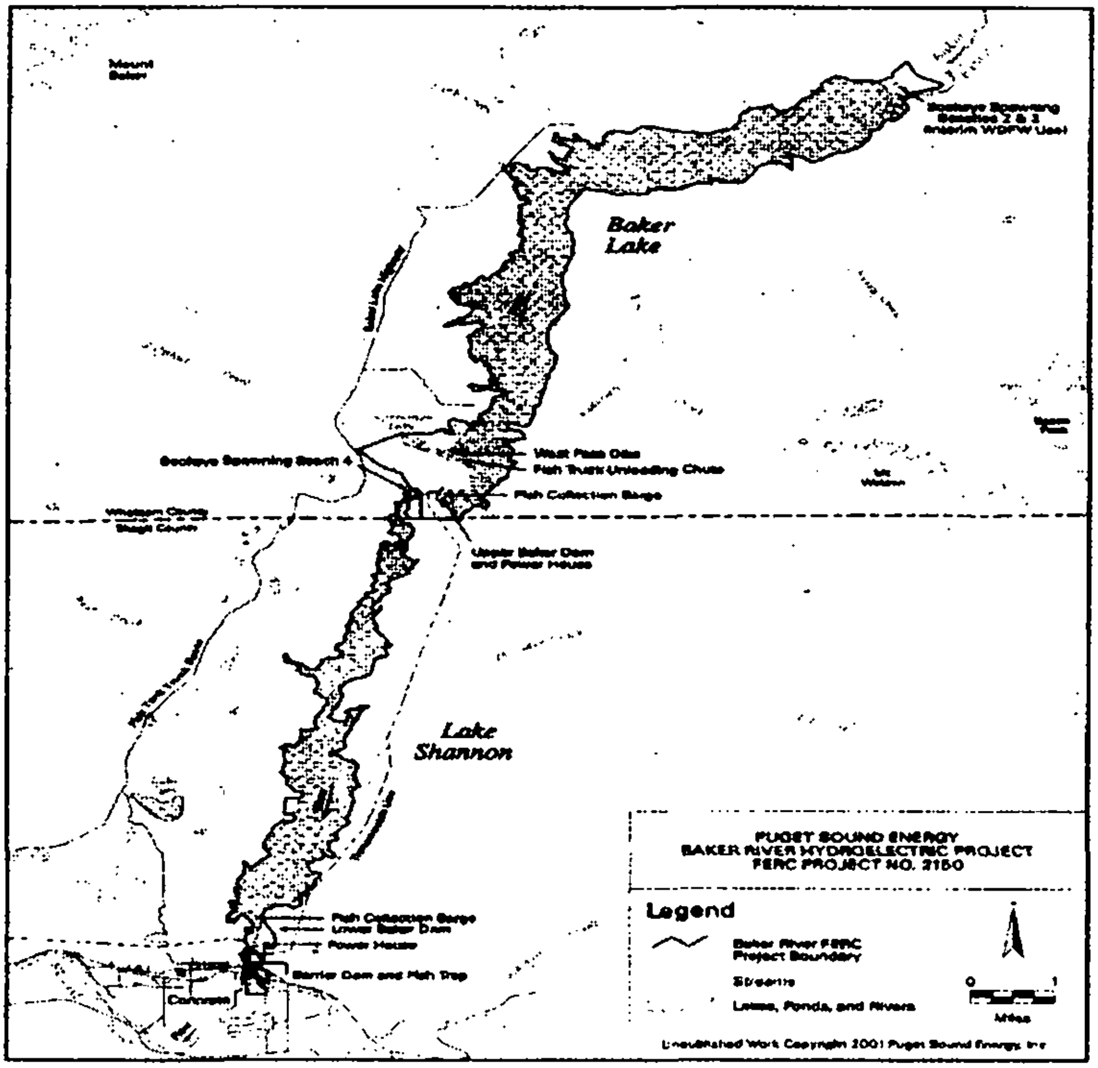
The Baker Project is located on the Baker River, a tributary of the Skagit River, in northwest Washington near the town of Concrete, Washington. The Baker Project area covers 8,247 acres and is located in both Skagit and Whatcom Counties. The Baker Project comprises two hydroelectric dams and their reservoirs and spans from RM 0.6 to approximately RM 19 on the Baker River. Figure 1 is a map of the Baker Project and associate reservoirs

Operation of the Baker Project affects flows in the lower 1.1 miles of the Baker River, and affects flows in the mainstem Skagit River downstream of RM 56.5. The Baker Project is typically operated as a load-following plant, operating once or twice a day, usually during mornings (i.e., 0600 to 1000) and evenings (i.e., 1700 to 2100). These periods of operation vary daily, weekly, and seasonally in response to power demands and power value. For instance, electrical demand is generally higher during Monday through Friday and, in response, the Baker Project may not operate during the weekend. Daily peaking operations may cause flows in the Lower Baker River to fluctuate up to 4,200 cfs.

The Upper Baker Development of the Baker Project consists of Upper Baker Dam, a powerhouse, a reservoir, and associated facilities, located in Whatcom County approximately 8 miles north of Concrete, Washington. The Upper Baker powerhouse contains two generating units with a combined authorized installed capacity of 90.7 megawatts (MW). Baker Lake, the reservoir behind the Upper Baker Dam, is about 9 miles long and covers an area of about 4,800 acres at normal full pool (El. 724.0 fmsl). Roughly 285,000 acre-ft of water are stored in Baker Lake at normal full pool.

The Lower Baker Development consists of the Lower Baker Dam, a powerhouse, a reservoir and associated facilities. Lower Baker Dam is located approximately 1 mile north of Concrete, Washington, and 1.2 RM upstream from the confluence of the Baker and Skagit Rivers (Skagit RM 56.5). The powerhouse contains a single generating unit that had an authorized installed capacity of 71.4 MW; in 2001, the unit was rebuilt and now has an anticipated authorized installed capacity of 79.3 MW. Lake Shannon, the reservoir formed by Lower Baker Dam, is approximately 7 miles long and covers an area of about 2,190 acres at normal full pool (El. 438.6 fmsl). Roughly 160,000 acre-ft of water are stored in Lake Shannon at normal full pool.

Figure 1. The Baker River Hydroelectric Project in Concrete, Washington.



2.1.1 Upper Baker Project

The Upper Baker Development begins at RM 9.35. This development consists of a concrete gravity dam, an earthen dam, a powerhouse, fish passage facilities, a substation, artificial spawning beaches, Depression Lake, a water recovery pumping station, and miscellaneous maintenance buildings. Construction of Upper Baker began in June 1956, and the plant began commercial operation in October 1959.

The primary dam at Upper Baker is a concrete gravity dam 312 ft high and about 1,200 ft long, including the spillway, non-overflow, and intake sections. The roadway over the dam has a clear width of 12 ft and is at El. 732 fmsl. An inspection gallery running nearly parallel to the rock abutments and foundation is provided inside the dam. The downstream face of the dam is sloped 7 to 10 (horizontal to vertical).

The spillway is an integral part of the main gravity dam. It has an ogee-type overfall and a long apron extending downstream. The crest is at El. 694 fmsl. Three tainter gates, each 25 ft wide by 30 ft high, control the spillway discharge. FERC classifies these tainter gates as Category One, which requires an annual spill test of each gate (test of emergency power and monitoring of lifting volts and current) and a full opening test every five years. The two intermediate reinforced concrete piers are 9 ft wide. The spillway width between the two downstream training walls is 93 ft. At the lower end of the spillway, the two walls are trained inward to constrict the spillway apron width to about 45 ft at the discharge end. The spillway apron is located about 100 ft above the Baker River channel. Spillway discharge water falls over the end of the apron into the channel below. Reinforced concrete beam bridges carry the roadway over the three spillway openings. The spillway capacity is about 48,000 cfs at the normal full pool El. of 724 fmsl. Spillgate operation is manual.

The intake section proper is located in the center of the dam and is of concrete gravity construction. The intake provides two water passages into the powerhouse. Each water passage has a bell-mouth entrance, an intake gate slot, an emergency stoplog slot, and a penstock. The steel intake gates are of the fixed-wheel type, 20 ft high by 16 ft wide. Each gate is raised or lowered by an electrically operated drum-type hoist and has remote control capability. Each hoist is mounted on a platform in a housing above the deck to permit raising the gates above deck level for maintenance. Emergency stoplogs may be used in the slots upstream of the gates. The intake gate lower seat is at El. 634 fmsl and the intake gate upper seat is at El. 654 fmsl, permitting reservoir drafting to El. 674 fmsl for power generation. Each steel penstock is 13.5 ft in diameter by 320 ft long. The hydraulic height is 297 ft. A fish baffle suspended from two rows of floating pontoons is located in front of the two intake openings. It consists of corrugated aluminum siding bolted to structural aluminum trusses guided at the two ends, which allows the entire structure to move up and down as the reservoir level fluctuates. The baffle in plan view is in the shape of the six chords of a half cylinder with a radius of about 37.5 ft. The half cylinder extends 100 ft below the surface; fish attempting to enter the intake would pass through the bottom of the baffle. In 2001, modifications were made to the baffle to permit flows near the surface to pass through the baffle.

The non-overflow sections of the dam are a gravity-type concrete structure. They extend for more than 550 ft to the north of the intake section, approximately 100 ft between the intake and spillway sections, and about 350 ft on the south side of the spillway sections. There are stair towers near each end of the dam in the non-overflow sections to provide access to the inspection gallery.

The foundation of the powerhouse totally encases the two elbow-type draft tubes and tailrace. The draft tubes discharge directly to the Baker River channel. The tailrace deck is accessible from the generator floor. Draft tube outlets can be closed by steel gates. When not in use, they are in a hoisted position in a slot just below the tailrace deck. The draft tube gates can be lowered and raised from the tailrace deck using a motor-driven hoist mounted on a traveling crane. The two draft tube gates each measure 10 ft by 16 ft. The channel follows the natural riverbed downstream of the powerhouse and terminates in Lake Shannon. The channel bottom is approximately at El. 420 fmsl and the bottom width varies from 50 to 100 ft.

The earth and rock-filled dam, known as West Pass Dike, is 115 ft high and 1,200 ft long, and is located about 1,500 ft northwest of the powerhouse. The 20-ft-wide crest is at El. 734 fmsl; a gated road passes across the dam. The upstream face is sloped approximately 2.5 to 1 (horizontal to vertical). The downstream face is generally sloped 1.3 to 1. West Pass Dike is a layered construction placed on top of a dumped rock-fill structure. On the upstream side of the dike are four layers: a compacted, impervious fill layer on the bottom; a sand and gravel filter layer; a rock fill layer; and riprap on the upstream face. At the upstream toe, a compacted impervious fill is laid horizontally on the rock fill and is overlaid with an impervious puddled clay layer that ties into the underlying rock strata.

Depression Lake is situated in a natural depression located on the west side of West Pass Dike. Water enters Depression Lake, in part, as the result of subsurface leakage from Baker Lake, which is transmitted through native materials that include a series of lava flows underlying both lakes. When Baker Lake drops below El. 698 fmsl, seepage stops. The water that collects in Depression Lake is pumped into Baker Lake by the water recovery pumping station to retain it for power generation. The two vertical propeller recovery pumps are rated at 50,000 gallons per minute (gpm). The pumps operate primarily during off-peak demand periods.

Initially, water was discharged into a short, rough channel leading into Baker Lake. Adult and juvenile fish attracted into this channel faced stranding when pump-back operations stopped. To remove the stranding potential, PSE operated the station only at high reservoir levels when the channel was fully submerged. PSE reconstructed the discharge channel in 2000, eliminating the stranding potential and allowing water recovery operations at any time.

Baker Lake, the reservoir formed by the Upper Baker Development, is about 9 miles long and covers an area of about 4,800 acres at normal full pool (El. 724.0 fmsl). Baker Lake has a total storage capacity of about 285,000 acre-ft at normal full pool. Baker Lake can be drawn down to an elevation of 655 fmsl, which is considered the minimum operating pool. The usable storage between the minimum operating pool and normal full pool is about 221,000 acre-ft.

Storage at Baker Lake began on July 9, 1959. Reservoir stage in most years has reached a maximum elevation of between 723 and 724 fmsl. Based on daily stage data for the period 1974 through 1998, the annual minimum pool elevation averages about 685 fmsl, which represents a drawdown of 39 ft below the normal full pool elevation. Baker Lake receives unregulated inflow from runoff occurring from 215 square miles of the Baker River Basin (this area includes the surface area of Baker Lake). The largest source of water entering Baker Lake is the Baker River, which empties into the reservoir at the northeast corner of the reservoir. Other tributary streams that flow directly into Baker Lake include Swift Creek, Park Creek, Boulder Creek, Sandy Creek, and Noisy Creek.

2.1.1.1 Fish Passage Facilities

Fish facilities at Upper Baker include artificial spawning beaches and downstream passage facilities. Upstream migrating adult salmon in the Baker River are guided by a weir, located at RM 0.6 downstream of the Lower Baker Dam, into a fish trap and into holding bins, from which they are transported by tank truck to either Upper Baker spawning beaches or into Baker Lake, depending on the species. Downstream passage facilities for juvenile salmonids consist of full-depth barrier nets that guide fish to the entrance of a surface collector where they pass to a fish trap and holding facility, from which they are transported by tank truck for release at the mouth of the Baker River.

Guide nets
The first guide nets, installed in 1986 and spanning the forebay extending to a depth of 100 ft, with a mesh size of 2 inches, yielded promising results. In 1987, the mesh size was decreased to one-quarter inch. This allowed juvenile passage only through the surface collector or underneath the net. In 1992, PSE placed a surface-to-lake-bottom net reaching the maximum depth of 285 ft and spanning the forebay. The net remains in the reservoir year round. The net has a 4-inch diameter inflatable hose for flotation at the surface (top), continuous cork floats at a depth of 50-ft, and 1-pound weights sewn in along the bottom at 1-ft intervals following the contour of the reservoir bottom. The guide net connects to the surface collector, which is located about 130 ft upstream of the dam. The surface current resulting from heavy spill could compromise the nets. During a spill event, the top vertical 50 ft of the net is submerged to reduce net drag and surface pull towards the spillgates. This operation is intended to prevent damage to the guide net and spillgate facilities. The net is raised immediately after a spill event to minimize the passage of fish into the forebay area downstream of the net.

Surface collection and passage

Downstream migrating fish are attracted by the simulated sound and movement of water. This attraction flow within the channel is created by the "gulper," a surface collector barge centrally located in the forebay and named after its sound. The gulper is located about 130 ft upstream of the dam. Fish entering the channel are guided over a weir into a flume that directs them into a pipe connecting to the fish trap. The surface collector is constructed of steel angle trusses and is about 36 ft by 70 ft. Within the truss work there are 28 steel flotation tanks that allow adjustable buoyancy.

The fish entrance channel is 12 ft wide by 35 ft long and is constructed of timber floors and walls attached to the steel trusses. The channel contains a sloping timber louver through which water is drawn by two 34,000 gpm pumps. The fish swim up and over this louver into a smaller flume. The fish enter a gravity-flow pipe connected to the fish trap located on the upstream face of the dam. The current trap facility was installed in 1996, replacing the smaller experimental trap, the capacity of which was exceeded. This facility measures 62 ft by 54 ft and is constructed of concrete flotation modules and a submersible steel box, with ballast that is compartmentalized into four raceway channels. The channels are utilized for holding and sorting fish species for sampling. After personnel sample and sort smolts at the trap, the smolts are placed in hoppers, which are raised by crane to the top of the dam and released into a 400-gallon fish tank-trailer. This tank-trailer provides aeration and oxygen diffusion. The smolts are transported to the mouth of the Baker River for release. Prior to 1987, the smolts would exit the fish trap and pass through a pipe that traversed through the dam near the crest, then across and down the face of the dam to empty into the Baker River channel. The smolts would then migrate the length of Lake Shannon. In 1987, an experimental trap-and-haul facility with a collection hopper was constructed, replacing the previous "pass-through" pipeline passage. The "pass-through" pipeline control valve maintains gravity-flow pressures from the gulper to the trap.

2.1.2 Lower Baker Project

The Lower Baker Development consists of a concrete arch dam at RM 1.2, a powerhouse at RM 0.9, a fish barrier dam and trap at RM 0.6, and an office, a visitor center, and maintenance buildings. The development began construction in 1924 and entered commercial operation in November 1925. The original development consisted of four horizontal Francis type turbines driving two generators, Units 1 and 2. In 1960 a vertical turbine-generator, Unit 3, was added, but in 1965 a large landslide destroyed the powerhouse. Subsequently, Units 1 and 2 were abandoned and a new powerhouse structure was built for Unit 3, which was refurbished and reinstalled. Unit 3 was returned to service in September 1968.

Lower Baker Dam is a 570-ft-long concrete gravity arch dam. In 1927, 33 ft of additional height was added to the original Lower Baker Dam, which brought the dam to its present height of 285 ft. The top of the dam, at El. 446.87 fmsl, provides a deck for spillgate equipment and operation. On the east side, above the trash racks, is the intake gatehouse.

The spillway section is in the center of the arch dam directly beneath the top of the dam. The dam's overflow crest is at El. 424.8 fmsl. The spillway contains 23 vertical slide gates that are each 14 ft high and 9.5 ft wide. The bottom of each gate sits on the dam crest. The tops of the gates are at El. 438.8 fmsl allowing a normal, full reservoir at El. 438.6 fmsl. FERC classifies these gates as Category One, requiring spill testing each gate annually and full gate testing every five years. The spillgates are lifted and lowered in a variety of ways. Thirteen are operated by motorized cable hoists, while the remaining ten use a manually operated, electric-powered gate car. Five of the motorized gates may be operated from Puget's Eastside Operations Center; the rest are manually operated. On the left abutment, a standby100-kW generator for spillgate operation is housed. The spillway capacity is about 40,000 cfs at the normal full pool El. 438.6 fmsl.

Intake and penstock
The intake and gatehouse are located near the left abutment of the dam (i.e., east side). Trash racks cover the intake opening, which are 107 ft tall by 50 ft wide. The intake narrows to two openings that are each 20 ft tall by 12 ft wide. The opening size is controlled by the headgates. The intake sill is at El. 330 fmsl. The headgate openings transition from a single 22-ft-diameter vertical penstock, to an elbow, and then to a 22-ft-diameter concrete lined tunnel with a mile slope, which extends horizontally about 895 ft to a bifurcation. At the bifurcation, the tunnel becomes two 16-ft-diameter steel-lined tunnels, one of which supplies Unit 3 and is about 586 ft long. The other tunnel supplied the penstocks to Units 1 and 2, but is plugged and not used.

Tailrace
The tailrace is an integral part of the powerhouse. Water exiting the turbines through the draft tube enters the Baker River. The tailrace deck is at El. 200 fmsl and is accessible from outside the powerhouse. Operation of the draft tube gates is from the tailrace deck. The draft tube gates are 9.67 ft high by 17.5 ft wide and are suspended immediately below the tailrace deck when they are not in use. When the plant is shut down, the gates may be lowered to their closed position, i.e., resting on the draft tube sill.

