UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OREGON 97232-1274

November 21, 2012

**VIA ELECTRONIC FILING**

Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, D.C. 20426

Subject: National Marine Fisheries Service Biological Opinion, Not Likely to Adversely Affect Determination, and Essential Fish Habitat Consultation for the Skagit River Hydroelectric Project, FERC Project No. 553.

Dear Secretary Bose:

Enclosed is the National Marine Fisheries Service's (NMFS) Biological Opinion for the Skagit River Hydroelectric Project in Whatcom County, WA. Also included are NMFS's Magnuson-Stevens Fishery Conservation and Management Act (MSA) Essential Fish Habitat consultation conservation recommendations. NMFS concludes that the proposed action would not jeopardize the continued existence of Puget Sound Chinook salmon or Puget Sound steelhead and will not destroy or adversely modify designated critical habitat for Puget Sound Chinook salmon. The proposed action is not likely to adversely affect endangered southern resident killer whales or their designated critical habitat.

Comments or questions regarding this Biological Opinion, Not Likely to Adversely Affect Determination, and MSA consultation should be directed to Steve Fransen at 360-753-6038 steven.m.fransen@noaa.gov, or Keith Kirkendall, FERC/Water Diversions Branch Chief, at 503-230-5431, keith.kirkendall@noaa.gov).

Sincerely,

Bruce K Suzumoto
for

William W. Stelle, JR.
Regional Administrator

Enclosure

cc: Dave Pflug
Seattle City Light
700 5$^{th}$ Ave. #3200
Seattle, WA 98104

Service List

**UNITED STATES OF AMERICA**

**FEDERAL ENERGY REGULATORY COMMISSION**

| | |
|---|---|
| **Seattle Public Utilities** | **) Skagit River Hydroelectric Project** |
| **Seattle City Light** | **) FERC No. P-553** |

## CERTIFICATE OF SERVICE

I hereby certify that I have this day served, by electronic or first class mail, a letter to Kimberly D. Bose, Federal Energy Regulatory Commission, from the National Marine Fisheries Service, regarding National Marine Fisheries Service Biological Opinion, Not Likely to Affect Determination, Essential Fish Habitat Consultation conservation recommendations and Magnuson-Stevens Fishery Conservation and Management Act (MSA) for the Skagit River Hydroelectric Project, FERC Project No. P-553 and this Certificate of Service to each person designated on the official service list compiled by the Commission in the above captioned proceeding.

Dated on November 21, 2012

Bonnie J. Hossack

Bonnie J. Hossack
Administrative Assistant

**Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion,**

**and**

**Magnuson-Stevens Fishery Conservation and Management Act**
**Essential Fish Habitat (EFH) Consultation**

**License Amendment of Seattle City Light's**

**Skagit River Hydroelectric Project FERC No. P-553**

**Skagit River, HUC 1702000503 Whatcom County, Washington**

**NMFS Consultation Number: 2011/06440**

**Action Agency: Federal Energy Regulatory Commission**

**Affected Species and Determinations:**

| ESA-Listed Species | Status | Is Action Likely to Adversely Affect Species or Critical Habitat? | Is Action Likely To Jeopardize the Species? | Is Action Likely to Destroy or Adversely Modify Critical Habitat |
|---|---|---|---|---|
| Puget Sound Chinook salmon (*Oncorhynchus Tshawytscha*) | Threatened | Yes | No | No |
| Puget Sound steelhead (*Oncorhyncus mykiss*) | Threatened | Yes | No | No |
| Southern Resident killer whale (*Orcinus orca*) | Endangered | No | — | — |

| Fishery Management Plan That Includes Stocks With EFH | Does Action Cause Adverse Effects to EFH? | Are EFH Conservation Recommendations Provided? |
|---|---|---|
| Pacific Coast Groundfish | No | No |
| Coastal Pelagic Species | No | No |
| West Coast Salmon | Yes | Yes |

Consultation Conducted By: National Marine Fisheries Service, Northwest Region

Issued By:

Bruce K Suzumoto for
William W. Stelle, Jr.
Regional Administrator

November 21, 2012
Date

## TABLE OF CONTENTS

## LIST OF FIGURES

## LIST OF TABLES

## TERMS AND ABBREVIATIONS

| | |
|---|---|
| AC-FT | Acre Feet |
| BA | Biological Assessment |
| BMI | Benthic Macroinvertebrates |
| BRT | Biological Review Team |
| cfs | Cubic Feet Per Second |
| Commission | Federal Energy Regulatory Commission |
| Corps | U.S. Army Corp of Engineers |
| DNR | Department of Natural Resources |
| DPS | Distinct Population Segment |
| DQA | Data Quality Act |
| EFH | Essential Fish Habitat |
| EPA | Environmental Protection Agency |
| ESA | Endangered Species Act |
| ESU | Evolutionarily Significant Unit |
| FERC | Federal Energy Regulatory Commission |
| FPC | Federal Power Commission |
| FSA | Fisheries Settlement Agreement |
| HCP | Habitat Conservation Plan |
| HPA | Hydraulic Project Approval |
| ILP | Integrated Licensing Process |
| ITS | Incidental Take Statement |

| | |
|---|---|
| HUC | Hydrologic Unit Code |
| ISAB | Independent Scientific Advisory Board |
| ITS | Incidental Take Statement |
| kV | Kilovolt |
| LWD | Large Woody Debris |
| MSA | Magnuson-Stevens Fishery Conservation and Management Act |
| MSY | Maximum Sustainable Yield |
| MW | Megawatts |
| MWh | Megawatt Hour |
| NMFS | National Marine Fisheries Service |
| Opinion | Biological Opinion |
| PCE | Primary Constituent Element |
| PFMC | Pacific Fishery Management Council |
| Project | Skagit River Hydroelectric Project |
| PS | Puget Sound |
| PSTRT | Puget Sound technical review team |
| PVA | Population viability analysis |
| RM | River Mile |
| ROW | Right Of Way |
| RPM | Reasonable and Prudent Measure |
| SA | Settlement Agreement |
| SAR | Smolt-to-Adult Return Run |

| | |
|---|---|
| SASSI | Salmon and Steelhead Stock Inventory |
| SCL | Seattle City Light |
| SR | Southern Resident |
| TDG | Total Dissolved Gas |
| TMDL | Total Maximum Daily Load |
| TRT | Technical Recovery Team |
| USFS | U.S. Forest Service |
| USGS | U.S. Geological Survey |
| USFWS | U.S. Fish and Wildlife Services |
| VSP | Viable Salmonid Population |
| WDF | Washington Department of Fisheries |
| WDFW | Washington Department of Fish & Wildlife |
| WDNR | Washington Department of Natural Resources |
| WDOE | Washington Department of Ecology |
| WRIA | Water Resource Inventory Area |

# 1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3 below.

## 1.1 BACKGROUND

The biological opinion (Opinion) and incidental take statement (ITS) portions of this document were prepared by NMFS in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531, et seq.), and implementing regulations at 50 CFR 402.

NMFS also completed an Essential Fish Habitat (EFH) consultation. It was prepared in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801, et seq.) and implementing regulations at 50 CFR 600.

The opinion and EFH conservation recommendations are both in compliance with section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-5444) ("Data Quality Act" (DQA)) and underwent pre-dissemination review.

## 1.2 CONSULTATION HISTORY

This is the first biological opinion written by NMFS covering the Skagit Hydroelectric Project (FERC Project No. 553) and covers all aspects of project configuration and operation as described in the Skagit Project license (FERC 1995) and Seattle's requested license amendment. FERC requested this consultation on December 12, 2011. This biological opinion is based on information provided in (Graybill et al. 1979), (Beck, R.W. and Associates 1989), the Skagit Project license and Environmental Assessment (FERC 1995), and the Biological Evaluation Seattle City Light 2010), field investigations, and other sources of information. A complete record of this consultation is on file at NMFS' Northwest Regional Office in Portland, Oregon.

## 1.3 PROPOSED ACTION

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies. Interrelated actions are those that are part of a larger action and depend on that action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

The proposed action under consideration in this Opinion is the continued operation of Seattle City Light's 650-MW Skagit River Hydroelectric Project on the Skagit River in Whatcom County, Washington under the license issued by the Federal Energy Regulatory Commission (FERC) in 1995, as modified by the proposed license amendment (Seattle City Light 2011) to add a second power tunnel from Gorge Dam to the Gorge powerhouse. FERC requested section 7 consultation on the license amendment, but NMFS is obligated to consult on projects in their entirety. Therefore, we have considered continued project operation and maintenance as described in the 1995 license as part of this consultation.