Baker River fish barrier dam
On the Baker River at RM 0.6, a barrier dam blocks adult fish from continuing upstream and guides them into a trapping facility. The concrete barrier dam crossing the river diagonally is 150 ft long with a 50-ft-wide apron and foundation slab. The crest of the barrier dam is at El. 171 fmsl. The height of the barrier dam was established by the Department of Fisheries, which determined that 8 ft of head was required to assure an effective barrier for migrations from July 1 through November 30. To maximize power generation, the lowest surface elevation is required at the tailrace. Skagit River flood events back water up the Baker River, raising the surface elevation at the barrier dam. Hydraulic analysis indicated that the addition of 2-ft-high crest gates would maintain the required 8 ft of head to block fish passage. Two 75-ft-long radial spillgates with a 2-ft operating range raise the crest elevation to El.173 fmsl, allowing some regulation of the tailwater pool. When closed, the gates are positioned beneath the crest of the dam. The gate arms and trunions are located upstream from the concave gate body. The electric

hoists are located on the abutments, keeping the length of the overflow spillway clear of obstructions. The hoists are manually operated from the east side of the dam. In cross-section, the dam is an A-frame structure that provides a fish passageway behind the spill zone, which directs fish over the entrance weirs to the adult fish trap facility.

Lake Shannon reservoir

Lake Shannon, the reservoir formed by Lower Baker Dam, is about 7 miles long and covers an area of about 2,190 acres at normal full pool (El. 438.6 fmsl). Lake Shannon has a total storage capacity of about 160,000 acre-ft at normal full pool. Lake Shannon can be drawn down to an elevation of 355 fmsl, the approximate elevation of the top of the intake to the penstock, although the minimum pool elevation for generation is about 370 fmsl. The usable storage between the top of the intake and normal full pool is about 142,000 acre-ft.

Storage at Lake Shannon began in November 1925. Reservoir stage in most years reaches the normal full pool elevation of 438.6 fmsl and in many years slightly exceeds this elevation for short periods while water is spilled from the reservoir. Based on daily stage data for the period 1975 through 1998, the annual minimum pool elevation averages about 390 fmsl, which represents a drawdown of about 49 ft below the normal full pool elevation.

The primary source of inflow to Lake Shannon is discharge from the Upper Baker Development. Lake Shannon also receives unregulated inflow from runoff occurring from about 82 square miles of the southern portion of the Baker River Basin. Tributary streams that flow directly into Lake Shannon include Sulphur Creek, Rocky Creek, Bear Creek, and Thunder Creek. Since 1991, the direct drainage to Lake Shannon has been diminished somewhat by the diversion of up to 120 cfs from Rocky and Sulphur Creeks to Baker Lake via the Koma Kulshan hydroelectric project located at Sandy Creek. The reservoir formed by Lower Baker Dam is about 7 miles long and covers an area of about 2,190 acres at normal full pool (El. 438.6 fmsl). Lake Shannon has a total storage capacity of about 160,000 acre-ft at normal full pool. Lake Shannon can be drawn down to an elevation of 355 fmsl, the approximate elevation of the top of the intake to the penstock, although the minimum pool elevation for generation is about 370 fmsl. The usable storage between the top of the intake and normal full pool is about 142,000 acre-ft.

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Lower Baker powerhouse

The powerhouse, located on the east bank at RM 0.9, was rebuilt after the landslide of 1965 to replace the destroyed original structure. The new powerhouse used most of the foundation structure and layout of the original powerhouse below grade-level, El. 200 fmsl. This foundation consists of reinforced concrete structural elements. Above grade-level, the powerhouse is built to withstand a significant landslide. The sloped roof configuration is designed for a landslide to simply slide down and off the powerhouse roof with minimal damage. The walls are constructed of reinforced concrete and the roof is constructed of structural steel framing, with two reinforced concrete access hatches. Since the slide that destroyed the original powerhouse in 1965, a monitoring program has been in place to measure and analyze slope movement and provide information on the stability of the hillside above the rebuilt powerhouse. Surface drainage in the slide area is controlled, and analysis of the area indicates the hillside is stable. The main floor of the powerhouse is roughly 90 ft long by 66 ft wide in usable plan space. This level contains the generator room, the control room, the step-up transformer room, a battery room, and a toilet room. There is a small amount of usable storage space behind the control room where the roof slopes back 56 ft into the hillside. An HVAC equipment room is located in the roof cavity space above the control room. The turbine floor is at El. 186 fmsl and is roughly 90 ft long by 66 ft wide. This floor contains the turbines' wicket gate shift ring access area, switch gear and motor control centers, a butterfly valve access pit, the generator breaker, and the isolated-phase bus duct. A 16-ft diameter butterfly valve is located in the valve pit to cut off penstock flow if access to the turbine scroll case is required. Other features of this floor level are an access hatch into the turbine scroll case and, in the event of a landslide, an escape tunnel which surfaces 300 ft to the south of the building. Lower levels of the powerhouse contain the air compressor room, the transformer oil storage room, the plant sump room, and the draft tube access corridor.

A unique feature of the powerhouse is the external 210-ton bridge crane. The crane also has a 25-ton auxiliary hook. The crane is able to access the step-up transformer and all the turbine generator components through two removable hatches in the powerhouse roof.

Power plant mechanical features

The primary equipment located within the powerhouse is a single turbine generator, Unit 3. The turbine is a vertical-shaft, Francis-style turbine and was originally manufactured by S. Morgan Smith. The original turbine design had an 80,000-hp rating at 227 ft head pressure. In 2001, American Hydro Corporation upgraded the unit by installing a new runner. The upgraded turbine's best gate peak efficiency is 93.8% at 243 ft net head and 4,000 cfs flow. The new power efficiency point rating is 105,774 hp or 79.3 MW. The unit operates at 163.6 rpm through an operating head range of 227 to 265 ft net head.

Power plant electrical features

The original generator, manufactured by General Electric, had a nameplate capacity of 73.6 MW, but in 2001 was rewound by General Electric and up-rated to a nameplate capacity of 85 MW. The generator is cooled using closed air ventilation and water-cooled heat exchangers. The generator output is 13.8 kV and is carried by the isolated-phase bus duct to a single, three-phase, step-up transformer, where it is stepped up to 115 kV transmission voltage. Currently, the transformer limits the amount of power from Lower Baker. The transformer nameplate rating is 70 MW; the transformer is capable of continuous 10% overage, which yields 77 MW as maximum continuous power production. Power from the Lower Baker powerhouse flows to the Baker River switching station, a part of PSE's distribution system. Lower Baker Unit 3 can be operated from the local Lower Baker powerhouse control room or, remotely, from the Eastside Operations Center.

2.1.2.1 Fish Passage Facilities

The upstream fish passage facilities are near the Lower Baker offices (RM 0.6). The adult trapping facility is a concrete and steel structure incorporating a small entrance vestibule, two holding ponds, a brail pond, and a hopper pond. Other features include an intake structure that collects 80 cfs of water from the tailrace pool and distributes it to each of the two ponds to provide attraction flow. The ponds constitute, essentially, a fish ladder, and each pond is regulated by a weir gate.

The entrance vestibule is the lowest chamber; it is 9 ft by 9 ft, and passes 80 cfs of attraction flow water out to the river through the two entrances. The water enters the vestibule both from a diffuser panel in the floor (20 cfs) and over the weir from Holding Pond No. 1 (60 cfs). Holding Pond No. 1 is the next chamber upstream. It is 40 ft by 15 ft and passes 60 cfs of attraction flow water, 20 cfs of which is diffused up from the intake structure, with the rest received from the upstream ponds. Holding Pond No. 2 is 40 ft by 15 ft and passes 20 cfs of attraction water. Of this flow, 10 cfs is diffused from the bottom and 10 cfs flows in from the brail pond. Each of the holding ponds has movable fish crowders that are used to encourage upstream movement of the fish during the sorting, trapping, and hauling operation. The brail pond is 12 ft by 12 ft and has a vertical crowder, or brail, that is used to guide fish into the hopper pond, which is a 10 ft by 12 ft stainless steel hopper holding 1,000 gallons of water and fish. The hopper is lifted by crane and moved over a waiting fish tank truck where the load is transferred into the truck. The tank truck is equipped with aeration and oxygen diffusers. The journey to the Upper Baker facilities takes approximately 20-25 minutes. Sockeye salmon are placed in the spawning beaches and coho salmon are placed in Baker Lake and Lake Shannon.

Guide net

The Lower Baker guide net was installed in 1986, spanning the forebay to a depth of 100 ft, with a mesh size of 2 inches. The net "guides" fish to the gulper, which is located about 600 ft upstream from the dam. Given the success at Upper Baker, the mesh size was decreased to one-quarter inch. In 1992, PSE placed a new guide net reaching a depth of 200 ft. In 2001, PSE added a deeper section. The net extends from shore to shore and from the surface to the contour of the reservoir bottom. The maximum depth is 236 ft. The depth of the 100-ft sections from west to east are 100 ft, 200 ft, 250 ft, 100 ft, 50 ft, and 50 ft. The net has cork flotation across the top and 1-pound weights sewn at 1-ft intervals along the bottom to ensure that the net follows the contour of the reservoir bottom. The nets are removed during the off-migration period, starting in August, and are redeployed in February.

Surface collection

Downstream juvenile fish passage at Lake Shannon is similar to that provided at the Upper Baker facility. The surface collector served as a prototype for the one at Upper Baker. Two

20,000 gpm pumps create the "gulper" attraction flow. Fish entering the channel are guided over a weir into a flume, which connects to a pipeline that discharges into the trap. A juvenile trap/barge facility was installed in 1989. It measures about 68 ft by 36 ft. At the trap, a screen diverts arriving smolts into holding bins. Smolts are counted/sampled by netting and then placed in the exit side of the trap that directs them into the gravity flow pipeline down to the Baker River. Originally, the gulper attraction flow, pipeline flow, and fish trap flow were provided by the gravity-flow discharge pipe that passed through the dam and along the west side of the canyon wall, downstream to a point opposite the powerhouse on the Baker River. In 1999, a heavy spill and small landslides damaged the fish transport pipeline. Instead of repairing the pipeline, a trap-and-haul operation was initiated. A low pressure pump now provides the attraction from the hopper to the trap. Smolts are placed in 200-gallon hoppers, which are transported by mini-barge to shore, where a crane lifts the hopper onto a truck for delivery of the smolts to the mouth of the Baker River.

2.1.3 Operations and Maintenance of Project Structures

Lake Shannon and Baker Lake are reservoirs managed for hydropower generation, fisheries, flood control, and recreation. Water level elevations in both reservoirs fluctuate seasonally in response to flood control measures, operational objectives, and variations in natural inflows to the reservoirs. PSE assists recreation use by continuing to provide access to the reservoirs for boating and fishing.

2.1.3.1 Power Scheduling and Generation

PSE generally attempts to operate the Baker Project to meet the power needs of its customers. On a weekly basis, the demand for electricity is generally higher Monday through Friday than on the weekends. Daily, the demand for power peaks during the morning (i.e., 0600 to 1000) and early evening (i.e., 1700 to 2100) when people are in their homes. Demand is lower during the nighttime and mid-day. These ranges vary from day to day, as well as weekly and seasonally, for a number of reasons. For instance, as days lengthen and warm, people spend less time in their homes, and electricity demand declines. In addition to responding to customer demand, the decision to produce power at the Baker Project depends on weather forecasts, flood control storage, basin in-flows, the amount of water stored in the reservoirs and available for generation, other available PSE generation, total system demand, and fisheries management. Based on 25-year averages, seasonal patterns show that electricity demand in the region is generally higher during the October-to-March time period due to increased electric heating and lighting. In this period, the Baker Project reservoirs are usually drafted during the daily and weekly peaks to provide power to meet the higher demand. This drawdown also serves to make room in the reservoirs for the spring runoff from snowmelt. From November 15 through March 1, PSE averts flood waters by providing storage for the U.S. Army Corps of Engineers (i.e., holding the elevation of the Upper Baker reservoir to 707.9 fmsl).

Due to the snowmelt and lower regional electricity demand during the summer, the reservoirs are traditionally refilled to near full pool during the April-to-July time period. Excess Northwest power generation is sold into high demand markets in California and the Southwest throughout the summer. This trend is changing the way the Northwest reservoirs are utilized during this seasonal period. It is becoming more likely that the reservoirs serving local utilities will be drafted during summer to meet regional market demands while major producers sell power into the Southwest. PSE coordinates operation of the Baker Project reservoirs with its other reservoirs and combustion turbine generating plants. Regionwide coordination among Northwest generators is governed by the Pacific Northwest Coordination Agreement. PSE was one of the original signatories to the Pacific Northwest Coordination Agreement in 1964. Although the two Baker Project dams generally follow similar operational patterns, Lower Baker must pass 35% more water in an average year than does Upper Baker. Lower Baker is further constrained by having a smaller reservoir storage volume and a single turbine generator with a maximum hydraulic capacity of 4,100 cfs, compared to two turbine generators at Upper Baker with a combined maximum hydraulic capacity of 5,100 cfs. The result of these conditions is that Lower Baker has a plant capacity factor of about 70%, whereas Upper Baker's plant capacity factor is more nearly 40%. On a daily operational basis, this means that Lower Baker will have to operate almost 30% longer than Upper Baker just to maintain the water balance between the two reservoirs and avoid spilling water.

2.1.4 Fish Propagation and Release

Current fish propagation activities funded and implemented by PSE are not essential to the protection and recovery of listed salmonid species. PSE proposes to continue coho and sockeye salmon enhancement. These programs are subject to continuous improvement processes, and PSE expects that minor changes may be implemented in the interim period in coordination with tribal, Federal, and State natural resource agencies. The rainbow trout planting program is under review. It will be terminated if NOAA Fisheries and the USFWS find that the activities jeopardize or interfere with recovery of listed species. However, no changes are proposed at this time.

2.2 Proposed Action

The Baker River Hydroelectric Project is operated by PSE. The proposed action is an amendment to the existing license for the Baker Project and continued operations under the current license, with proposed amendments, through the expiration of the current license in 2006.

PSE proposes to amend Article 33 of its Baker Project license by adding the following:

License Article 33:

(i) Baker River Flow Reduction rate. Whenever the total Skagit River flow falls below 18,000 cfs as measured at the Skagit River USGS Gage No. 12194000 near Concrete, WA, operate the Baker Project to limit the average hourly rate of Baker River flow reduction attributable to the Baker Project to a rate not greater than 2,000 cubic feet per second (cfs), and

(ii) Enhanced Flood Control/Split Chinook Spawning Season Flow Management Plan. Subject to and so as not to affect the existing PSE/Corps of Engineers flood control agreement (and absent circumstances beyond PSE's reasonable control), operate the Baker Project during late summer/fall as follows:

Enhanced Flood Control:

Create 115,000 acre-feet of flood storage at the Baker Project by October 1. From October 1 through November 15, available flood storage will not, by virtue of fisheries directed operations exceed 156,000 acre-feet (i.e., PSE will reserve up to 41,000 acre-feet of reservoir storage as a hedge against dry conditions). If the Skagit River flow measured at the USGS gage near Concrete is greater than 40,000 cfs during this period, and Baker Project storage exceeds 74,000 acre-feet, PSE will consult with the Corps of Engineers regarding the timing of flow releases to reduce peak flow. If the flood peak can be significantly reduced, PSE will shutoff all generation and store inflow until the flood crest estimated by the Corps passes the Baker River/Skagit River confluence.

Early Chinook Spawning Period October 1 to 21

1) When Baker River inflow to the Baker Project is between 550 and 2,500 cfs (70% frequency), PSE will store inflow to the Baker Project and avoid generation a the Lower Baker Development

2) During periods fo low inflow (less than 550 cfs, 85% exceedence value), PSE will generate at least 3,200 cfs on a continuous basis not to exceed 156,000 acre-feet of evacuated reservoir storage. If PSE cannot meet the amplitude limitation without violating storage directives, PSE will still try to release no more water than the volume of the Skagit Project load following troughs (subject to high flow conditions outlined below).

3) During periods of high Baker River inflow (greater than 2,500 cfs, 15% exceedence value), PSE will generate power at the Lower Baker Development to restore available flood storage. PSE will initially generate to fill Skagit Project load-following troughs or generate continuously at the Lower Baker Development if needed to maintain 115,000 acre-feed of total flood storage.

Late Chinook Spawning Period October 21 to November 15

1) During the majority of the 24-day late spawning period, PSE will generate power at the Lower Baker Development to restore available flood storage. Depending on the level of available flood storage on October 21, PSE will initially generate into Skagit Project load-following troughs or generate continuously at the Lower Baker Development if needed to restore available flood storage. If available flood storage capacity on October 21 is less than 74,000 acre- feet, PSE will generate continuously to restore flood storage capacity to that level. If the available flood storage capacity is greater than 74,000 acre-feet but less than the target level of 115,000 acre-feet, PSE will evacuate storage through generation at a rate needed to achieve the target storage level by November 15. Flow will preferentially be released during the Skagit Project troughs prior to releasing flows outside of these time periods.

2) During periods of low inflow to the Baker Project (750 cfs, 85% exceedence value), PSE will generate at least 3,200 cfs at the Lower Baker Development into Skagit Project load-following troughs or will generate at 3,200 cfs on a continuous basis not to exceed 156,000 acre-feet of evacuated reservoir storage.

3) During periods of high Baker River inflow (greater than 3,400 cfs, 15% exceedence value), PSE will generate power at the Lower Baker River Development to restore available flood storage. PSE will initially generate into Skagit Project load following troughs or generate continuously at the Lower Baker development if needed to maintain 115,000 acre-feet of total flood storage.

Emergency Exclusion
Flood control measures required to protect human life and property will override requested releases for fisheries benefits. In the event of an emergency power shortage, all available water stored behind the Baker Project reservoirs may be used to generate power.

Monitoring and Reporting
Bi-annually, the licensee shall submit a report to the Commission and National Marine Fisheries Service identifying and describing any instances of project operations that deviate from the proposed conservation measures.