### 1.3.1 PROJECT COMPONENTS

The Skagit River Project has existed in one form or another since 1919, first as the Gorge Timber Crib Dam and powerhouse. The Federal Power Commission (FPC) issued Seattle a license for its facilities on the Skagit in 1927 for Gorge and the upstream addition of Diablo Dam and powerhouse. The FPC issued a series of license amendments over the next 50 years authorizing Ross Dam and powerhouse and several project improvements. The most recent licensing action FERC was issuance of the new operating license in 1995.

Ross is the upstream most and largest of the three Skagit dams at 540 ft high. It impounds a reservoir of 11,860 acres with a usable storage of 1,052,000 ac-ft (acre-feet). The powerhouse has four generating units with an operating capacity of 338.6 megawatts (MW). Diablo is the middle dam, stands 389 ft high, impounding a reservoir of 770 acres and a usable storage of 8,820 ac-ft. Diablo has four generating units and an operating capacity of 152.8 MW. Gorge Dam is the lowermost, located at river mile (RM) 97. It is 300 ft high and impounds a reservoir of 240 acres, with a usable storage of 6,500 ac-ft. Gorge Timber Crib Dam has four generating units with an operating capacity of 158.8 MW.

The project transmission lines occupy a right-of-way about 100 miles long, following and crossing the Skagit and Sauk Rivers, and ending at the Bothell substation just north of Seattle.

This three-dam complex is operated to provide base and peak load energy to Seattle. Ross Dam is the largest of the three dams and provides the main storage component. Diablo and Gorge Dams have very little live storage capacity (measured in hours), so they are nearly run-of-river operations. Lower-most Gorge Dam most directly affects instream flow in the Skagit River downstream of the complex, except when high tributary inflow above Diablo and Ross causes spill events from either winter storm events or extreme snowmelt runoff exceeding the storage capacity of Ross reservoir.

The proposed Gorge 2$^{nd}$ tunnel will not use any new water withdrawal or discharges into the Skagit River. Nor will it increase the amount of water going into the Gorge powerhouse. Dividing the existing flow between two tunnels for the two miles, (the approximate length of the companion tunnel) will significantly decrease the amount of energy lost to friction. The Gorge 2$^{nd}$ tunnel project is expected to capture about 57,700 megawatt-hour (MWh) of energy a year. FERC and Seattle City Light (SCL) propose to continue implementing settlement agreement (SA) license terms and conditions associated with the management and operation of the Skagit Project, to protect, mitigate, and enhance fish and fish habitat in the license issued in 1995.

The original license for the Skagit project expired in 1977. However very little in the way of relicensing studies specific to project effects on fisheries were developed, except that the Washington Department of Fisheries (WDF) (Thompson, J.S., 1970) documented project flow fluctuations stranded juvenile salmon on the Skagit River. Through a series of extensions granted by FERC, a flow agreement between SCL and Federal, state, and tribal fish agencies was reached in 1981. Seattle City Light, Washington State, and the tribes through the 1980s conducted additional salmon and steelhead stranding studies, and a Fisheries Settlement Agreement (FSA) was reached in 1991 that included all stakeholder parties, with FERC issuing the new license order in 1995.

Gorge Dam blocks access to Chinook salmon and steelhead from the dam upstream to RM 101 or 102. Large rapids and cascades blocked other species and made most of this reach unusable as spawning and rearing habitat. Spawning noted only in two locations in the Skagit River, called Cedar Bar and Reflector Bar. Stetattle Creek is upstream of Gorge Dam and has no known migration blockage for five miles, but it is most likely that anadromous fish used only its lower reaches for spawning and rearing.

## 1.4 ACTION AREA

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). For the purposes of this Opinion, the action area includes all areas directly affected by the Skagit River Project. The Skagit Project action area is the Skagit River from the upstream limit of Ross Reservoir, six miles north of the U.S.Canada border downstream past Ross, Diablo, and Gorge Dams to Skagit Bay in Puget Sound. The action area also includes the 100-mile 230-kilovolt (kV) transmission line right-of-way (ROW). That part of the Skagit River and Project action area from Gorge Dam to Skagit Bay are the subject of this consultation. That is where the listed Puget Sound (PS) Chinook and PS steelhead occur and is the area where Project operations affect them and their habitat.

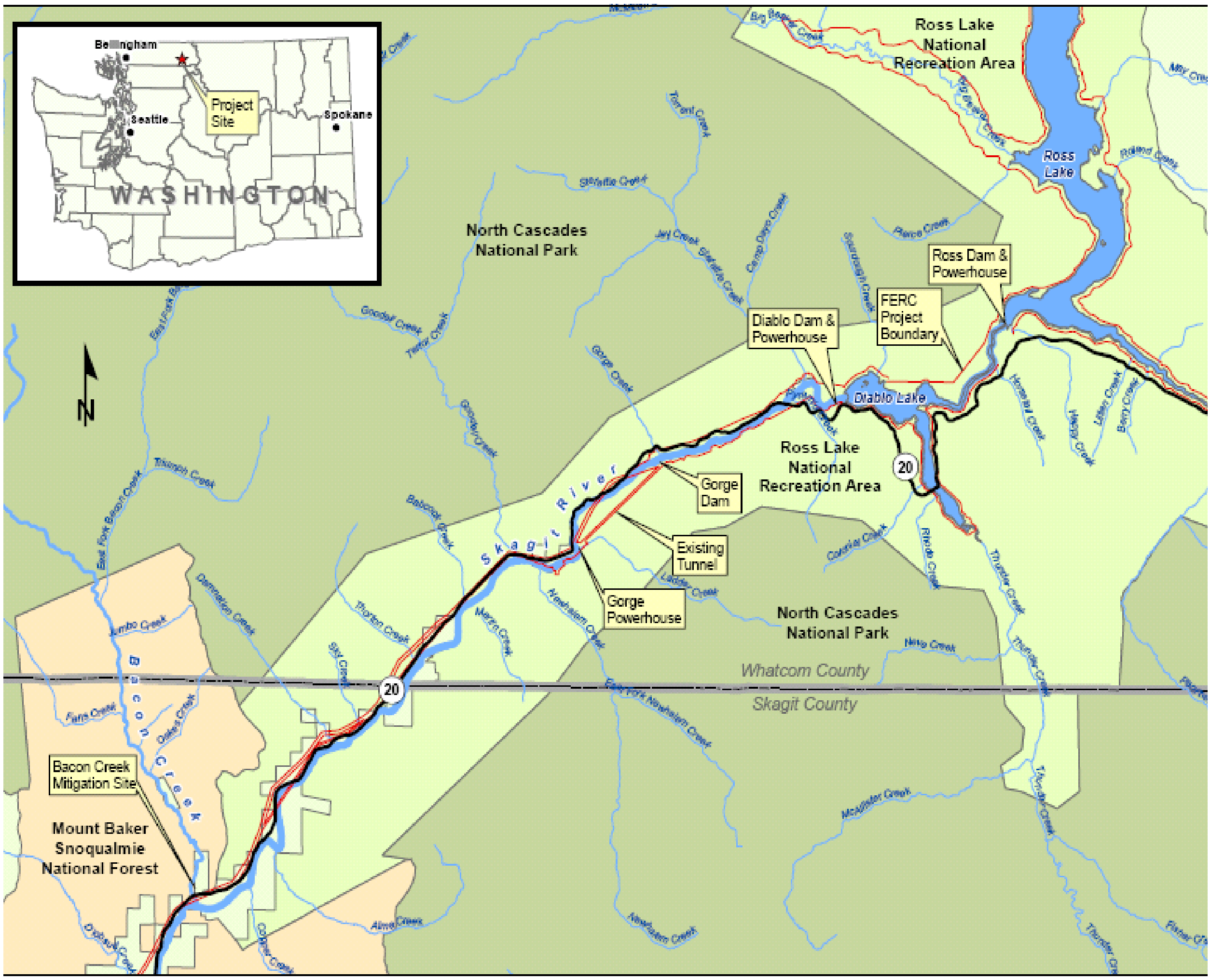


**Figure 1**. General Location of the Skagit River Project

## 2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the United States Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), or both, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Section 7(b)(3) requires that at the conclusion of consultation, the Service provide an opinion stating how the agencies' actions will affect listed species or their critical habitat. If incidental take is expected, Section 7(b)(4) requires the provision of an incidental take statement (ITS) specifying the impact of any incidental taking, and including reasonable and prudent measures to minimize such impacts.