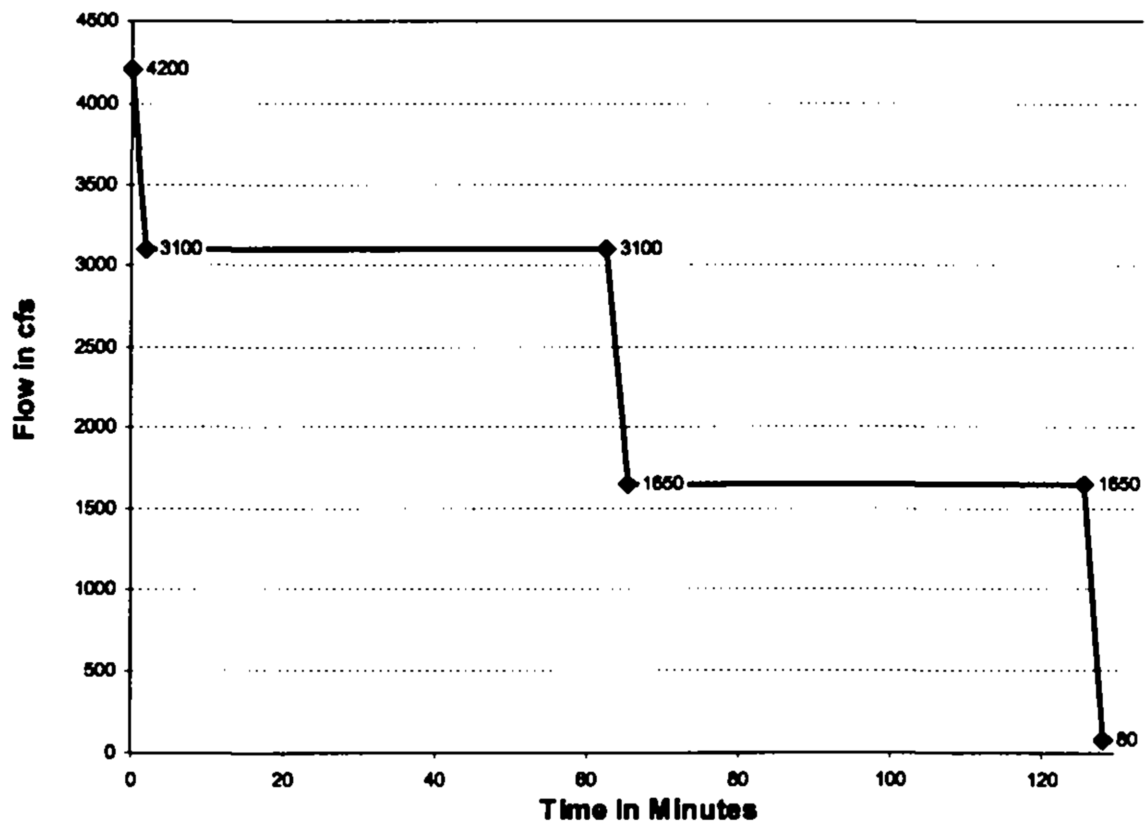
The purpose of the proposed amendment is to reduce the negative effects of project operations on PS chinook salmon redds, eggs and juveniles caused by changing levels of water releases from the project during spawning and incubation. The amount of water released from the Baker project directly effects river levels in the Skagit River downstream of the Baker River confluence. Excessively high flows potentially result in salmon spawning in locations which will be exposed when the river returns to normal flows, low flows may expose redds leading to mortality of PS chinook eggs and juveniles. An alternative to the above flow management plan was also included in the License amendment. It is called the "Enhanced Food Control/Coordinated Flow Management Plan." The adoption of this plan is dependent on reaching an agreement with Seattle City Light to coordinate flows between the Seattle City Light's Skagit Project (FERC No. 553, located on the Upper Skagit River) and the Baker Project to limit flow fluctuations caused by peaking operations. No agreement has been reached at this time so this alternative is not considered in the Biological Opinion.

2.2.1 Down Ramping Rate

Under current operations, water in the Lower Baker River passes through the single power-generating unit at Lower Baker Dam, through a 24-inch bypass pipe (80 cfs), leakage through pressure relief holes in dam abutments, or is spilled through the Lower Baker Dam over the spillway crest at El. 425 ft. When Lower Baker Unit 3 ceases generation, an 80-cfs flow is continually released below Lower Baker through the 24-inch bypass valve to allow operation of the adult trap-and-haul facility. During periods of peak sockeye salmon adult migration (i.e., late June through July), PSE has typically generated for 4 hours beginning at daylight into the Lower Baker River to provide additional attraction for adult fish staging at the confluence of the Baker and Skagit Rivers.

The Lower Baker plant has operated under a voluntary, gradual, unit shutdown program since 1978. PSE limits the average rate of reduction of river flow whenever the total Skagit River flow falls below 18,000 cfs (measured at the Skagit River USGS gage near Concrete, No. 12194000). The purpose of the protocol is to reduce rapid flow reductions in the mainstem Skagit River immediately below the confluence of the Baker River. Figure 2 shows PSE's current downramping profile, which is consistent with the capabilities of the single generating unit at the Lower Baker plant. The recently refurbished Lower Baker generating unit develops severe vibrations when running at less than about 75% capacity. To achieve the downramping protocol, PSE needs to hold the unit for a 1-hour period in the cavitation zone. This activity will continue to be evaluated. When Skagit River flows are greater than 18,000 cfs at the USGS gage near Concrete, PSE does not conduct ramping at the Lower Baker Development.

Figure 2. Diagram of downramping curve at Lower Baker Dam.



2.2.2 Research and Monitoring Activities

PSE plans to file an application to relicense the Baker Project on or before April 30, 2004. In advance of that filing, PSE (as the prospective license applicant) began working with tribal, Federal, State, and local agencies, non-governmental organizations, and private parties to identify studies and monitoring efforts necessary to support an application to relicense the Baker Project. A Hydrology and Aquatic Resource Working Group was formed to develop and review flow, fish, and aquatic habitat related study requests and study plans. Any working group member can prepare and submit a study request that provides the working group with information necessary to evaluate and prioritize study efforts. Once the working group approves the study concept, an in-depth proposal and budget is prepared and distributed to the working group for review. Final approval and funding of the study is decided based on methods described in the Baker River Project Process Document.

A total of 35 study requests have been submitted to the Hydrology and Aquatic Resources Working Group as of February 2002. Several of the study requests were approved in 2001 and field measurement efforts and data analyses are underway. Approval of other study requests is still pending, and some study requests and resultant studies may not proceed. Information developed during relicensing will examine the effects of project operations on listed and non-listed species and their habitats, and are anticipated to be used to identify and develop other conservation measures for their long-term protection.

In addition to research measures described in Appendix D of the BA, monitoring and reporting of flow management measures will be implemented during the interim licensing period. Real-time monitoring of flows at the Baker River USGS gage at Concrete, Washington (No. 12193500) is currently available at the USGS Internet website: wa.water.usgs.gov/realtime/frames_view.html. The USGS Internet site provides a running 7-day record of hourly flow fluctuations below the Lower Baker Project that clearly identifies the effects of project operations. Every 6 months, PSE will submit a report to NOAA Fisheries and FERC identifying and describing any instances of project operations that deviate from the proposed conservation measures.

2.3 Term of this Biological Opinion

The term of this Opinon is from its issuance until the expiration of the current Baker Project license on April 30, 2006. This Opinion does not cover any license extensions, annual license, subsequent licenses, or other actions that authorize operations beyond the expiration of the current hydropower license.

3. CRITICAL HABITAT

This Opinion does not include a critical habitat analysis, because critical habitat designation for this ESU was recently vacated by court order. On February 16, 2000, NOAA Fisheries designated critical habitat for 19 ESUs of chinook, chum, and sockeye salmon as well as steelhead trout in Washington, Oregon, Idaho, and California. On September 27, 2000, NOAA Fisheries approved Amendment 14 to the Pacific Coast Salmon Fishery Management Plan designating marine and freshwater EFH for Pacific salmon pursuant to the MSA. Shortly after these designations, the National Association of Homebuilders filed a lawsuit challenging the designations on a number of grounds. On April 30, 2002, the United States District Court for the District of Columbia issued an order vacating the critical habitat designations, but retaining the MSA EFH designations. National Association of Homebuilders, et al. v Evans, Civil Action No. 00-2799 (CKK)(D. D.C., April 30, 2002). Thus, the critical habitat designation for Puget Sound chinook salmon is no longer in effect. NOAA Fisheries intends to reissue critical habitat designations. Reinitiation of consultation will be required if the proposed action affects critical habitat designated after consultation has been completed (50 CFR §402.16(d)).

4. STATUS OF SPECIES

4.1 Biological Opinion

The objective of this Opinion is to determine whether continued operation of the Baker Project, as amended by the proposed action, is likely to jeopardize the continued existence of Puget Sound chinook salmon.

4.2 Biological Requirements

The first step NOAA Fisheries uses when applying the ESA Section 7(a)(2) to the listed ESU considered in this Opinion is to define the species' biological requirements. Biological requirements within the action area are a subset of the rangewide biological requirements of the ESU. Identification of the rangewide biological requirements provides context for subsequent evaluation of action area biological requirements.

Relevant biological requirements are those necessary for the listed ESU to survive and recover to naturally reproducing population sizes at which protection under the ESA would become unnecessary. This will occur when populations are large enough to safeguard the genetic diversity of the listed ESU, enhance their capacity to adapt to various environmental conditions, and allow them to become self-sustaining in the natural environment. McElhany et al. (2000) describe the biological requirements of salmonid populations, which are the components of ESUs, as adequate abundance, productivity (population growth rate), spatial scale, and diversity. These attributes are influenced by survival, behavior, and experiences throughout the entire life cycle.

4.3 Status of Species

NOAA Fisheries considers the current status of the listed species, taking into account population size, trends, distribution, and genetic diversity. To assess the current status of the listed species within the action area, NOAA Fisheries starts with the determinations made in its decision to list for ESA protection the ESU considered in this Opinion and also considers any new data that is relevant to the determination. This section covers the listing status, general life history, and population dynamics of the species.

All five eastern Pacific species of salmon and steelhead are found in the Skagit River Basin. Puget Sound chinook salmon is the only listed species under NOAA Fisheries' jurisdiction.

Table 1. ESA status of listed anadromous salmonids in the Skagit River Basin.

Species	ESU	Status	Protective Regulations
Chinook Salmon *Oncorhynchus tshawytscha*	Puget Sound Chinook Salmon	Threatened	July 10, 2000; 65 FR 42422

4.3.1 Puget Sound Chinook Salmon

The Puget Sound chinook salmon ESU has been defined to include all naturally spawned Puget Sound chinook salmon populations residing below impassable natural barriers (e.g., long-standing natural waterfalls) in the Puget Sound region from the Nooksack River to the Elwha River on the Olympic Peninsula, inclusive. The Puget Sound Technical Review Team (PSTRT), an independent scientific body convened by NOAA Fisheries to develop technical delisting criteria and guidance for salmon recovery planning in Puget Sound, has identified 21 geographically distinct populations representing the primary historical spawning areas of chinook salmon in Puget Sound (PSTRT 2001). The boundaries of the Puget Sound chinook salmon ESU correspond generally with the boundaries of the Puget lowland ecoregion. The Puget Sound chinook salmon ESU comprises 21 populations ranging from the southern Puyallup and White River stocks, to the most northern populations of the Nooksack River system.

Overall abundance of Puget Sound chinook salmon in this ESU has declined substantially from historical levels, and many populations are small enough that genetic and demographic risks are likely to be relatively high (March 9 1998, 63 FR 11494). Both long- and short-term trends in abundance are predominantly downward, and several populations within this ESU are exhibiting severe short-term declines (March 9 1998, 63 FR 11494). Myers et al. (1998) roughly approximated that 690,000 adults of this ESU returned in 1908. Recent numbers of naturally spawning fish are drastically below this historical estimate.

Like all other salmonid species, Puget Sound chinook salmon are anadromous and semelparous (i.e., dies after spawning once). Within this general life history strategy, however, Puget Sound chinook salmon display a broad variation in survival tactics. A large part of the variation derives from the fact that the species occurs in two distinct behavior forms or races. One form, designated "stream-type"(Groot and Margolis 1991; Myers et al. 1998), spends one or more years as a fry or parr in freshwater before migrating to sea, performs extensive offshore oceanic migrations, and returns to its natal river in the spring or summer, several months prior to spawning. The second form, designated "ocean-type" (Groot and Margolis 1991; Myers et al. 1998) migrates to sea during the first year of life, normally within three months after emergence from the spawning gravel, spends most of its ocean life in coastal waters, and returns to its natal river in the fall, a few days or weeks before spawning (Groot and Margolis 1991; Myers et al. 1998).

Some adult stream-type Puget Sound chinook salmon, referred to as "spring" fish, often return to their natal streams from April through July and hold in freshwater several months prior to spawning. Ocean-type Puget Sound chinook salmon, commonly referred to as "summer" or "fall" fish, typically return later than spring fish, and usually spend less time in freshwater prior to spawning, usually from September through November. Most rivers in the ESU have returns of stream-type Puget Sound chinook salmon, though ocean-type Puget Sound chinook salmon make up the predominant returns in the ESU (Myers et al. 1998). Stream- and ocean-type ratios are not static; freshwater rearing conditions and ocean survival, among other factors, alter adult returns of each from year to year (Groot and Margolis 1991). Stream-type fish are thought to account for at least 20% of returning adults within the South Fork Nooksack, Skagit, Snohomish, and White Rivers (Myers et al. 1998).

Harvest rates on Puget Sound chinook salmon populations averaged 75% (median=85%; range 31%-92%) in the 1970s and early 1980s and have dropped to an average of 44% (median= 45%; range 26%-63%) over the most recent 5-year period measured by the PSTRT (approximately 1997-2002) (WSCBRT 2003).

5. ENVIRONMENTAL BASELINE

The environmental baseline includes "the past and present impacts of all Federal, State, or private actions and other human activities in the action area, including the anticipated impacts of all proposed Federal projects in the action area that have undergone Section 7 consultation and the impacts of State and private actions that are contemporaneous with the consultation in progress" (50 CFR §402.02). In step 2 of its analysis, NOAA Fisheries evaluates the relevance of the environmental baseline in the action area to the species current status. In describing the environmental baseline, NOAA Fisheries emphasizes important habitat indicators for the listed salmonid ESU affected by the proposed action. The action area is described in Section 1.2 of this Opinion. NOAA Fisheries does not expect any other areas to be directly or indirectly affected by the proposed action.

5.1 Status of Species within the Action Area

The action area is inhabited by all five eastern Pacific species of salmon (pink, chum, coho, sockeye, and chinook) and steelhead. The only ESA-listed species within the action area is Puget Sound chinook salmon. Although the ESU is not listed, the action area also comprises the entire spawning range of the Baker Lake sockeye salmon ESU.

5.1.1 Puget Sound Chinook Salmon

5.1.1.1 Life History

The Skagit River supports the largest population of naturally-spawning chinook salmon stock in the Puget Sound region. Skagit River chinook salmon stocks are comprised of spring (Upper Sauk, Suiattle, and Upper Cascade), summer (Upper Skagit Mainstem/Tributaries and Lower Sauk) and fall (Lower Skagit Mainstem/Tributaries) runs (WDF et al. 1994; PSTRT 2001). The only population with its primary spawning habitat in the action area is the Lower Skagit fall chinook salmon. The other stocks primarily use the action area for rearing and migration habitat. Although the majority of chinook salmon spawning in the Skagit River Basin occurs upstream of the Baker River confluence (upstream of the limits of the action area), all stocks must pass through the action area during their life cycles and are thus still potentially strongly affected by project effects in the action area. The PSTRT (2001) identified 6 historical populations of Puget Sound chinook salmon that occur in the action area: Lower Skagit, Upper Skagit, Lower Suak, Upper Suak, Suiattle, and Upper Cascade.

Spring chinook salmon (Upper Suak, Suiattle, Upper Cascade)
Spring chinook salmon spawn in higher elevation tributaries of the Skagit River, and constitute a small portion of total number of chinook salmon in the Skagit River system. Spring chinook salmon runs generally spawn earlier than summer and fall runs, from late July to early October (WDF et al. 1994).

Summer chinook salmon (Lower Suak, Upper Skagit)
Most of the chinook salmon production in the Skagit River is from populations that migrate and spawn as summer runs in the mainstem Skagit River and its tributaries above the Sauk River confluence (RM 67.2), and in the lower Sauk River. Summer chinook salmon typically migrate from early July through September, and spawn from mid-August to mid-October (WDF et al. 1994).

Fall chinook salmon (Lower Skagit)
Fall chinook salmon spawn in the mainstem Skagit River and its tributaries, downstream of the Sauk River confluence (RM 67.2). This section includes areas affected by operation of the Baker Project, downstream of the Baker River confluence (RM 56.5). From 1997 to 2001, average total escapement for the fall run of chinook salmon was 1,942, with approximately 80% of spawning occurring downstream of the Baker River in 2000 (WDFW 2001). The fall chinook salmon stock is classified as depressed based on long-term and short-term negative declines in abundance (WDF et al. 1994). Escapement levels for all the fall stock have appeared to be lower in odd years than in even years, possibly due in part to incidental catch of chinook salmon in pink salmon fisheries or biennial differences in production. Data on total production, catches, and returns per spawner are unavailable.

5.1.1.2 Juvenile Rearing and Migration

In the Upper Skagit, studies have found that juvenile chinook salmon emergence from the gravel begins in January, peaks in March, and continues through April (Graybill et al. 1979 as cited in FERC 2002). Following emergence, juveniles may follow a number of different rearing strategies. In all strategies, juveniles rear in low velocity habitat along mainstream margins, in off-channel habitat, or in tributaries for varying lengths of time. The variability in life histories involves the length of time spent in these habitats before migrating downstream to the estuary. Residence time varies from almost immediate downstream migration to migration in early summer or fall (usually coinciding with increased flows during those periods), to rearing for a year in river habitat, with migration downstream in the spring one year after emergence.

Summer and fall chinook salmon juveniles are generally thought to spend a relatively short time in streams, ranging from moving downstream soon after emergence, to spending 30 to 90 days before migrating to the estuary. Spring chinook salmon populations typically spend up to a year in streams before migrating downstream. Since the Skagit River Basin is inhabited by all three types of chinook salmon life history types, there is the possibility of juveniles being present in the action area throughout the year. Since the action area also includes the Skagit delta, itself important rearing habitat, it is almost certain that some Puget Sound chinook salmon juveniles are present in the action area throughout the year.

5.1.1.3 Abundance

Ecosystem Diagnostic Tool (EDT) estimates of abundance yield and estimate of a total historical run size for the Skagit River Basin of over 70,000 Puget Sound chinook salmon, while the geometric means of recent run sizes is less than 10,000 (Table 2).

Over the last 20 to 30 years, harvest rates for Skagit River Basin chinook salmon stocks have declined from over 80% in the late 1960s and early 1970s to recent harvest rates of 50% to 60%.

Table 2. Estimated brood-year harvest rates on PSTRT-defined populations of Skagit River Basin chinook salmon (WCSBRT 2003).

Population	Data Years (brood year)	Earliest 5-year mean fishing rate (%)	Most recent 5-year mean fishing rate (%)
Lower Skagit	1969-2002	81	61
Upper Skagit	1969-2002	88	63
Upper Cascade	1982-2002	89	56
Lower Suak	1969-2002	88	63
Upper Suak	1979-Present	84	55
Suiattle	1979-present	84	30

5.1.1.4 Productivity/Population Trajectory

Skagit River Basin chinook salmon populations have experienced dramatic declines in abundance from historical levels. Table 3 incorporates the parameter "lambda" to describe if Skagit Basin Puget Sound chinook salmon populations are declining (values <1.0), stable (1.0), or increasing (values >1.0). Although the actual calculations are more complex (WCSBRT 2003), lambda essentially represents the slope of the line formed by connecting the points on a graph of salmon abundance over time. The value of lambda may change depending on the period over which it is calculated, reflecting differences between long-term and short-term population trends. Long-term lambdas estimate the population change over the longest period available and are considered to be descriptive of the overall historical change in populations. Short-term lambdas estimate population change over a shorter term, usually less than 20 years) to describe recent trends in population change. Estimates of growth rates (lambda values, Table 3) indicate that all populations but the Upper and Lower Sauk are stable or slightly increasing.

Table 3. Estimates of historical capacity, recent spawning counts, and lambda (rate of population change) estimates for Skagit Basin populations of Puget Sound chinook salmon. Short-term lambda were calculated from data from 1990 to the most recent year of data (minimum of 10 data points within 13-year period). Long-term lambda were calculated from all data in the time series (WCSBRT 2003).

Population	EDT estimate of historical capacity	Geometric mean of natural spawners (recent 5 years)	Short-term lambda (1990 to most recent data)	Long-term lambda	Data years
Lower Skagit	22,000	1,537	1.027 (0.942-1.121)	1.005 (.0921-1.096)	1952-2001
Upper Skagit	35,000	7,332	1.053 (0.965-1.149)	1.005 (0.921-1.097)	1952-2001
Upper Skagit (assuming hatchery fish are as successful as wild fish when spawning naturally)			1.048 (0.959-1.147)	1.001 (0.922-1.231)	1952-2001
Upper Cascade	1,700	268	1.067 (0.911-1.249)	1.036 (0.885-1.213)	1984-2001
Lower Suak	7,800	480	0.991 (0.908-1.081)	1.001 (0.918-1.092)	1952-2001
Upper Suak	4,200	298	0.935 (0.857-1.02)	0.975 (0.894-1.064)	1984-2001
Suiattle	830	401	1.006 (0.921-1.1)	1.0 (0.915-1.092)	1952-2001

5.1.1.5 Distribution

Distribution within the basin is similar to historical distributions with some barriers on Skagit River tributaries limiting distribution.