### 2.1 INTRODUCTION TO THE BIOLOGICAL OPINION

The jeopardy analysis in this Opinion considers both survival and recovery of the species. The adverse modification analysis considers the impacts to the conservation value of the designated critical habitat. "To jeopardize the continued existence of a listed species" means to engage in an action that 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 that species (50 CFR 402.02).

This Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.[1]

- *Identify the rangewide status of the species and critical habitat likely to be adversely affected by the proposed action*. This section describes the current status of each listed species and its critical habitat relative to the conditions needed for recovery. For listed salmon and steelhead, NMFS has developed specific guidance for analyzing the status of the listed species' component populations in a "viable salmonid populations" (VSP) paper (McElhany et al. 2000). The VSP approach considers the abundance, productivity, spatial structure, and diversity of each population as part of the overall review of a species' status. For listed salmon and steelhead, the VSP criteria therefore encompass the species' "reproduction, numbers, or distribution" (50 CFR 402.02). In describing the range-wide status of listed species, we rely on viability assessments and criteria in technical recovery team documents and recovery plans, where available, that describe how VSP criteria are applied to specific populations, major population groups, and species. We determine the rangewide status of

[1] Memorandum from William T. Hogarth (NMFS 2005a) to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005a).

critical habitat by examining the condition of its physical or biological features (also called "primary constituent elements" or (PCEs) in some designations) which were identified when the critical habitat was designated. Species and critical habitat status are discussed in Section 2.2.

- *Describe the environmental baseline for the proposed action*. The environmental baseline includes the past and present impacts of Federal, state, or private actions and other human activities *in the action area*. It includes the anticipated impacts of proposed Federal projects that have already undergone formal or early section 7 consultation and the impacts of state or private actions that are contemporaneous with the consultation in process. The environmental baseline is discussed in Section 2.3 of this opinion.

- *Analyze the effects of the proposed actions*. In this step, NMFS considers how the proposed action would affect the species' reproduction, numbers, and distribution or, in the case of salmon and steelhead, their VSP characteristics. NMFS also evaluates the proposed action's effects on critical habitat features. The effects of the action are described in Section 2.4 of this opinion.

- *Describe any cumulative effects.* Cumulative effects, as defined in NMFS' implementing regulations (50 CFR 402.02), are the effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area. Future Federal actions that are unrelated to the proposed action are not considered because they require separate section 7 consultation. Cumulative effects are considered in Section 2.5 of this opinion.

- *Integrate and synthesize the above factors to assess the risk that the proposed action poses to species and critical habitat.* In this step, NMFS adds the effects of the action (Section 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5) to assess whether the action could reasonably be expected to: (1) appreciably reduce the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the status of the species and critical habitat (Section 2.2). Integration and synthesis occurs in Section 2.6 of this opinion.

## 2.2 RANGE-WIDE STATUS OF THE SPECIES AND CRITICAL HABITAT

Two fish species in the action area and one's designated critical habitats are ESA listed, Puget Sound (PS) Chinook salmon and PS steelhead and PS Chinook critical habitat. The biological requirements, life histories, migration timing, historical abundance, and factors for the decline of these species have been well-documented (Busby et al. 1996; Myers et al. 1998; West Coast Biological Review Team (WCBRT 2003; NMFS 2007). The following sections summarize the relevant biological information for PS Chinook and PS steelhead.

**Puget Sound Chinook**

Chinook salmon in the PS evolutionarily significant unit (ESU) were listed as threatened under the ESA in 1999. This listing was reaffirmed in June 2005 (NMFS 2005b). The ESU includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound, including the Strait of Juan de Fuca. This area stretches from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound, and the Strait of Georgia in Washington, and includes fish from 26 artificial propagation programs (hatcheries).