5.1.1.6 Diversity

Based on differences is spawning location, genetic surveys, and life history characteristics, the following six populations of Puget Sound chinook salmon have been identified (PSTRT (2001):

1. Lower Skagit
2. Upper Skagit
3. Lower Suak
4. Upper Suak
5. Suiattle
6. Upper Cascade

Populations are named by the spawning area of each population.

The identity of Puget Sound chinook salmon in the Baker River is uncertain. If there was at one time a distinct Baker River population of Puget Sound chinook salmon, it is believed to have been extirpated. Current Puget Sound chinook salmon in the Baker River drainage are believed to be strays from other Skagit Basin populations (FERC 2002).

5.1.1.7 Hatchery Effects

The Washington Department of Fish and Wildlife (WDFW) operates Marblemount Hatchery, located at RM 0.5 of the Cascade River, which flows into the Skagit River at RM 78. The hatchery programs include fall chinook salmon fingerling (220,000 release target), spring chinook salmon fingerling (250,000 release target), summer chinook salmon (200,00 release target), yearling spring chinook salmon (150,000 release target), Baker Lake coho salmon (120,000 fry, 60,000 yearling release target), and winter steelhead (334,000 release target). All hatchery programs use Skagit Basin stocks (WDFW 2002a, 2002b, 2002c, 2002d, 2002e).

Table 4. Estimates of hatchery fish in natural escapements, estimated returns of hatchery-born chinook salmon, and most recent releases in the Skagit River Basin (WCSBRT 2003).

Population	Hatchery fraction data available (?)	% Hatchery escapment (mean, min, max)	Average annual hatchery return to stream 1997-present (min, max)	Most Recent (1999-2001) total release of chinook salmon hatchery juveniles by life stage
Lower Skagit	None available	-	1,031 (0-4,028)	3,000,000 fall 5,000,000 spring 4,000,000 summer Total=12,000,000
Upper Skagit	Yes	2% (0-3%)		
Upper Cascade	None available	-		
Lower Suak	None available	-		
Upper Suak	None available	-		
Suiattle	None available	-		

Available data (Table 4) suggests that there may be low levels of introgression of hatchery stocks with wild Skagit Basin salmon, although available data is limited. There is a risk of competition and predation to wild chinook salmon fry and juveniles from hatchery stocks, especially steelhead and coho salmon. Hatchery genetic management plans submitted for these programs by WDFW outline efforts to reduce or avoid these negative interactions (WDFW 2002a, 2002b, 2002c, 2002d, 2002e).

5.2 Physical Description and Status of Habitat Within the Action Area

The Baker River is a tributary of the Skagit River Basin, the largest river basin in the Puget Sound region, located in northwest Washington. Rivers of the Skagit Basin originate in the Cascade Mountain Range of Washington and British Columbia, Canada, and flow in a generally westward direction, emptying into Skagit Bay on the northern end of Puget Sound. The Skagit River is 162 miles long and drains an area of 3,140 square miles. Major tributaries of the Skagit River include the Suak River, the Suiattle River, the Cascade River, and the Baker River.

The Baker River flows into the Skagit at RM 56.5. The Baker River drains an area of 297 square miles. The Baker River contributes approximately 18% of the flow of the Skagit River below the confluence. The Baker River is 28 miles long, with its headwaters located near Mount Fury in the North Cascades National Park. There was one natural lake on the Baker River before the construction of hydroprojects in the early twentieth century. It was located near the head of the Baker River valley and had an area of approximately 1 square mile. This lake supported a run of sockeye salmon. Historically, downstream of Baker Lake, the Baker River meandered across a broad floodplain that was associated with a hardwood swamp and a network of side channels and wall-based tributaries (USFS 2002 as cited in WCC 2003). The channel contained a number of islands and received flow from numerous tributaries. Figure 3 is a map of the pre-project and current course of the Lower Baker River.

Downstream of the confluence of the Baker River, the Skagit River valley opens onto a broad floodplain. Historically, in this section of the river the channel was very sinuous, with many side channels and evidence of oxbow formation. The Skagit River forms a delta before entering Skagit Bay. The delta, before modification, was marked by numerous small channels, sloughs, and marshland. The Lower Skagit River has been heavily diked and modified for flood control and agricultural development.

Just before reaching the delta, the Skagit River splits into two distributaries, the North Fork Skagit and the South Fork Skagit. Historically, the Skagit River delta was a complex system of distributary channels, tidelands, floodplain, marsh, and sloughs. Extensive filling, diking, and ditching, primarily for agricultural development, has resulted in the loss of an estimated 72% of historical delta habitat (WCC 2003).

Two large hydroelectric projects are located in the Skagit River Basin, the Baker Project (the subject of this Opinion) and the Skagit Project, located on the Upper Skagit River. The Skagit Project, while it is located outside of the action area, has significant effects on the Skagit River downstream of the confluence of the Baker and Skagit Rivers.

The average annual discharge of the Baker River at Concrete is 2,657 cfs; the average annual discharge of the Skagit River at Concrete is 15,070 cfs. Rivers in the Skagit Basin show a pattern of peak flows in the spring associated with snowmelt, a decrease in flows through the summer months, and an increase in flows in response to increased rainfall in late October

(Figure 4). The Skagit River is subject to frequent flooding; since 1941, peak flows exceeding 100,000 cfs have been observed in 8 years, and peak flows exceeding 50,000 cfs have been observed in 40 years (Figure 5).

Figure 3. Map of Baker River before and after construction of the Baker River Hydroelectric Project. The original lake and course of the river are represented in black. (Modified from HRI 2002).

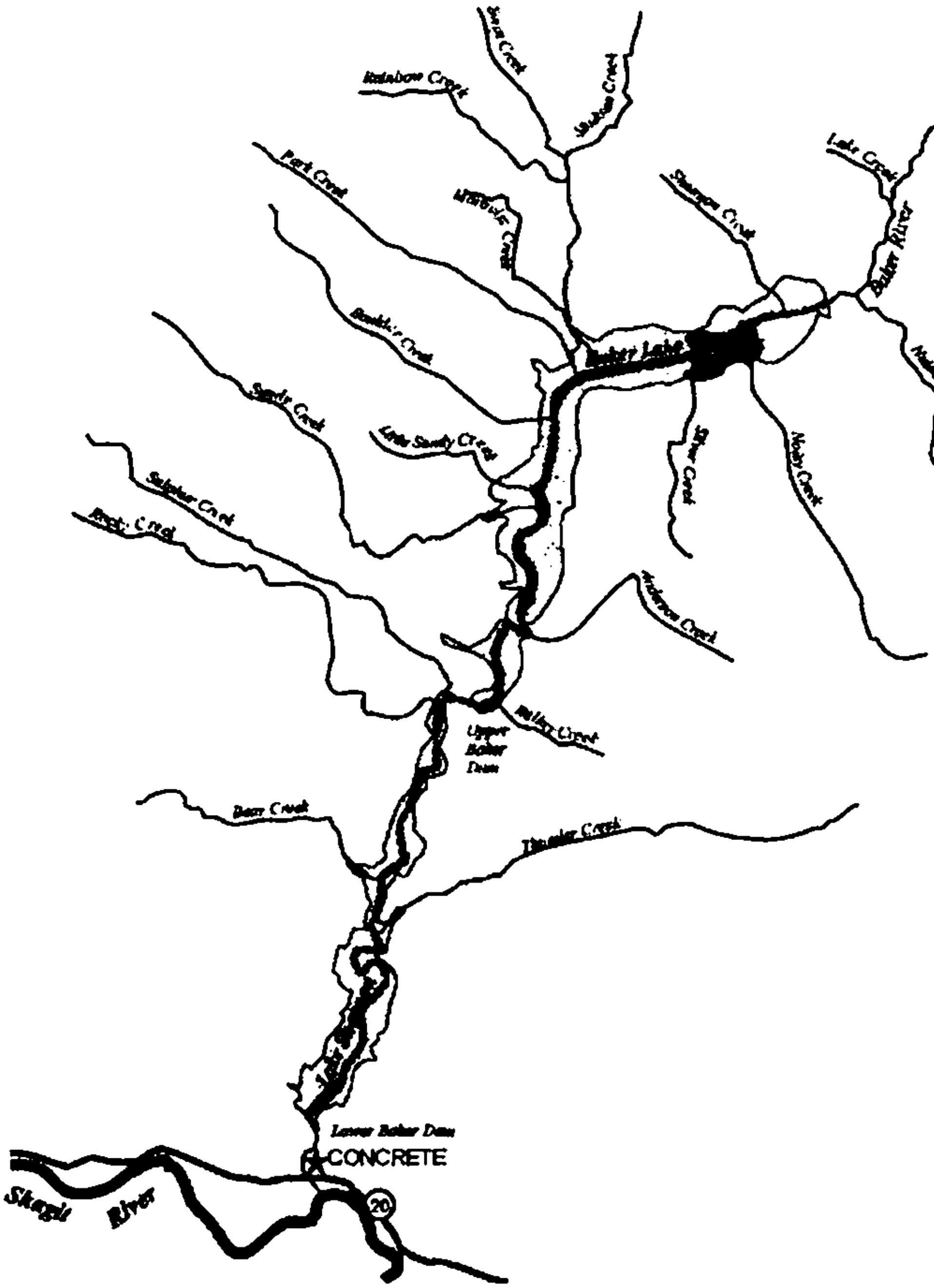


Figure 4. Average monthly flows of Skagit River at Mount Vernon, Washington, 1941-2002.

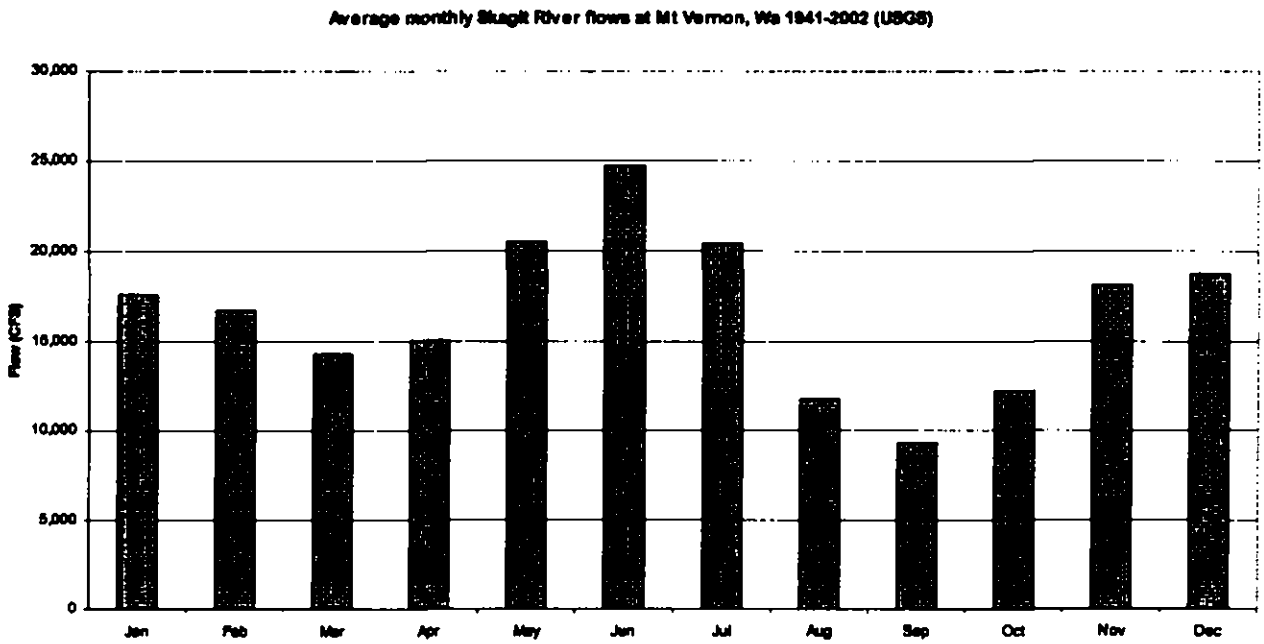
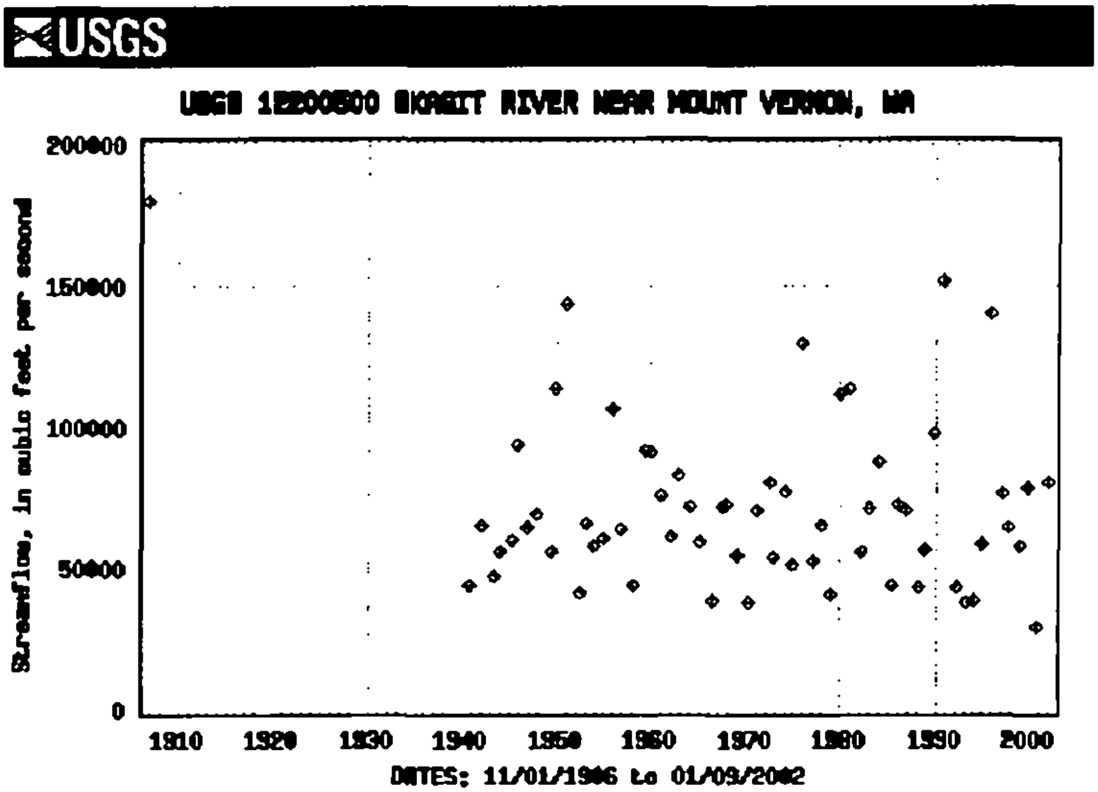


Figure 5. Peak flows in the Skagit River, 1910-2002.



Land use in the upper end of the action area is dominated by commercial timberland and National Forest and Park. Below the confluence of the Baker and Skagit Rivers, land use becomes dominated by urban and agricultural development. The cities of Concrete, Sedro Wooley, Burlington, and Mount Vernon in Washington are located on or near the Lower Skagit River. The Lower Skagit has been extensively diked for flood control.

5.3 Baseline Conditions

This section includes descriptions of historical project effects and effects of other factors. Continuing project effects are not included in the environmental baseline, since they are the subject of the proposed action. The historical project effects are included in this section to give a more complete description of current conditions. In particular, historical project effects have influenced survival in the action area and contributed to the current status of listed species in the action area. Historical project effects which are not modified by the proposed action are assumed to continue through the duration of the proposed action.

Properly functioning condition and the habitat approach
Habitat-altering actions affect salmon population viability, frequently in a negative manner. However, it is often difficult to quantify the effects of a given habitat action in terms of its impact on biological requirements for individual salmon (whether in the action area or outside of it). Thus it follows that while it is often possible to draw an accurate picture of a species' rangewide status—and in fact doing so is a critical consideration in any jeopardy analysis—it is difficult to determine how that status may be affected by a given habitat-altering action. Given the current state of the science, usually the best that can be done is to determine the effects an action has on a given habitat component and, since there is a direct relationship between habitat condition and population viability, extrapolate that to the impacts on the species as a whole. Thus by examining the effects a given action has on the habitat portion of a species' biological requirements, NOAA Fisheries has a gauge of how that action will affect the population variables that constitute the rest of a species' biological requirements and, ultimately, how the action will affect the species' current and future health.

Ideally, reliable scientific information on a species' biological requirements would exist at both the population and the ESU levels, and effects on habitat should be readily quantifiable in terms of population impacts. In the absence of such information, NOAA Fisheries' analyses must rely on generally applicable scientific research that one may reasonably extrapolate to the action area and to the population(s) in question. Therefore, for actions that affect freshwater habitat, NOAA Fisheries usually defines the biological requirements in terms of a concept called properly functioning condition (PFC). The PFC is the sustained presence of natural habitat-forming processes in a watershed (e.g., riparian community succession, bedload transport, precipitation runoff pattern, channel migration) that are necessary for the long-term survival of the species through the full range of environmental variation. PFC, then, constitutes the habitat component of a species' biological requirements. The indicators of PFC vary between different landscapes based on unique physiographic and geologic features. For example, aquatic habitats on timberlands in glacial mountain valleys are controlled by natural processes operating at different scales and rates than are habitats on low-elevation coastal rivers.

In the PFC framework, baseline environmental conditions are described as "properly functioning" (PFC), "at risk" (AR), or "not properly functioning" (NPF). If a proposed action would be likely to impair properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of impaired habitat toward PFC, it will usually be found likely to jeopardize the continued existence of the species or adversely modify its critical habitat, or both, depending upon the specific considerations of the analysis. Such considerations may include, for example, the species' status, the condition of the environmental baseline, the particular reasons for listing the species, any new threats that have arisen since listing, and the quality of the available information.

Since lotic habitats are inherently dynamic, PFC is defined by the persistence of natural processes that maintain habitat productivity at a level sufficient to ensure long-term survival. Although the indicators used to assess functioning condition may entail instantaneous measurements, they are chosen, using the best available science, to detect the health of underlying processes, not static characteristics. "Best available science" advances through time; this advance allows PFC indicators to be refined, new threats to be assessed, and species status and trends to be better understood. The PFC concept includes a recognition that natural patterns of habitat disturbance will continue to occur. For example, floods, landslides, wind damage, and wildfires result in spatial and temporal variability in habitat characteristics, as will anthropogenic perturbations.

5.3.1 Water Quality

NOAA Fisheries has identified water quality as a factor through which a Federal action can affect anadromous salmonids or their habitat. Indicators of water quality include water temperature, sediment/turbidity, and chemical contaminants/nutrients. Existing information on baseline water quality and water temperature and effects of existing project operations on water quality and water temperature are summarized below.