On August 15, 2011, NMFS completed a five-year review for the PS Chinook salmon ESU and concluded that the species should remain listed as endangered (NMFS 2011). The ESU includes all naturally spawned populations of Chinook salmon in all river reaches accessible to Chinook salmon in the Skagit River basin. Of the 22 independent populations of PS Chinook, six are located within the Skagit River basin (Ford et al. 2011). They are:

- Lower Skagit Fall Chinook salmon
- Upper Skagit Summer Chinook salmon
- Lower Sauk Summer Chinook salmon
- Suiattle Spring Chinook salmon
- Upper Cascade Spring Chinook salmon

Each of these populations is considered a “demographically independent population” that was identified using a number of criteria including distinct trends in population abundance and variability, genetic separation, differences in life history characteristics and age structure, spatial and or temporal separation of spawners, unique habitat and hydrological characteristics of a watershed, and catastrophic risk (e.g. drainage located near volcano) (PSTRT 2005). However, many of their freshwater, estuarine, nearshore, or marine rearing life stages may overlap in both time and space.

The six Skagit River Chinook salmon stocks occupy distinct geographic areas in the basin in regards to spawning. Several mainstem reaches of the Skagit basin are used for rearing and migratory habitat by multiple Chinook salmon populations, including the upper Skagit River (used by upper Skagit summers and upper Cascade springs), the lower Sauk River (used by lower Sauk River summers, upper Sauk River springs, and Suiattle River spring, and the lower and middle Skagit River (used by all six populations). The outmigration timing and spatial habitat use patterns of juvenile Chinook salmon outmigrating from the six spawning population areas is not well known. With the exception of the Baker River sub-basin, Chinook salmon occupies nearly all of the historically accessible and used spawning areas in the Skagit River basin.

- ***Lower Skagit Fall Chinook salmon*** spawn downstream of the Sauk River in the mainstem river and tributaries. Most Lower Skagit Fall Chinook salmon spawning occurs in the mainstem between RM 23.0 and the mouth of the Sauk River at RM 67.2. River entry for Skagit River Fall Chinook salmon begins in late July and spawning begins in late September, but most spawning occurs in October (Orrell 1976; WDFW and WWTIT 1994; SRSC and WDFW 2005).

- ***Upper Skagit Summer Chinook salmon*** spawn in the Skagit River mainstem and its tributaries upstream of the confluence with the Sauk River (SRSC and WDFW 2005; WDFW 2002a). Important tributaries include the lower Cascade River, and Illabot, Diobsud, Bacon, and Goodell creeks. Spawning begins in late August, but primarily occurs in September to early October, which is somewhat earlier than the Lower Skagit Fall Chinook salmon population. The upper extent of spawning is near the Gorge Powerhouse.

- ***Lower Sauk Summer Chinook salmon*** spawn in the Sauk River mainstem and its tributaries from the mouth to Darrington (RM 21.1) (SRSC and WDFW 2005; WDFW 2002a). The only important tributary used by this population is Dan Creek. Most of the spawning is between the Suiattle River and the Darrington Bridge. Spawning begins in late August, but primarily occurs in September to early October, which is somewhat earlier than the Lower Skagit Fall Chinook salmon population and similar to the Upper Skagit Summer Chinook salmon population.

- ***Upper Sauk Spring Chinook salmon*** spawn in the Sauk River mainstem and its tributaries upstream of the Darrington Bridge (RM 21.1) (SRSC and WDFW 2005; WDFW 2002a). The only important tributary used by this population is the White Chuck River (RM 31.8) and spawning also occurs in the North Fork to the falls at RM 41.2 and the South Fork to RM 3.5 (PSIT and WDFW 2009). Most of the spawning is between the confluence with the White Chuck River and the confluence of the North and South Forks of the Sauk River (RM 40). River entry begins in April and spawning occurs in late July through early September.