5.3.1.1 Water Quality: Temperature

Water temperature affects the growth and survival of juvenile and adult fish and may be a determining factor in fish distribution. Excessively low water temperatures may inhibit growth rates or development of eggs. High temperatures can lead to increased physiological stress, low dissolved oxygen concentrations, and increased disease risk. NOAA Fisheries defines PFC as water temperatures ranging from 10°C to13.9°C, and AR as temperatures ranging from 13.9°C to 15.6°C for spawning habitat and 15.6°C to 17.8°C for rearing habitat. Temperatures exceeding the AR category are NPF conditions (NOAA Fisheries 2000).

The Lower Skagit River, below the confluence with the Baker River, receives flows from a number of tributaries whose summertime water temperatures exceed standards and would be rated as NPF. The mainstem of the Lower Skagit is generally deemed acceptable in regards to temperature, with the exception of infrequent temperature exceedences observed at a station near Sedro Wooley (WCC 2003).

The occasional exceedences observed within the action area lead NOAA Fisheries to categorize this element as AR.

5.3.1.2 Water Quality: Turbidity

NOAA Fisheries defines low PFC as turbidity, not exceeding Washington State water quality standards.

The Skagit River near Mount Vernon (RM 15.9) was monitored from 1982-2002. The Washington State Department of Ecology (WDOE) has rated this segment "poor" for suspended solids in 2 of the last 10 years and "moderate" in the remaining 8 years (DOE 2003 as cited in WCC 2003). Turbidity was rated "moderate" in 6 out of 10 years and "poor" in 2 out of 10 years. A segment upstream of Sedro Woolley (RM 24.4) was sampled in 2000, and the WDOE rated the segment as "moderate" for suspended solids and turbidity. The Skagit River near Concrete (RM 54.1) was sampled from 1977 through 1993 (no data for 1992). The WDOE rated this segment as "poor" for suspended solids and turbidity. The frequent ratings of poor for turbidity within the action area leads NOAA Fisheries to classify this element as AR.

5.3.1.3 Water Quality: Dissolved Substances

NOAA Fisheries defines PFC as having no 303(d) designated reaches in the basin. The category AR is defined as one 303(d) designated reach. Multiple 303(d) designated reaches indicate an NPF condition.

The Skagit River near Mount Vernon (RM 15.9) has been monitored from 1982 to 2002 and water quality exceedences included frequently elevated levels of nitrogen, nitrate, ammonia, or phosphorus. For this segment, the WDOE has rated phosphorus levels as "moderate" in 6 out of 10 years and "poor" in 1 out of 10 years. The causes of these problems were not stated, but are likely related to the surrounding urban and agricultural land use and possibly from discharges from the four wastewater treatment plants (the City of Sedro Woolley, the City of Burlington, the City of Mount Vernon, and the Big Lake/Skagit County Sewer District #2) in the area (WCC 2003). In 1992, the discharge from these plants had very high nutrient levels and warm water temperatures (Entranco 1993 as cited in WCC 2003).

A segment upstream of Sedro Woolley (RM 24.4) was sampled in 2000, and the WDOE rated the segment as "moderate" for phosphorus, with September as the worst month. Dissolved oxygen levels were within acceptable ranges.

Chronic levels of lead and copper and acute levels of copper were found in the mainstem Skagit River in 1992 (Entranco 1993 as cited in WCC 2003). These metals were detected above WDOE metals criteria near RMs 15, 20, and 26. The significance of these findings is unknown. Typical sources of metals include industry, urban and highway runoff, and landfills; heavy industry is not located in this area. Further investigation is needed to determine if metals are at levels that can impact salmonids and, if so, identify the sources of pollution.

The Skagit River near Concrete (RM 54.1) was sampled from 1977 through 1993, with the exception of 1992. The WDOE rated this segment as "moderate" for phosphorus (DOE 2003 as cited in WCC 2003). Dissolved oxygen levels met standards. Although there are no 303(d) listed reaches on the mainstem Skagit or Baker Rivers, 8 tributaries or sloughs appear on the 303(d) list for temperature, 7 sloughs or tributaries appear on the 303(d) list for fecal coliform levels, 6 tributaries or sloughs appear on the 303(d) list for dissolved oxygen, and 1 stream is on the 303(d) list for fish habitat (WDOE 2000). Although there are no 303(d) listed reaches on the mainstem, WDOE has frequently rated Lower Skagit River water quality as poor to moderate (WCC 2003). NOAA Fisheries classifies this element as NPF.

5.3.2 Habitat Access: Barriers

NOAA Fisheries defines PFC as a lack of any barriers in the river, allowing upstream and downstream passage at all flows without significant levels of mortality or delay. If barriers are present that cause relatively low mortality, moderate levels of delay, or block passage at base flows, the habitat is considered to be AR. Barriers causing moderate to high rates of mortality among migrating fish, cause significant delay, or which block passage at a range of flows are considered to be an NPF condition.

5.3.2.1 Habitat Access: Barriers - Upstream

Upstream passage barriers primarily affect adult salmonids on spawning migrations, though it may also affect within-stream movements of rearing juveniles. Blocked access to spawning habitat, or significant delay of spawners, may reduce the productivity of the population. Small-scale barriers to upstream migration are present throughout the Skagit Basin in the form of culverts and road crossings. A recent survey by the Washington Conservation Commission (WCC) identified numerous significant small-scale barriers to migration.

Seattle City Light's Skagit Project, comprising Canyon, Ross, and Diablo Dams, is located on the Upper Skagit River. These dams are believed to be above the historical upstream limits of anadromous salmonid distribution, so they do not present a barrier to salmonid distribution. The Baker Project has historically impeded upstream migration and influenced the status of listed species. These effects are described in detail in Section 5.5.2. NOAA Fisheries rates this factor as NPF.

5.3.2.2 Habitat Access: Barriers - Downstream

Juvenile anadromous salmonids produced upstream of dams must pass through reservoirs and over or around dams or through turbines in their migration to the ocean. These impediments to migration can reduce outmigrant survival due to injury or mortality of juveniles passing through turbines or over spillways, increased vulnerability to predation in reservoirs, and delays in migration from passing through reservoirs and locating passage routes through obstacles. There are no known non-project barriers to downstream migration of salmonids. The only significant non-project barriers on the Skagit River, the Skagit Project, is located above the upstream limits of anadromous salmonid distribution. Historical barrier effects of the Baker Project, which have influenced the status of listed species, are described in Section 5.5.3.

5.3.3 Habitat Elements

5.3.3.1 Habitat Element: Substrate

Because salmonids bury their eggs, substrate composition is critical to a population's productivity. Adult salmonids must be able to displace the substrate to bury the eggs and there must be adequate interstitial spaces to shelter the eggs, allow a free exchange of water to provide oxygen and carry away wastes, and allow emerging fry a route of escape to the surface. Substrate composition may also effect rearing salmonids because of the presence or absence of cover and different degrees of productivity associated with different types of substrate.

NOAA Fisheries defines PFC as predominantly gravel and cobble substrate with >12% fine sediment component (<0.85 mm) and >20% embeddedness. Substrate in which cobble and gravel are not predominate, or with a fine sediment component of 12%-17% (12%-20% east of the Cascade Range), or with embeddedness of 20%-30% (or any combination of these), are considered to be AR. Substrate in which the predominate type is bedrock, sand, silt, or small gravel, or with a fine sediment component exceeding AR conditions, or with embeddedness exceeding 30% (or any combination of these) are considered NPF.

Available information indicates high sediment loading in many tributaries that flow into the action area (WCC 2003). These high sediment levels appear to be related to roads, landslides, and clear cuts (WCC 2003). Little information is available on mainstem Lower Skagit substrate quality, though the heavy sediment loads of tributaries suggest that sedimentation may be a problem. NOAA Fisheries classifies this element as AR.

5.3.3.2 Habitat Element: Large Woody Debris

Large woody debris (LWD) is an important structural element in channel morphology, affecting the quality and quantity of habitat and stream productivity. It is often a key element in the development of pools or other potential refugia for juvenile and adult salmonids. NOAA Fisheries defines PFC as >80 pieces of wood per mile which are >24 inches in diameter and > 50 ft long, with adequate sources of woody debris recruitment in riparian areas (east of the Cascade Range, standard > 20 pieces/mile, >35 ft long). Habitat which should presently meet standards for PFC, but lacks potential sources of recruitment of new woody debris is considered to be AR. Habitat which does not meet PFC standards and lacks potential sources of LWD recruitment is NPF.

Baker River tributaries were rated as fair-good for LWD by the WCC (2003). This information suggests that there is probably good LWD recruitment to the Baker River. The WCC (2003) rated the Lower Skagit River as poor (though requiring further data) for LWD. Most of the Lower Skagit tributaries were also rated as poor for LWD. Historical blockage of LWD transport the Baker Project is described in Section 5.5.5. NOAA Fisheries classifies this element as NPF.

5.3.3.3 Habitat Element: Pool Frequency/Quality

Pools provide cover for rearing fish and adults. Low pool frequency or poor pool quality may be a limiting factor in the total number of salmonids a stream can support. NOAA Fisheries defines PFC for pool frequency based on channel width (Table 5). Pool quality for PFC is defined as pools >1 m deep with cover, cool water, low amounts of fine sediment, and LWD recruitment rated as PFC. If pool frequency standards are met, but LWD recruitment is not PFC, or few pools exceed 1 m depth, or there is a moderate reduction of pool volume by silt (or any combination of these), the habitat is considered to be AR. If habitat does not meet pool frequency standards, or there are no pools >1m deep, or if there is a major reduction in pool volume by silt (or any combination of these), the habitat is considered to be NPF.

Table 5. Pool frequency for properly functioning condition.

Channel Width (ft)	Pools/Mile
5	184
10	96
15	70
20	56
25	47
50	26
75	23
100	18

Much of the Lower Skagit River is a single, hydromodified channel, particularly from RM 8.1 to 18.6, and from RM 22.3 to 24.3 (Duke Engineering 1999 as cited in WCC 2003). Only 10% of the river from Sedro Woolley (RM 24.3) to the Forks (8.1) has split channels or island habitat. This reach consists mostly of deep glides with riprap on one or both sides of the river (Duke Engineering 1999 as cited in WCC 2003). Along the lowest reaches of the mainstem Skagit River, 50.9 km of channel length (62%) are modified downstream of Sedro Woolley (Beamer et al. 2000 as cited in WCC 2003). Upstream of Sedro Woolley, 45.6 km of stream channel length are modified (Beamer et al. 2000 as cited in WCC 2003). NOAA Fisheries rates this factor as NPF.

5.3.3.4 Habitat Element: Refugia and Off-Channel Habitat

Refugia and off-channel habitat provide areas where rearing fish can escape from high-water events, and increase the amount of sheltered habitat, with low-water velocities preferred by rearing juveniles.

NOAA Fisheries defines PFC for refugia as being buffered by riparian reserves and of sufficient size, number, and connectivity to maintain a viable population. These habitats include backwaters with cover and low energy off-channel areas (ponds, oxbows, side channels, etc.). Refugia and off-channel habitat that is classified by NOAA Fisheries as AR includes habitat that is similar to that described for PFC, but is inadequately buffered (e.g., by intact riparian reserves) or insufficient in size, connectivity, or number to maintain viable populations in the action area. Habitat conditions that are NPF have little or no off-channel habitat.

In the Lower Skagit Basin, beaver ponds historically occupied at least 8% of the tributary channel length, and anastomosing channels (stable, forested islands between channels) accounted for about 44% of channel length (Beechie et al. 2001 as cited in WCC 2003). Many former channels have been converted into ditches to drain farmlands and are no longer accessible at their upper ends, reducing flood refuge habitat. Hydromodification of the Lower Skagit has led to a loss of secondary channels. The Skagit River delta has suffered the greatest losses of refugia and off-channel habitat through diking, filling, and ditching. An estimated 72% of historical refugia and off-channel habitat has been lost (WCC 2003). The historical effects of the Baker Project on the loss of refugia and off-channel habitat are described in Section 5.5.5. NOAA Fisheries rates this factor as NPF.

5.3.4 Channel Dynamics

5.3.4.1 Channel Dynamics: Channel Morphology

NOAA Fisheries defines PFC as a width/depth ratio of <10, streambank condition of >90% stable, and well-connected, off-channel areas. Channel width-to-depth ratios of 10-12 are classified by NOAA Fisheries as AR. Channel width-to-depth ratios exceeding 12 are classified by NOAA Fisheries as NPF.

Much of the Lower Skagit River is a single, hydromodified channel, particularly from RM 8.1 to 18.6, and from RM 22.3 to 24.3 (Duke Engineering 1999 as cited in WCC 2003). Only 10% of the river from Sedro Woolley (RM 24.3) to the Forks (8.1) has split channels or island habitat. This reach consists mostly of deep glides with riprap on one or both sides of the river (Duke Engineering 1999 as cited in WCC 2003). Along the lowest reaches of the mainstem Skagit River, 50.9 km of channel length (62%) are modified downstream of Sedro Woolley (Beamer et al. 2000 as cited in WCC 2003). Upstream of Sedro Woolley, 45.6 km of stream channel length are modified (Beamer et al. 2000 as cited in WCC 2003). Historical effects of the Baker Project on channel morphology are described in Section 5.5.7. NOAA Fisheries rates this factor as NPF.

5.3.4.2 Channel Dynamics: Streambank Condition

Excessive erosion, or bank failures, can cause barriers to migration and introduce large amounts of fine substrate to the stream. Unstable banks also affect channel morphology and habitat forming processes, often leading to broad shallow channels and little of the channel-edge habitats often favored by juvenile salmonids. Excessive armoring of streambanks by diking, riprap, or other structures, also leads to a degradation of stream-edge habitat favored by juvenile salmonids. Habitat with > 10% of streambanks with active erosion and little or no armored streambanks are classified by NOAA Fisheries as PFC. Habitat with 10%-20% of streambank with active erosion or low-to-moderate levels of armored streambanks is classified by NOAA Fisheries as AR. Habitat with >20% of streambanks showing active erosion or high levels of streambank armoring is classified by NOAA Fisheries as NPF.

The Lower Skagit River has been extensively modified by diking and bank hardening. The WCC (2003) rated the lower mainstem Skagit River as poor for floodplain conditions due to extensive diking, coupled with the probable loss of considerable wetland habitat. NOAA Fisheries rates this factor as NPF.

5.3.4.3 Channel Dynamics: Floodplain Connectivity

This element assesses habitat connectivity with off-channel areas that are frequently linked hydrologically to the main channel. Overbank flows maintain wetland functions, riparian vegetation, and riparian succession in these habitats. Reduced linkage of wetland floodplains and riparian areas to the main channel is typically the result of reduced overbank flows (relative to historical frequency). Habitat with reduced hydrologic connectivity between the main channel and off-channel habitat shows reduced wetlands and altered riparian vegetation and riparian succession.

The WCC (2003) rated the lower mainstem Skagit River poor for floodplain conditions due to the extensive diking coupled with the probable loss of considerable wetland habitat. The study estimates a 45% loss of side-channel habitat in the Skagit Basin (Beechie et al. 2001 as cited in WCC 2003), with much of the loss occurring in the Lower Skagit subbasin. More than 90% of the loss of floodplain and delta habitat is due to diking, the draining of sloughs and wetlands, and the loss of beaver ponds, with 46% of the loss due to diking, draining, and ditching, and 44% due to the lost beaver dams (Beechie et al. 2001 as cited in WCC 2003). NOAA Fisheries rates this factor as NPF.

5.3.4.4 Channel Dynamics: Altered Flows

NOAA Fisheries defines PFC for the watershed hydrograph as being similar to pre-development conditions in terms of peak flow, base flow, and timing characteristics, or an undisturbed watershed of similar size, geography, and geology. Pronounced changes to the hydrograph are classified as NPF. The assessment for "Channel dynamics: Altered flows" is equal to the worst altered flows subcategories.

This factor has been identified as one of the most significant limiting factors to salmon production in the action area (WCC 2003). Historically, both the Skagit and Baker Projects have been operated as power-peaking operations. These operations have caused large daily variations in flow both in terms of magnitude (maximum and minimum flows) and rate of change (ramping). The operation of two independent projects, one in the upper basin and one in the lower basin, also complicates the variations of flows in the Lower Skagit River. Flow changes from the Skagit Project progress downriver in a wave-like fashion. After some delay, the flow changes reach the mouth of the Baker River where water releases from the Baker Project (almost always through power generation) may amplify or dampen the existing flow effects from Skagit Project operations.

Channel dynamics: Altered flows - False attraction flows
Water discharges from sources other than the river channel may attract migrating fish, diverting them from the migration route and resulting in delay or potential injury.

No non-project sources of false attraction have been identified in the action area. Historical effects of the Baker Project on false attraction flows are described in Section 5.5.8. NOAA Fisheries rates this factor as PF.

Channel dynamics: Altered flows - High flows
High flows play a major role in the physical alteration of the river channel and habitat-forming processes. Downstream migration of salmonids also often occurs during high flows, which rapidly carry the migrating smolts downstream. Reduction or elimination of high flows may interfere with habitat-forming processes and migration of salmonid smolts.

High flows in the Skagit River Basin have been reduced by water storage for both power generation and flood control at the Skagit Project. Daily high flows are also strongly affected by the power generation schedules at this project. The historical effects of the Baker Project on high flows are described in Section 5.5.9.

Channel dynamics: Altered flows - Minimum flows
Minimum flows are a limiting factor to the volume of habitat available to salmonids of all life stages. Reduced flows may expose redds, reduce the amount of rearing habitat available, cause barriers to migration, and lead to increased water temperature and other water quality problems. Habitat with properly functioning conditions has minimum flows through the whole year that provide an adequate amount of spawning and rearing habitat for population viability, no flow-related barriers to migration, water quality in PFC, and no exposure of redds. Habitat with water quality or barrier values of AR caused by flow-related phenomena, or a decrease in minimum flows compared to pre-project (or above project) conditions is considered AR. Habitat with water quality or barrier values of NPF, caused by flow-related phenomena, exposure of redds, or significant (to a degree which compromises population viability or recovery) decrease in spawning or rearing habitat from decreased flows (including loss of attachment to off-channel habitat), is considered NPF.

Operations of the Skagit Project in the Upper Skagit Basin strongly effect the magnitude of minimum flows in the upper basin. The effect is somewhat attenuated by the time it reaches the action area because of water contributed by major tributaries between the Skagit Project and the upstream portion of the action area. Historical effects of the Baker Project on low flows are described in Section 5.5.10. NOAA Fisheries rates this factor as AR.

Channel dynamics: Altered flows - Flow fluctuations

Flow fluctuations can result in stranding or entrapment of juvenile and adult salmon in de-watered or isolated areas as flows recede (during downramping). Stranding occurs when fish are trapped in dewatered areas and die of asphyxiation or desiccation. Entrapment occurs when fish are isolated in potholes or side channels that become separated from the flowing channel. These entrapped fish may subsequently become stranded if flows continue to recede. They may also be subject to increased predation and physiological stress (caused by high temperatures and oxygen deficit). If flows increase and inundate the side channel or pothole, the entrapped fish may return to the main channel (R.W. Beck and Associates 1987). Stranding and entrapment of salmon have been documented on many rivers in the Pacific Northwest (Phinney 1974; Bauersfeld 1978; Becker et al. 1981; Woodin et al. 1984; and R.W. Beck and Associates 1987). Flow fluctuations during spawning seasons can also result in dewatering of redds.

Flow fluctuations both in terms of difference between daily maximum and minimum flows and ramping (rate of change) have strongly affected salmonids in the Skagit Basin. The source of fluctuation, other than the proposed action, is the Skagit Project. By the time these fluctuations reach the action area they have been somewhat dampened by intervening tributaries. Seattle City Light entered into a flow management agreement with NOAA Fisheries in 1995, which greatly improved protection for juvenile fish in the Upper Skagit Basin. Historical effects of the Baker Project on flow fluctuations are described in Section 5.5.11. NOAA Fisheries rates this factor as NPF.

Channel dynamics: Altered flows - Seasonal flow patterns

An important aspect of the local adaptation of salmonid populations is adaptation to the local temporal patterns of river flows. Timing of spawning and juvenile outmigration is often related to seasonal patterns of flows. NOAA Fisheries defines PFC as seasonal patterns of flows similar to pre-development conditions in both timing and volume. NOAA Fisheries defines streams which have temporal patterns of flows similar to pre-development conditions, but maxima and minima significantly different from pre-development conditions are considered to be AR. Streams which have significantly different temporal patterns of flow from pre-development conditions, or greatly reduced maxima and minima, are considered to be NPF.

Hydropower and flood control operations in the Skagit Basin have significantly affected historical seasonal flow patterns. About 29% of the flow in the Skagit River goes through the Skagit Project and 17% through the Baker Project (PSE 2002 as cited in WCC 2003). Water storage occurs behind each of the dams in the mainstem Skagit River and in Baker Lake, and because of dam storage and operations it is estimated that the magnitude of peak flows by return period has been reduced by about 50% (Beamer et al. 2000 as cited in WCC 2003).

Historical effects of the Baker Project on seasonal flows are described in Section 5.5.12. NOAA Fisheries rates this factor as AR.

5.3.5 Watershed Condition

5.3.5.1 Watershed Condition: Road Density/Drainage Network

High road densities lead to an increased drainage network and the potential for increased introduction of sediment and contaminants to streams. Streamside roads may constrain channel morphology and stream crossings may form migration barriers to salmonids.

NOAA Fisheries defines PFC as <2 mi of road per square mile with no valley bottom roads. NOAA Fisheries defines PFC as no more than medium increases in drainage network due to roads; that is, that construction of roads and their companion drainage systems has not increased the total number of drainage routes to the river (potentially increasing input of sediment and contaminants). Habitat with road density of 2-3 miles of road per square mile with some valley bottom roads is considered to be AR. Habitat with road density > 3 miles of road per square mile and many valley bottom roads is considered to be NPF.

In the Baker subbasin, road density is relatively low at less than 2% of the area (USFS 2002). Road-related sediment is a major concern in the Baker subbasin based upon the sediment delivery information. While the Shannon West WAU has on overall road density that is in the "fair" range (Lunetta et al. 1997), road densities on a finer scale show some watersheds with high ("poor") road densities, including Morovitz (4.1 mi/mi2), lower Sulphur (3.6 mi/mi2), and Little Sandy (3.3 mi/mi2) Creeks (USFS 2002). "Fair" road density levels (2 to3 mi/mi2) are found in the Lake Shannon, South Fork Thunder, Lower Rocky, Baker Lake, Lower Sandy, and Lower Swift watersheds (data from USFS 2002). "Good" watersheds for road density include Thunder, Watson, Bear, upper Rocky, upper Sulphur, Welker, Anders, Silver, Noisy, Dillard, upper Sandy, Boulder, Park, upper Swift, Shuksan, Hidden, Baker, and Sulphide Creeks. Some road decommissioning has occurred on National Forest lands (WCC 2003).

Road-related sediment is a major concern in the Baker subbasin based upon the sediment delivery information. While the Shannon West WAU has on overall road density that is in the "fair" range (Lunetta et al. 1997), road densities on a finer scale show some watersheds with high ("poor") road densities, including Morovitz (4.1 mi/mi2), lower Sulphur (3.6 mi/mi2), and Little Sandy (3.3 mi/mi2) Creeks (USFS 2002). "Fair" road density levels (2 to3 mi/mi2) are found in the Lake Shannon, South Fork Thunder, lower Rocky, Baker Lake, lower Sandy, and lower Swift watersheds (data from USFS 2002). "Good" rated watersheds for road density include Thunder, Watson, Bear, upper Rocky, upper Sulphur, Welker, Anders, Silver, Noisy, Dillard, upper Sandy, Boulder, Park, upper Swift, Shuksan, Hidden, Baker, and Sulphide Creeks. Some road decommissioning has occurred on National Forest lands.

Only one WAU (Pressentin) in the Lower Skagit subbasin rates "good" for road density. Several WAUs have a "fair" rating, including the Nookachamps, Hansen, Loretta, Gilligan, Miller, Jackman, and Day Creek WAUs. The Alder, Grandy, and Finney Creek WAUs have overall road densities that rate "poor." However, a watershed analysis for Finney Creek has further refined road densities to result in a "poor" rating for non-Federal lands and a "fair" rating for Federal lands (USFS 1999 as cited in WCC 2003).

There are high (3.3 mi/mi2) road densities in flood plain in the Lower Skagit Basin associated with urban, agricultural, and residential development (WCC 2003). NOAA Fisheries rates this factor as NPF.

5.3.5.2 Watershed Condition: Disturbance History

The surrounding watershed profoundly influences the physical and biological processes that occur in a stream. Disturbances in the watershed associated with logging or development can lead to increased sediment input, increased water temperatures, and other habitat degradation which directly affect listed salmonids. The condition of disturbance history in the action area is rated according to the following standards:

PFC <15% Equivalent clear-cut area (ECA) (entire watershed) disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for Northwest Forest Plan (NWFP) area (except adaptive management areas), 15% retention of late successional old growth (LSOG) timber in watershed.

AR <15% ECA (entire watershed) but disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area (except adaptive management areas), 15% retention of LSOG in watershed.

NPF >15% ECA (entire watershed) and disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; does not meet NWFP standard for LSOG retention.

Logging and associated roads in the Baker River subbasin have led to numerous landslides, increasing sediment input in the system While only about 10% of the riparian areas within the National Forest boundaries have been disturbed in the Baker River subbasin, an estimated 78% of the riparian areas in non-Federal lands have been impacted by timber harvest through 1990 (USFS 2002). Some of these areas are listed below as having current moderate LWD recruitment and good future LWD recruitment potential, suggesting that riparian conditions are "fair" and are expected to improve over time (WCC 2003).

The Lower Skagit floodplain has been almost entirely cleared for agricultural, urban, and rural development. The Skagit delta, an extremely important salmonid rearing habitat , has been highly modified by diking, ditching, and filling. NOAA Fisheries rates this factor as NPF.

5.3.5.3 Watershed Condition: Riparian Reserves

NOAA Fisheries defines PFC as a riparian reserve system which provides adequate shade, LWD recruitment, habitat protection, and connectivity to all subwatersheds. The condition of the riparian reserves in the action area as rated according to the following standards:

PFC: The riparian reserve system provides adequate shade, LWD recruitment, and habitat protection and connectivity in all subwatersheds, and buffers or includes known refugia for sensitive aquatic species (>80% intact), and/or for grazing impacts: current riparian vegetation <50% similarity to the potential natural community/composition.

AR: Moderate loss of connectivity or function (shade, LWD recruitment, etc.) of riparian reserve system, or incomplete protection of habitats and refugia for sensitive aquatic species (70%-80% intact), and/or for grazing impacts: current riparian vegetation 25%-50% similarity to the potential natural community/composition.

NPF: Riparian reserve system is fragmented, poorly connected, or provides inadequate protection of habitats and refugia for sensitive aquatic species (<70% intact), and/or for grazing impacts: current riparian vegetation <25% similarity to the potential natural community/composition

The riparian areas within the Baker River subbasin are in generally good condition. The Mount Baker WAU riparian was rated as near 90% functional, while fewer than 60% of the riparian areas in the Mount Blum and Lake Shannon East WAUs were described as functional (Beamer et al. 2000). A little over 50% of the riparian areas in the Lake Shannon West WAU had functional riparian reaches. Conifer comprised over 60% of the Mount Baker WAU and nearly 50% of the Lake Shannon East WAU (Lunetta et al. 1997 as cited in WCC 2003).

While only about 10% of the riparian areas within the National Forest boundaries have been disturbed in the Baker River subbasin, an estimated 78% of the riparian areas in non-Federal lands have been impacted by timber harvest through 1990 (USFS 2002). Some of these areas have current moderate LWD recruitment and good future LWD recruitment potential, suggesting that riparian conditions are "fair" and are expected to improve over time.

Most of the riparian functions within the Baker River subbasin appear to be adequate. In general, the Baker River streams have sufficient shade except for the alpine areas, which have naturally low shade levels, and the lower air temperatures in these regions keep water temperatures cool (USFS 2002 as cited in WCC 2003)

The Skagit Watershed Council's Strategy Application contains an analysis of riparian conditions along the mainstem Skagit River and its tributaries, and in general, riparian conditions along the Lower Skagit River are "poor" (Beamer et al. 2000 as cited in WCC 2003). Approximately 58%-68% of the lengths from Sedro Woolley to Grandy Creek are described as impaired, while

72%-76% are either impaired or moderately impaired, resulting in a "poor" rating for this long stretch. Riparian conditions are generally better ("fair") from Grandy Creek to Grassmere, with about 35% impaired channel lengths, and 45%-50% impaired or moderately impaired lengths (Beamer et al. 2000 as cited in WCC 2003). From Grassmere to the Sauk River, impaired riparian lengths comprise an estimated 38%-57% of the reaches, and the combined impaired to moderately impaired riparian consists of 51%-63% (Beamer et al. 2000). The WCC (2003) rates these reaches as rated "poor" for riparian conditions. NOAA Fisheries rates this factor as NPF.

5.4 Biotic Interactions

5.4.1 Increased Predation

There is no known significant negative effect of increased predation rates on Puget Sound chinook salmon in the action area.

5.4.2 Competition/Predation with Native Species or Hatchery Fish

There is no known significant effect of competition with or predation by native species on Puget Sound chinook salmon in the action area.

5.4.3 Harvest

Harvest rates have declined over the past 20 years from approximately 80% to 50% (discussed in detail in Section 5.1.1.3).

5.5 Historical Project Effects

Historical operations of the Baker Project over the last 78 years have significantly affected the current status of habitat and fish populations in the action area.

5.5.1 Water Quality: Temperature

Water temperatures in the Baker River subbasin are generally within standards. There is some warming of the reservoirs, with summer temperatures ranging from 10.7°C to 18.3°C (average 15.7°C) (WCC 2003). Reservoir temperatures seem highly likely to exceed historical Baker River temperatures, although no known data exist to make comparisons. Release of warm reservoir water in the summer could affect Lower Skagit water temperatures. However, summer spill is extremely rare and powerhouse releases come from the intake, which is located at a depth of 200 ft in the reservoir. Water from these depths in a reservoir is typically much colder than surface water.

5.5.2 Habitat Access: Barriers - Upstream Migration

The construction of the Lower Baker Dam in 1927 and the Upper Baker Dam in 1956 significantly impeded migration of salmon into the Baker River Basin. Passage of varying degrees of effectiveness has been provided since dam construction. The persistence of various salmonid populations (often with hatchery supplementation or other interventions) suggests that passage measures are at least effective enough to maintain salmonid populations upstream of the dam.

There is a small barrier dam downstream of Lower Baker Dam that blocks adult fish passage upstream and directs migrating fish into a fish ladder and trap. The trap includes a lift that provides water-to-water transfer of fish into a transport truck for hauling to upper watershed locations that vary by species.

Chinook salmon transport and release is governed by a protocol approved by the Baker River Committee, an ad hoc technical group that has been addressing Baker River subbasin fisheries issues since 1985. Representatives on the Baker River Committee are from NOAA Fisheries, the USFWS, the WDFW, the U.S. Forest Service (USFS), the National Park Service (NPS), the Skagit Basin Treaty Indian Tribes, and PSE. The present chinook salmon protocol requires that adult chinook salmon entering the Baker trap prior to August 1 are hauled upstream to Baker Lake and released. These fish are part of an ongoing experiment to establish a naturally reproducing subpopulation of spring chinook salmon into the Baker system. Skagit hatchery chinook salmon are within the Puget Sound ESU, but they are not protected by the ESA under the current listing. Adult chinook salmon that enter the trap after August 1 will be transported downstream and released in the Skagit River.

The upstream fish passage facilities and fish handling occasioned by transport is generally not observed to harm the fish. Before PSE installed a foot crowder device in the trap, chinook salmon were sometimes delayed a long while, with some mortality, but no issues involving trauma to chinook salmon have been reported in recent years. Chinook salmon arrive at the Baker trap some 56 river miles from Skagit Bay. The scales are freshwater-hardened, and the protective slime layer over the skin has increased, further improving the fish's ability to withstand handling without suffering appreciable harm.

The protocol is designed to keep chinook salmon that originate in the Middle Skagit River returning there to spawn. This is why trap returns after August 1 are transported back to the Skagit. No native chinook salmon from the Baker River subbasin are believed to exist any longer. Sampling at the Baker trap has shown that the preponderance of summer-fall chinook salmon trapped are strays, always from a river basin other than the Skagit. Any adverse injury, stress, or delay associated with the upstream passage facilities appear to have been to be minor.

5.5.3 Habitat Access: Barriers - Downstream Migration

PSE operates floating surface collectors on both Lake Shannon above Lower Baker Dam and Baker Lake above Upper Baker Dam to attract, guide, and collect downstream migrating smolts of all species. The facilities are aged Merwin gulpers, from 1950s' technology. The fish collection efficiency (FCE) varies from approximately 53% at Upper Baker and 23% at Lower Baker (PSE 2003). FCE estimates are based on mark recapture monitoring of juvenile coho salmon and sockeye salmon smolts. FCE is unknown for chinook salmon, but it appears to be very low. A few hundred chinook salmon smolts are collected, regardless of how large the adult escapement. This could be partially accounted for by many of the adult chinook salmon being strays and not actually returning to natal streams in the Baker subbasin. However, it seems to be correlated with other incidents of poor juvenile chinook salmon migration through storage reservoirs (like Howard Hanson on the Green River, Washington) and the fact that the Baker collectors are not screened, and the louvers are not the proper size for subyearling smolts, like chinook salmon.

Juvenile chinook salmon may migrate through the reservoir past the barrier/guide nets. The nets have a pattern of being incomplete barriers due to sunken sections of corkline and occasional tears. Chinook salmon and other fish may sound and exit the reservoirs via the turbine penstocks. No systematic sampling has occurred, so chinook salmon have not been identified among the fish that are entrained. Assuming that some chinook salmon do pass that way, mortality is approximately 31% (EPRI 1987).

5.5.4 Habitat Element: Substrate

The dams of the Baker Project interfere with substrate transport from the Baker River to the mainstem Skagit. However, NOAA Fisheries is not aware of any data suggesting that the lower mainstem Skagit River suffers from a lack of substrate recruitment.

5.5.5 Habitat Element: Large Woody Debris

The Baker Project interferes with LWD transport from the Baker River to the Lower Skagit River. Since there appear to be adequate supplies of LWD in the Baker River Basin, this is likely to contribute to the lack of LWD in the Lower Skagit River.

5.5.6 Habitat Element: Refugia and Off-Channel Habitat

The Baker Project effectively eliminated all off-channel habitat in the lower 18 miles of the Baker River when the reservoirs were filled. Historically, the Lower Baker River is described as having numerous side channels and hardwood wetlands (WCC 2003). The dams have also directly altered anadromous salmonid habitat in the Baker subbasin. An estimated 117 acres of wetlands and ponds, 5 miles of side-channel habitat, and 52 miles of tributaries have been lost due to the creation of the reservoirs (USFS 2002 as cited in WCC 2003).

5.5.7 Channel Morphology

Before inundation by the Upper and Lower Baker Dams, the Lower Baker River was characterized as meandering across a broad valley floor with numerous islands in the river channel. All of the lower 18 miles of the Baker River, with the exception of a 1-mile reach below Lower Baker Dam, has essentially been converted into lacustrine habitat. The short free-flowing section of the Lower Baker has been extensively dredged, greatly simplifying the channel and eliminating a small distributary known as the Little Baker River.

5.5.8 Altered Flows - False Attraction Flows and Migration Delay

Upstream migrating salmon are blocked by a barrier dam below the Lower Baker Dam. Any salmon that are able to pass the barrier dam would likely be attracted by outflows at the powerhouse and could suffer injury.

5.5.9 Altered Flows - High Flows

The Baker Project strongly affects maximum flow levels in the Lower Skagit Basin. Natural peak flows have been reduced, and during non-flood conditions the power generation schedule at this Project strongly affects maximum daily flows in the Lower Skagit Basin. Springtime flows in the Lower Skagit have been reduced by 4.3% in recent years due to reservoir-filling operations (FERC 2002).

5.5.10 Altered Flows - Minimum Flows

Because of its essentially "on or off" operations, the Baker Project has had a very strong effect on minimum flows within the action area. Because it has only one operational turbine, and a bypass with only an 80 cfs capability, water releases from the Baker Project typically range from 4,000 cfs to 80 cfs within a single day. Routine or emergency maintenance has resulted in no water releases from the Baker Project for varying periods of time. Both the effect on the differences between maximum and minimum flow and the cessation of flows caused by maintenance have caused stranding of fish and exposure of redds. The 4,000 cfs difference between maximum and minimum flows can result in salmon spawning in areas covered by high flows, only to have the redds exposed at minimum flows. Additionally, during periods of maintenance or reduced operations river levels may drop, exposing redds. These extremes of flows may also cause stranding, and affect aquatic productivity in the areas exposed by flow fluctuations.

5.5.11 Altered Flows - Flow Fluctuations

Operations of the Baker Project have significantly affected flow fluctuations in the action area. Daily variations in flow follow an "on or off" pattern with water released for a few hours a day for power generation and then ceased except for 80 cfs to operate the Baker Project fish ladder.

Rates of change exceed Washington State ramping standards. Flow variations has also been observed to cause stranding of juvenile salmonids and dewatering of redds (WDFW 2002; R.W. Beck and Associates 1987).

Baker Project dam operations have affected salmonids because of rapidly changing flows that lead to stranding and redd dewatering. The problems have been persistent. In 1997, the Skagit System Cooperative analyzed the downramp flows from the Baker Project for the 1996 water year. It found 93 downramps where the flow of the Skagit River at Concrete was lower than the agreed upon 18,000 cfs, and 92 downramps that were faster than the agreed upon 2,000 cfs per hour protocol (SSC 2003). In a 1997 meeting, PSE agreed to resolve the problem.

In addition to regular project operations, emergency or routine maintenance at the Lower Baker Dam has also been observed to have a significant effect on flows within the action area. In November 2000, the Lower Baker Dam ceased water releases for routine maintenance activities. The Baker River flow rapidly dropped from 2,600 cfs to 130 cfs, and flows in the mainstem Skagit River dropped from 9,000 cfs to 5,700 cfs, resulting in a large loss of salmonid production due to dewatered redds (Brulle 2002 as cited in WCC 2003). WDFW biologists estimated a possible loss of 20%-25% of the chinook salmon redds below the Baker River (WDFW 2001). The current configuration of the Lower Baker Dam only allows water releases by spill (limited by reservoir level), through the turbines (up to 4000 cfs), or through the fish ladder (80 cfs). This configuration makes it likely that more low flow events will occur due to either routine or emergency maintenance at Lower Baker Dam.

5.5.12 Altered Flows - Ramping

Daily flow variation adversely affects juvenile chinook salmon rearing and migration. Downramping affects juvenile salmon by stranding them on gravel bars and in potholes, literally by rapidly draining the water out from under them. Downramping affects downstream rearing habitat by making juvenile rearing habitat a moving target, so that when downramping amplitude is large as a percentage of daily flow, juvenile fish may have to move significant distances, from secondary side channels to primary, or from primary to the mainstem river, etc., to obtain suitable rearing habitat. Downramping effects are seasonal, with the period February through June being most critical to chinook salmon. Juvenile chinook salmon are present in the Skagit River year round, but either in low numbers or at sizes greater than 50 mm, which are less likely to be affected. Juveniles are likely to be most vulnerable to stranding in the period soon after emergence. Their small size and weak swimming ability, in combination with their preference for habitat which is typically strongly affected by variations in river flows, makes them especially vulnerable to stranding during this period.

PSE downramps the Baker Project according to the schedule described in FERC 2002. PSE reduces discharge from 4200 cfs to 3100 cfs in about two minutes and holds at that flow for one hour. Discharge is then reduced to 1650 cfs in about two minutes, holding at that flow for about one hour. Discharge is then reduced to the minimum flow of 80 cfs in about two minutes.

During ramping events, flow changes of up to 2,000 cfs/hour have been observed in the Skagit River downstream of the Baker River confluence. The resulting changes in water surface elevation have caused stranding of chinook salmon fry (Phinney 1974; R.W. Beck and Associates 1987). Most stranded fry are less than 50 mm in length.

In addition to the downramping rate, the daily amplitude change is 4,000 cfs. Seattle City Light found that amplitude is a major factor in fry stranding (Beck 1989). PSE regularly cycles the Baker Project on a daily basis. Frequent flow fluctuations amplify the effects of individual fry stranding incidents.

The step-down process PSE proposes for downramping, 1,100 cfs to 1,570 cfs in about two minutes, appears equivalent to instantaneous rates of about 33,000 cfs to 47,000 cfs per hour. Meeting the Washington State downramping rate standard (Table 6) would require rates ranging from about 200 cfs, 600 cfs, or 900 cfs per hour, with respect to Skagit flow stages of 4,000 cfs, 15,000 cfs, and 20,000 cfs.

Table 6. Washington State ramping rate standards (Hunter 1992).

Season	Daylight Rates[3]	Night Rates
February 16 to June 15[1]	No Ramping	2 inches/hour
June 16 to October 31[2]	1 inch/hour	1 inch/hour
November 1 to February 15	2 inches/hour	2 inches/hour

[1] Salmon fry are present.
[2] Steelhead fry are present.
[3] Daylight is defined as one hour before sunrise to one hour after sunset.

The vulnerability of juvenile salmonids to stranding appears to be strongly correlated with fish size. Juveniles greater than 50 mm-55 mm total length are much less susceptible to stranding during rapid flow reductions (Hunter 1992 as cited in FERC 2002). Studies in the upper mainstem Skagit River observed that the mean size of stranded chinook salmon fry was 43 mm, and that 99% of stranded chinook salmon fry were less than 50 mm, even when salmonid fry larger than 50 mm were abundant (R.W. Beck 1989). Another study observed that mean length of wild chinook salmon fry reach 55 mm by mid-June (Hayman et al.1996 as cited in FERC 2002). The critical period for fry stranding in the action area appears to be between emergence in January and when salmonid fry reach a size that is less susceptible to stranding in mid-June.

No quantitative estimates are available of fry stranded that are attributable to Baker Project operations. Further, the effects of project cycling at the Skagit Project on the Upper Skagit River are not fully attenuated by the time they pass the Baker River. This complicates isolating the individual stranding effects of the respective projects.

5.5.13 Routine Maintenance

PSE performs a variety of routine maintenance actions. Minor maintenance tasks are performed daily or periodically. Maintenance occurs along the roads, the reservoir shorelines, the resort, the recreational facilities, and other ancillary facilities and buildings. Seepage through West Pass Dike into Depression Lake is pumped back to Baker Lake. Extensive maintenance, overhauls, and major repairs are performed during outages scheduled around water availability and system demands. Adverse effects to chinook salmon are normally not associated with these actions. The 2001 outage and turbine overhaul at Lower Baker was correlated with chinook salmon spawning at high river flows caused in part by heavy reservoir drafting and subsequent lack of water to contribute to egg incubation.

5.6 Summary of Environmental Baseline

The habitat biological requirements of Puget Sound chinook salmon appear not to be met under the environmental baseline when effects of historical project operations on current status are considered. The current environmental baseline supports populations that are greatly depressed from historical run sizes. Environmental baseline conditions in the action area would be expected to improve in the future because continuing operation of the project and other Federal actions that have not undergone Section 7 consultation are not included in the baseline. However, the extent of this potential improvement is unknown. Maintenance or further degradation of the existing conditions within the action area would contribute to the long-term declining trend of Puget Sound chinook salmon. Any further degradation of these conditions may lead to the biological baseline failing to meet the biological requirements of Puget Sound chinook salmon. Table 7 displays a summary of the relevant factors discussed in Section 5.3-5.6, based on the Matrix of Pathways and Indicators described in NOAA Fisheries (1996).

Table 7. Matrix of Pathways and Indicators for the environmental baseline (including historical project effects). Unless otherwise noted, the descriptions apply to the habitat biological requirements of the populations of Puget Sound chinook salmon found in the action area. Function codes: PF: properly functioning, NPF: Not properly functioning, AR: At Risk.

Path way	Indicator	Function	Description	Source
Water Quality	Temperature	AR	Numerous subbasins in Lower Skagit have summertime water temperatures exceeding standards. Some observations of temperature exceedences in Lower Skagit.	Land clearing for development, logging
	Sediment/ Turbidity	AR	Landslides in tributaries contribute to high levels of suspended solids and turbidity	Road building, logging
	Dissolved substance	NPF	Numerous observations of exceedences for nitrogen, phosphorous, and ammonia in the Lower Skagit Basin. Multiple tributaries and slough appear on 303(d) list for temperature, dissolved oxygen, fecal coliforms	Uncertain, may be related to agriculture or sewage treatment
Habitat	Barriers	AR	Passage at Baker Project provided by trap and haul and downstream juvenile collectors	Upper and Lower Baker Dams
Habitat Elements	Substrate	PF		
	Large Woody Debris	AR	Blockage of LWD transport by Baker and Skagit Projects. Poor recruitment because of limited riparian reserves	Baker and Skagit Projects Loss of riparian reserves due to logging and development

Function codes: PF: properly functioning, NPF: Not properly functioning AR: At Risk

Pathway	Indicator	Function	Description	Source
Habitat Elements	Pool Frequency/ Quality	NPF	Lower Skagit channel mostly comprised of long runs	Hydromodification, lack of LWD
	Refugia & Off-Channel Habitat	NPF	Most off-channel habitat in Lower Skagit Basin lost to diking and channelization. Loss of most off-channel habitat in Skagit delta	Agricultural and urban development, flood control
Channel Dynamics	Channel Morphology		Lower Skagit channel highly hydromodified, loss of secondary channels and meanders.	Agricultural and urban development, flood control
	Streambank Condition	NPF	Extensive diking and bank hardening in Lower Skagit Basin	Agricultural and urban development, flood control
	Flood plain Connectivity	NPF	Extensive diking, ditching, and filling in Lower Skagit Basin	Agricultural and urban development, flood control

Function codes: PF: properly functioning, NPF: NOT properly functioning AR: At Risk

Pathway	Indicator	Function	Description	Source
Chamnel Dynamics	Altered Flows	NPF	Hydropower and flood control operations of Baker and Skagit Projects. Reduced peak flows. Altered seasonal flow patterns. Ramping rates exceeding Washington State standards	Baker and Skagit Projects
	Road Density and Location	NPF	Extensive road network in Lower Skagit Basin	Urban, agricultural, and residential development
	Disturbance History	NPF	Logging in upper watershed, extensive clearing and development in Lower Skagit floodplain, Skagit River delta highly modified	Logging, urban, agricultural, and residential development
	Riparian Reserves	NPF	Reserves good in Baker River subbasin, Reserves poor downstream of Baker/Skagit confluence	Logging, urban, agricultural, and residential development
Biotic Interactions	Predation	PF	Some predation may occur in project reservoirs, predator populations do not appear to exceed historical levels	
	Competition	AR	Some potential competition with hatchery reared fish, no known exotic species or out of basin stocks present	Marblemount Hatchery (WDFW)
	Harvest	PF	Harvest rates reduced from over 80% in 1970s to 50%-60% in recent years	

Function codes: PF: properly functioning, NPF: NOT properly functioning AR: At Risk

6. ANALYSIS OF EFFECTS OF THE PROPOSED ACTION

6.1 Effects of Proposed Action

Effects of the action are defined as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline" (50 CFR §402.02). Direct effects occur at the project site and may extend upstream or downstream based on the potential for impairing important habitat elements. Indirect effects are defined in 50 CFR §402.02 as "those that are caused by the proposed action and are later in time, but still are reasonably certain to occur." They include the effects on listed species of future activities that are induced by the proposed action and that occur after the action is completed. "Interrelated actions are those that are part of a larger action and depend on the larger action for their justification" (50 CFR §403.02). "Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR §402.02).

6.2 Methods of Analysis

In step 3 of NOAA Fisheries' jeopardy approach, it evaluates whether or not the proposed action results in a reduction of the reproduction, numbers, or distribution of the species which constitutes an appreciable reduction in the likelihood of both survival and recovery. This determination is informed by the rangewide status of the species and the effects of the environmental baseline and cumulative effects in the action area.

NOAA Fisheries may use either or both of two independent techniques in determining whether the proposed action jeopardizes a species continued existence. First, NOAA Fisheries may consider the impact in terms of how many listed salmon will be killed or injured during a particular life stage and then gauge the effects of that take on population size and viability. Alternatively, NOAA Fisheries may consider the effect on the species' freshwater habitat requirements, such as water temperature, streamflow, etc. The habitat analysis is based on the well documented cause-and-effect relationships between habitat quality and population viability. While the habitat approach to the jeopardy analysis does not quantify the number of fish adversely affected by habitat alteration, it considers this connection between habitat and fish populations by evaluating existing habitat condition in light of habitat conditions and functions known to be conducive to salmon conservation (Spence et al. 1996). In other words, it analyzes the effect of the action on habitat functions that are important to meet salmonid life cycle needs. The habitat approach then links any failure to provide habitat function to an affect on the population and to the ESU as a whole. For this consultation, NOAA Fisheries utilizes the habitat approach in considering the biological requirements best described by important habitat characteristics.

6.3 Direct Effects of the Project

Direct effects are the direct or immediate effects of the project on the species or its habitat. Direct effects result from agency action, including the effects of interrelated actions and interdependent actions. Future Federal actions that are not a direct effect of the action under consideration (and not included in the environmental baseline or treated as indirect effects) are not considered in this Opinion.

6.3.1 Effects of Continued Operations

The direct, indirect, and cumulative effects of historical project operations on listed, proposed, and candidate species and on their designated critical habitat are described under baseline conditions in the BA. Continued operation of the project with no modification would result in continuation of the baseline conditions.

Since the proposed action involves continued operations of the Baker Project with only modification of some project operations, effects associated with the physical properties of the project are expected to remain unchanged. Historical project effects that are expected to continue unchanged as the proposed action relatively unchanged include all of those noted in Section 5.5, with the exception of Section 5.5.10, Minimum Flows, and Section 5.5.11, Flow Fluctuation.

6.3.2 Effects of Modified Operations

Split season management plan
The split season management plan is intended to balance risks of chinook salmon egg losses associated with dewatering and risks of eggs to losses associated with peak flood flows (primarily redd scouring). Dewatering risks occur when chinook salmon spawn at relatively high flows followed by a dry winter incubation period. Flood loss risks are greatest when chinook salmon spawn at very low flows - nearer the channel thalweg - and then are exposed to incubation season flooding, which scours redds and destroys eggs. The split season plan will maintain relatively low flows during the early spawning period to mid-October, and allow chinook salmon to spawn higher along the stream margins during the later, normally wet, half of the spawning period, providing a small measure of redd protection from potential flood flows during winter storm events.

Recent outputs from PSE's HYDROPS model estimated the effects of the split season management plan would increase survival of chinook salmon eggs and juveniles in redds in the reach downstream of the Baker/Skagit confluence by 11% (PSE 2002). In its comments on the proposed flow plan, the WDFW noted that the plan failed to protect chinook salmon spawning earlier than October 1, and that the proposed increased storage would yield little benefit to chinook salmon spawning downstream of the Baker River. The WDFW also disagreed that the potential for redd dewatering caused by the plan would be offset by increased protection from scour during flooding, as proposed in the BA.

NOAA Fisheries agrees with WDFW that the plan fails to protect Puget Sound chinook salmon spawning earlier than the October 1 starting period of the plan and that the benefits of protection from redd scouring during flood events are probably less than predicted in the BA. Under the proposed action, some chinook salmon redds are likely to be dewatered during low water winters. Although the proposed action has shortcomings, NOAA Fisheries predicts the net effect of the proposed action will be positive compared to current operations. The redds of chinook salmon spawning upstream of the Baker River confluence would not be affected by the proposed action. Unlisted pink and chum salmon would still be affected by project operations. Large numbers of chum salmon redds would likely be dewatered, and significant numbers of pink salmon redds may be dewatered (R2 2003). Steelhead redds may be dewatered during the early summer as a result of project operations, but specific examples have not yet been identified.

Ramping
Various strategies for meeting ramping rate standards were discussed during consultation with PSE. The physical limitations of the facility and reservoir managment considerations complicated the development of strategies to meet ramping standards. Some scenarios involving the use of spill to meet ramping rates were considered; however, NOAA Fisheries is concerned with possible effects of spill on downstream migrant collection at Lower Baker Dam. Strategies using spill to meet ramping rates require further assessment before they are ready for implementation.

6.4 Indirect Effects

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the area directly affected by the action. If they are reasonably certain to occur, indirect effects may include other Federal actions that have not undergone Section 7 consultation, but will result from the action under consideration.

6.5 Summary

The proposed action is likely to have both positive and negative effects on Puget Sound chinook salmon during the term of this Opinion (see Table 8). The proposed IPP modifies project operations to provide improved protection to redds and juveniles. The studies included in the proposed action should provide information that will allow NOAA Fisheries, FERC, and PSE to more effectively deal with remaining problems during project relicensing in 2006.

However, the proposed action is limited in scope, proposing only a change to operations during a portion of the year. Because of this, most of the historical negative effects associated with the project will continue during the term of this Opinion. The most notable remaining negative effects are associated with water releases from the Baker Project, with the most significant of these being ramping rates which exceed Washington State ramping rate standards, and the shutoff of water releases from the project during maintenance activities.

The negative effects adversely affect listed Puget Sound chinook salmon. However, the effects do not rise to the level of appreciably affecting the survival and recovery of this ESU due to the short term of the Opinion, which will be followed by project relicensing (which provides an opportunity to more comprehensively address the remaining negative effects). Studies to be completed before relicensing will provide information that will allow the remaining negative effects to be effectively addressed during the relicensing period.

Table 8. Analysis of project effects. Summary of effects of proposed action on Skagit River Basin listed salmonids. IMPAIR = impair properly functioning habitat; REDUCE = appreciably reduce the functioning of already impaired habitat; RETARD = retard the long-term progress of impaired habitat towards properly functioning condition; NR = not reduce, retard, or impair; NPF = baseline not properly functioning; AR = baseline at risk; PFC = baseline properly functioning conditioning. NKE=no known significant project effects.

Category	Effect	ESU affected	Life Stage affected	Habitat Parameter affected	Baseline Status with Historical	Result	Viable Population parameter affected
Barrier	Upstream Passage	PSC	Adult	Habitat: Barrier	AR	Retard	Productivity, Abundance, Distribution
	Downstream Passage	PSC	Juvenile	Habitat: Barrier	AR	Retard	Productivity, Abundance, Distribution
Reservoir	Habitat inundation	PSC	All	Habitat	AR	Retard	Distribution
	Passage barrier	PSC	All	Habitat: Barrier	AR	Retard	Distribution
	Increased predator populations	NKE		Biotic interactions: Predation			
	Increased competitior populations	NKE		Biotic interactions: Competition			
	Upstream or downstream export of competitors or predators	NKE		Biotic interactions: Competition or predation			
	Water Quality: Organics	NKE		Water Quality: Dissolved substances			
	Water Quality: Dissolved oxygen	NKE		Water Quality: Dissolved substances			

	Water Quality: Temperature	NKE		Water Quality: Temperature			
	Water quality : Dissolved substances	NKE		Water Quality: Dissolved substances			
Interruption of lotic processes	Large Woody debris transport	PSC	Adult, Juvenile	Habitat elements: Large Woody Debris	NPF	Retard	Productivity
	Substrate transport	PSC	Adult, Juvenile	Habitat Elements: Substrate	AR	NR	Productivity
	Nutrient transport	NKE		Water Quality: Dissolved substances			
Flow Modification	Altered minimum flows	PSC	Adult, Juvenile	Channel Dynamics: Altered flows	NPF	Retard	Productivity
	Altered maximum flows	PSC	Adult, Juvenile	Channel Dynamics: Altered flows	NPF	Retard	Productivity, Abundance
	Altered flow timing	PSC	Adult, Juvenile	Channel Dynamics: Altered flows	AR	Retard	Productivity, Abundance
	Ramping	PSC	Adult, Juvenile	Channel Dynamics: Altered flows	NPF	Retard	Productivity, Abundance
	False attraction flows	PSC	Adult	Channel Dynamics: Altered flows	AR	Retard	Abundance

Downstream water quality	Dissolved gas saturation	NKE		Water Quality: Dissolved substances			
	Temperature	NKE		Water Quality: Temperature			
	Dissolved Oxygen	NKE		Water Quality: Dissolved substances			
	Contaminant	NKE		Water Quality: Dissolved substances			
	pH	NKE		Water Quality: Dissolved substances			

7. CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR §402.02 as "those effects of future State, tribal, local or private actions, not involving Federal activities, that are reasonably certain to occur in the action area considered in this biological opinion." Future Federal actions, including the ongoing operation of hatcheries, fisheries, and land management activities, are not considered within the category of cumulative effects for ESA purposes because they require separate consultations pursuant to Section 7 of the ESA after which they are considered part of the environmental baseline. Future non-Federal actions which are most notable include Washington State TMDL (total maximum daily load) development and implementation, Washington State legislation to enhance salmon recovery through tributary enhancement programs, and recent human population trends in the action area. However, after considerable review, NOAA Fisheries has determined that these actions cannot be deemed reasonably likely to occur based on its ESA-implementing regulations.

The Endangered Species Consultation Handbook describes this standard as follows:

> Indicators of actions "reasonably certain to occur" may include, but are not limited to: approval of the action by State, tribal or local agencies or governments (e.g., permits, grants); indications by State, tribal or local agencies or governments that granting authority for the action is imminent; project sponsors' assurance the action will proceed; obligation of venture capital; or initiation of contracts. The more State, tribal or local administrative discretion remaining to be exercised before a proposed non-Federal action can proceed, the less there is a reasonable certainty the project will be authorized.

There are, of course, numerous non-Federal activities that have occurred in the action area in the past, which have contributed to both the adverse and positive effects of the environmental baseline. This step of the analysis for application of the ESA Section 7(a)(2) standards requires the consideration of which of those past activities are "reasonably certain to occur" in the future within the action area.

First of all, any of these actions that involve Federal approval, funding, or other involvement are not considered "cumulative effects" for this analysis (see ESA definition, above). The Federal involvement will trigger ESA Section 7(a)(2) consultation in the future. Once the consultation on those actions is completed the effects may be considered part of the environmental baseline, consistent with the ESA regulatory definition of "effects of the action" (50 CFR §402.02). Thus, for example, State efforts to improve water quality in compliance with the Federal Clean Water Act would not be considered because of the involvement of the U.S. Environmental Protection Agency, until separate ESA consultations are completed. Others examples include irrigation water withdrawals involving the USFS (right-of-way permits for irrigation canals) or agricultural practices that receive Federal funding through the U.S. Department of Agriculture.

Next, actions that do not involve Federal activities must meet the "reasonably certain to occur" test for NOAA Fisheries to consider their effects in this Opinion. NOAA Fisheries finds that currently few, if any, of the future adverse or beneficial State, tribal, or private actions qualify for consideration in this analysis as "cumulative effects." Therefore, when evaluating the status of the listed species, including their likelihood of survival and recovery, NOAA Fisheries concludes that most of the factors for the decline of these species are not eligible for consideration in determining whether the authorization of incidental take under the proposed action is likely to jeopardize their continued existence. Thus the future abundance and productivity of listed Puget Sound chinook salmon, against which the effects of this action are considered, are likely to be improved, although to an unknown or possibly minor extent, over those reflected by the historical trends under the environmental baseline.

A number of other commercial and private activities, including timber harvest, recreation, urban and rural development, and water supply development, could potentially affect listed species occur in the Skagit River Basin. NOAA Fisheries is not aware of any additional State or private action in the project area that is reasonably certain to occur, or that would affect the listed species or their critical habitat. It is likely that ongoing non-Federal activities that affect listed salmonids and their habitat will continue in the short term at similar intensities as in recent years.

8. CONCLUSION

This section presents NOAA Fisheries' biological opinion regarding whether the aggregate effects of the factors analyzed under the environmental baseline, the effects of the proposed action, and the cumulative effects in the action area, when viewed against the current rangewide status of the species are likely to jeopardize the continued existence of Puget Sound chinook salmon. To "jeopardize the continued existence of "means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of the species (CFR §402.02). This determination is informed by the rangewide status of the species and the effects of the environmental baseline and cumulative effects in the action area. As previously discussed in Section 3 of this Opinon, the critical habitat designation for Puget Sound chinook salmon was withdrawn on April 30, 2002. Therefore, this Opinion does not address critical habitat for this species

As discussed in Section 5, the environmental baseline, as influenced by historical project operations, does not adequately fulfill the biological requirements of Puget Sound chinook salmon populations. The effects of the proposed action, including the continuing activities of the Baker Project, are summarized in Table 8. The continued operation of the Baker Project, as modified by the proposed action, will have the following adverse effects that potentially reduce the likelihood of survival and recovery of Puget Sound chinook salmon within the action area:

1. Partial barrier to upstream migration.

2. Partial barrier to downstream migration.

3. Loss of spawning and rearing habitat in Lower Baker River (above Lower Baker Dam) from inundation by project reservoirs.

4. No release of Baker River flows because of routine or emergency maintenance at Lower Baker Dam, leading to injury or mortality due to stranding or redd dewatering.

5. Ramping rates exceeding Washington State standards leading to stranding of juvenile salmonids.

6. Degraded spawning and rearing habitat in the Lower Baker River (below Lower Baker Dam) caused by dredging and channel simplification.

7. Potential dewatering of redds due to seasonal flow patterns altered by project operations.

These effects have been observed to have significant negative effects on Puget Sound chinook salmon populations within the action area. The most significant adverse effects are related to flow regulation, which has the potential to harm or kill chinook salmon from all Puget Sound chinook salmon populations in the action area below the Lower Baker Dam. The partial barriers to migration and loss of habitat on the Baker River affect a relatively small portion of one population (Lower Skagit) of Puget Sound chinook salmon within the action area. The Baker downstream passage facilities appear to be ineffective at safely passing chinook salmon downstream, but since the subbasin chinook salmon population appears to be extirpated, there is also limited adverse effect.

NOAA Fisheries must also consider the duration of the proposed action, in this case approximately two years (the current license expires April 30, 2006). If the Baker Project is to be operated beyond this date, presumably in accordance with a new license (or annual license while a new license is pending), FERC must first reinitiate consultation with NOAA Fisheries to determine the effects of those operations before any further activity can take place.

For the interim period covered by this Opinion, the current status of listed populations within the action area is estimated by the PSTRT to be stable to slightly increasing for all populations but the Suak. The incremental improvement in protection for redds provided by the proposed action should also yield some improvements in population productivity for those populations spawning downstream of the Baker River confluence. This combined with the recent trend of increasing adult returns suggest that the populations have sufficient resilience to withstand these effects and remain viable for the relatively short term of this Opinion.

NOAA Fisheries has determined that, when the effects of the proposed action are added to the environmental baseline and cumulative effects occurring in the action area, and given the status of the stocks and condition of important habitat features, and the duration of the proposed action, the action is not likely to jeopardize the continued existence of Puget Sound chinook salmon. In reaching this conclusion, NOAA Fisheries has relied upon the best scientific and commercial data currently available.

The short term of the proposed action is a major factor in reaching this conclusion. For a proposed action of longer duration, project effects would have a much greater potential impact on the viability of Puget Sound chinook salmon within the action area. Thus it should not be assumed that future operation of the Baker Project beyond the period covered by this Opinion would reach the same conclusions regarding population viability. Any license proposed to be issued by FERC for the operation of the Baker Project beyond the period of this Opinion will be subject to its own independent review under the ESA.

9. INCIDENTAL TAKE STATEMENT

Sections 4(d) and 9 of the ESA prohibit any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species without a specific permit or exemption. Harm is further defined in 50 CFR §222.102 as "an act that may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering." Harass is defined as actions that create the likelihood of injuring listed species to such an extent as to significantly alter normal behavior patterns which include, but are not limited to, breeding, feeding, and sheltering. Incidental take is take of listed species that results from, but is not the purpose of, the Federal agency or the applicant carrying out 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 prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

An incidental take statement specifies the impact of any incidental taking of endangered or threatened species. It also provides resonable and prudent measures (RPM) that are necessary to minimize impacts and sets forth terms and conditions with which the action agency must comply in order to implement the RPMs.

9.1 Amount and Extent of Anticipated Take

NOAA Fisheries anticipates that the proposed action will cause incidental take of some Puget Sound chinook salmon within the action area for the duration of the current license. Project effects causing this take are analyzed and described in this Opinion. Take examples may include redd and juvenile harm or mortality caused by ramping and variation in water releases. Despite the use of the best scientific and commercial data available, NOAA Fisheries cannot quantify a specific amount of incidental take or individual fish or incubating eggs for this action. Instead, the extent of take is anticipated to be that associated with the operation of the Baker Project in accordance with the measures of the preferred alternative in the existing license and proposed amendment issued by FERC.

9.2 Effect of Anticipated Take

As analyzed in this Opinion, NOAA Fisheries has determined that the extent of anticipated take over the approximately two years remaining on the current license is not likely to jeopardize the continued existence of Puget Sound chinook salmon.

9.3 Reasonable and Prudent Measures

Reasonable and prudent measures are non-discretionary measures to minimize take that are not already part of the description of the proposed action. They must be implemented as binding conditions for the proposed action to go forward. FERC has the continuing duty to regulate the activities covered in this incidental take statement. If FERC fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, or fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of Section 7(o)(2) may lapse. NOAA Fisheries believes that activities carried out in a manner consistent with these RPMs, except those otherwise identified, will not necessitate further site-specific consultation. Activities which do not comply with all relevant RPMs will require further consultation.

NOAA Fisheries believes that the following RPMs are necessary and appropriate to minimize the effect of anticipated incidental take of Puget Sound chinook salmon. FERC must require PSE to:

- Reduce the take associated with project operations through immediate actions.
- Reduce the take associated with project operations through long-term modifications. The first step to be completed within the term of this Opinion and applied to licensing considerations is implementation of studies to evaluate operational modifications to reduce take.
- Monitor take and critical operations likely to result in take, and report this information to NOAA Fisheries.
- PSE must design the Enhanced Flood Control/Split Chinook Spawning Season Flow Management Plan in a manner which most closely matches the presence of spawning Puget Sound chinook salmon attempting to enter the project area.

9.4 Terms and Conditions

In order to be exempt from the take prohibitions of Section 9 of the ESA and regulations issued pursuant to Section 4(d) of the ESA, FERC must include in the license amendment and PSE must implement the following terms and conditions, which implement the RPMs listed above. These terms and conditions are non-discretionary.

1. Develop and submit to NOAA Fisheries for approval, at least 30 days before the action, plans for all routine maintenance that may cause interruptions in releases from Lower Baker Dam, showing how all effects have been made to schedule these interruptions during periods that will have the least impact on Puget Sound chinook salmon.

2. Ramping rates at Lower Baker Dam will not exceed those described in the gradual shutdown protocol described in Section 2.2.1 of this Opinion and section 4.5 of the BA.

3. Conduct studies on possible modifications to project facilities or operations (or a combination of both) to meet Washington State Standards for Ramping Rates and report the results to NOAA Fisheries no later than April 29, 2006. FERC will also incorporate the results of these studies into the BA for relicensing.

4. Conduct studies described in Table 9 of this Opinion and Appendix D of the BA and report the results of the studies to NOAA Fisheries by April 29, 2006.

Table 9. Studies described in Appendix D of the Biological Assessment.

Study number	Title
A-01a	Reservoir Tributary Habitat Surveys
A-01b	Reservoir Tributary Biological Surveys
A-01c	Reservoir Tributary Delta Surveys
A-02	Lower Baker River Habitat Mapping
A-03	Reservoir Fish Population Characteristics
A-04	Lower Baker/Skagit River Flow Coordination, Gaging
A-05	Water Quality Sampling
A-06	Upper Baker Passage Design Baffle Modification
A-07	Lower Baker Forebay Bathymetric Survey
A-08	Upper Baker Passage System Evaluation
A-09a	Skagit River Flow, Ramping and Habitat Assessment
A-09b	Distribution, Timing, and Depth of Salmonid Redds
A-09c	Distribution, Timing, and Depth of Salmonid Redds
A-09d	Distribution, Timing of Salmonid Fry
A-12	Instream Flows for Biodiversity
A-13	Water Quality Assessment
A-14a	Reservoir Shoreline Erosion-mapping and evaluation of physical processes
A-14b	Reservoir Shoreline Erosion-effects on aquatic resources
A-14c	Reservoir Shoreline Erosion in deltaic tributary channels-effects on aquatic resources
A-15	Upper Baker River Delta Scour
A-16	Lower Baker Alluvial Fan/Channelization

A-17	Tributaries Surveys Upstream of Barriers
A-18	Baker River Survey 1 kilometer form Reservoir Upstream to Anadromous Fish Barriers
A-19	Review Limnological Information
A-20	Large Woody Debris Mangement
A-22	Baker Lake Trout Impacts Evaluation
A-24	Hydrologic and Geomorphic Analysis
A-25	Reservoir Predation
A-26	Reservoir Production Potential
A-28	Fish Passage-Reservoir Management
A-29	Sockeye Smolt Incubation Origin-Otolith
A-30	Near Field Smolt Behavior Study
A-31	Far Field Smolt Behavior Study
A-32	Kelt Radio-Telemetry Study
A-33	Passive Integrated Transponders (PIT) Tag Migration Study
A-34	Downstream Fish Passage Periodicity Correlation Analysis
A-35	Upstream Fish Passage Run-Timing Correlation Analysis

5. Conduct studies on possible modifications to project facilities or operations (or a combination of both) and develop a plan to allow water release to maintain Lower Baker and Skagit River flows during routine or emergency maintenance operations report the results to NOAA Fisheries no later than April 29, 2006. FERC will also incorporate the results of these studies into the BA for relicensing.

6. PSE will conduct a monitoring program to document the number of redds exposed by project operations and submit an anual report of the results of this monitoring to NOAA Fisheries by January 1 of each year. NOAA Fisheries will review and approve the monitoring plan before implementation.

7. PSE will conduct an annual monitoring program to document the rate of juvenile stranding caused by project operations and submit an anual report of the results of this monitoring to NOAA Fisheries by December 1 of each year. This monitoring will cover the critical period of January through the end of June. NOAA Fisheries will review and approve the monitoring plan before implementation.

8. PSE will notify NOAA Fisheries and the WDFW within 4 hours of any divergence from the ramping rates or the proposed Enhanced Flood Control/Split Chinook Spawning Season Flow Management Plan, or emergency maintenance that requires an interruption of releases from Lower Baker Dam. If PSE determines that a divergence from ramping or flow plans or an interruption of water releases from Lower Baker Dam will be required in the course of future operations, PSE will contact NOAA Fisheries and the WDFW in advance of the action.

9. PSE will prepare and submit to an annual report to NOAA Fisheries documenting any divergence from the ramping rates or the proposed Enhanced Flood Control/Split Chinook Spawning Season Flow Management Plan, or routine or emergency maintenance that requires an interruption of releases from Lower Baker Dam. The report will also include the results of monitoring required in items 1 and 2, above.

10. Adjust the dates for the Early Chinook Spawning Period (October 1-October 21) and the Late Chinook Spawning Period (October 16-November 15) to September 15-October 15 and October 16- November 15, respectively. New information gathered by PSE while conducting studies related to the relicensing supports these changes and may be provided upon request.

11. During low flow conditions in both the Early and Late Chinook Spawning Periods (Paragraph 2 in each respective section), the point and quantities where flow exceedences are measured are moved from the Baker River to the Skagit River. The new conditions are: if flows in the Skagit River as measured above the confluence of the Skagit River and the Baker River are less than 4,200 cfs during the Early Chinook Spawning Period or less than 6,000 cfs during the Late Chinook Spawning Period, low flow augmentation may be utilized.

10. 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 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 to develop additional information.

A. FERC and PSE should reduce or eliminate the effects of operations of Lower Baker Dam on river level changes in the Lower Baker and Skagit Rivers.

1. Physical modifications of the project, changes in operation, spill, and other measures should be pursued to enable Lower Baker Dam operations to meet Washington State ramping rate standards.

2. Changes in river elevation caused by the operations of Lower Baker Dam should be minimized during the critical period of spawning and emergence of fry, September 10-April 30.

3. The Lower Baker Dam should provide a consistent minimum level of water releases, one third of the Baker spawning flow, except when masked by high Skagit River flows, during the critical period of spawning and fry emergence, September 10-April 30.

4. Immediate action should be taken to develop a means of maintaining water releases from Lower Baker Dam during periods of turbine shutdown.

5. No non-emergency cessation of water releases from Lower Baker Dam during the critical period of spawning and emergence of fry, September 10-April 30.

6. Load following operations of the Lower Baker Project should be ceased and an operation protocol which eliminates the historically observed problems of river levels in the Lower Baker and Skagit Rivers should be adopted.

11. REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed action. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency 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 agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion, 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat no 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, any operations causing such take must cease pending reinitiation, unless such action is not expected to constitute an irreversible or irretrievable commitment of resources that has the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures that would not violate 16 USC §1536(a)(2).

FERC has provided NOAA Fisheries with a BA describing a proposed action to occur during the interim period addressed by this Opinion. FERC's BA contemplates incorporation of this proposed action into amended license articles for the Baker Project. In the event that the amended license fails to incorporate the proposed action as analyzed in this Opinion, then the conclusions of this Opinion and the protection afforded by the incidental take statement do not apply, and FERC should reinitiate consultation under Section 7 of the ESA to seek NOAA Fisheries' opinion on the alternative action.

This Opinion analyzes actions to be implemented through the expiration of the current license on April 30, 2006. At that time, NOAA Fisheries expects that another biological opinion, developed pursuant to a consultation with FERC, relating to the relicensing of the entire Baker Project will supersede this Opinion. An extension of the proposed action beyond April 30, 2006, through annual licenses, has not been addressed in this Opinion and would require reinitiation of consultation.

12. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

12.1 Background

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

1. Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2)).

2. NOAA Fisheries must provide conservation recommendations for any Federal or State action that would adversely affect EFH (§305(b)(4)(A)).

3. Federal agencies must provide a detailed response in writing to NOAA Fisheries within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NOAA Fisheries' EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH, waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR §600.10). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey or reduction in species fecundity), site-specific, or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR §600.810).

EFH consultation with NOAA Fisheries is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

12.2 Identification of EFH

Pursuant to the MSA, the Pacific Fisheries Management Council has designated EFH for three species of Federally managed Pacific salmon: chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), and Puget Sound pink salmon (*O. gorbuscha*) (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable manmade barriers (PFMC 1999), and longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the proposed action is based, in part, on this information.

12.3 Proposed Action

The proposed action and action area are detailed above in Sections 1 and 2 of this Opinion. The action area includes habitats that have been designated as EFH for various life history stages of chinook, coho, and pink salmon.

12.4 Effects of Proposed Action

As described in detail in Section 6.3 of this Opinion, the proposed action may result in short- and long-term adverse effects to a variety of habitat parameters. These adverse effects are:

1. Historical spawning and rearing habitat in Lower Baker River inundated by project reservoirs (most significant for coho salmon) or lost because of dredging of the Lower Baker River.
2. Loss of connectivity to off-channel habitat because of varying flows.
3. Reduced productivity of mainstem rearing habitat because of varying flows.
4. Potential exposure of redds because of varying flows (appears to be more serious for coho and pink salmon than chinook salmon).
5. Potential stranding of juveniles and adults because of high ramping rates.

12.5 Conclusion

NOAA Fisheries concludes that the proposed action would adversely affect designated EFH for chinook, coho, and pink salmon.

12.6 EFH Conservation Recommendations

Pursuant to Section 305(b)(4)(A) of the MSA, NOAA Fisheries is required to provide EFH conservation recommendations to Federal agencies regarding actions which may adversely affect EFH. The terms and conditions outlined in Section 9.4 are generally applicable to designated

EFH for chinook, coho, and pink salmon, and address adverse project effects. NOAA Fisheries recommends that they be adopted as EFH conservation measures. Specific examples include:

1. Ramping rates studies, specifically addressing project effects on chum and coho salmon.
2. Habitat protection/flow studies, specifically addressing project effects on chum and coho salmon.
3. LWD enhancement studies.
4. Gravel enhancement studies.
5. Redd protection/flow studies, specifically addressing project effects on chum and coho salmon.

12.7 Statutory Response Requirement

Pursuant to the MSA (§305(b)(4)(B)) and 50 CFR §600.920(j), Federal agencies are required to provide a detailed written response to NOAA Fisheries' EFH conservation recommendations within 30 days of receipt of these recommendations. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity on EFH. In the case of a response that is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

12.8 Supplemental Consultation

FERC must reinitiate EFH consultation with NOAA Fisheries if the proposed action is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR §600.920(k)).

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UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Baker River	)	FERC No. 2150
	)	(Baker River Hydroelectric Project)
Amendment to Current License	)	
	)	

CERTIFICATE OF SERVICE

I hereby certify that I have this day served, by first class mail, the NOAA Fisheries' Draft Biological Opinion for Endangered Species Act Section 7 Consultation for the Baker River Hydroelectric Project, FERC No. 2150. NOAA Fisheries Consultation No. 2002/01040, cover letter to Magalie Salas, FERC, and this Certificate of Service upon each person designated on the official service list compiled by the Commission in the above captioned proceeding.

Dated this 3rd day of June, 2004.

Nona Carter

Nona Carter
Paralegal