- ***Suiattle Spring Chinook salmon*** spawn in the Suiattle River mainstem and its tributaries upstream of approximately Big Creek (RM 7.7) (SRSC and WDFW 2005; WDFW 2002a). Because of high sediment loads from glaciers, observation of spawning in the mainstem Suiattle River is difficult; some spawning does occur in the mainstem (WDFW 2002a), but there is some uncertainty regarding the magnitude of mainstem spawning. Suiattle Spring Chinook salmon extensively use clear-running tributaries including Big, Tenas, Straight, Circle, Buck, Lime, Downey, Sulphur, and Milk creeks for spawning (WDFW 2002a; HSRG 2003, NMFS 2005c). Most of the spawning in these tributaries occurs in the lower sections because of upstream migration barriers. River entry begins in April and spawning begins in mid-July and lasts through mid-September.

- ***Upper Cascade Spring Chinook salmon*** spawn in the Cascade River mainstem and larger tributaries upstream of RM 7.8 and the end of the canyon near Lookout Creek (SRSC and WDFW 2005; WDFW 2002a). Tributaries to this part of the Cascade River are typically steep. Spring Chinook salmon may use the lower valley floor reaches of some of the larger tributaries such as Marble, Sibley, Found, Kindy, Sonny Boy creeks, and North Fork and South Fork Cascade River for spawning (Williams et al. 1975;

WDFW 2002a). River entry begins in April and spawning occurs in mid-July through mid-September.

Analysis of genetic material is commonly used as one of the key factors for determining population structure and assignment of particular individuals to a population. However, criteria for grouping versus separating populations based upon genetic similarities or differences can be somewhat subjective and dependent upon the scale of the analysis. The Puget Sound Technical Review Team (PSTRT) (Ruckelshaus et al. 2006) used a variety of metrics to examine genetic similarity among Puget Sound Chinook salmon populations, along with life history traits and geographic separation, in their determination of population independence. Genetic metrics included allele frequency analysis, estimates of divergence time in generations, and Cavalli-Sforza cord distance. Each of the metrics provided evidence regarding the relatedness of the populations, which the Puget Sound technical review team (PSTRT) integrated into their decision-making process. The PSTRT's premise was that population segments were independent unless the available information suggested they should be grouped. For the Skagit River Chinook salmon populations, they concluded the six populations did qualify as demographically independent populations. However, the evidence presented in (Ruckelshaus et al. 2006) suggests that from a genetics perspective, the Upper Sauk Spring Chinook salmon population and the Upper Skagit Summer Chinook salmon populations are relatively similar, and the Upper Cascade Spring Chinook salmon and Suiattle Spring Chinook salmon populations are relatively similar. The Lower Skagit Fall Chinook salmon and Lower Sauk Summer Chinook salmon populations appear to have the highest amount of genetic divergence relative to other Skagit River Chinook salmon populations.

***Life History***

Chinook salmon juvenile life history patterns are typically grouped into "ocean-type" and "stream-type" (Healey 1991). Ocean-type juveniles outmigrate to marine waters as sub-yearlings, while stream-type juveniles rear in freshwater for at least a year. In the Skagit River ocean-type, Chinook salmon juvenile life history forms have been further refined such that there are four life history strategies: fry migrants, delta rearing migrants, parr migrants, and yearlings (SRSC and WDFW 2005).

Analysis of scales from spawned-out adults suggest the yearling life history strategy accounts for 2.6 to 51.2 percent of spawning populations with the yearling component being relatively minor for the Upper Skagit Summer Chinook salmon (2.6%), Lower Sauk Summer Chinook salmon (9.1%), and Lower Skagit Fall Chinook salmon (17.8%). Yearling outmigrants are relatively common for the spring Chinook salmon populations, accounting for 44.5 percent, 50.3 percent, and 51.2 percent of the Upper Sauk, Upper Cascade, and Suiattle Spring Chinook salmon populations, respectively (SRSC and WDFW 2005). The larger proportion of yearling outmigrants for the more upstream spring Chinook salmon populations is consistent with the life history characteristics of Chinook salmon observed in other Pacific Northwest rivers as discussed in (Healey 1991); (Quinn 2005).

Early fry outmigrants captured in the traps at Mt. Vernon are about 38 mm in size. As the season progresses, the average size as well as the range of sizes for subyearling outmigrants increase as parr migrants account for a larger proportion of the population passing the trap location. After April 15, sub-yearling outmigrants are considered parr migrants. During the last week of sampling in late July 2007, the combined scoop trap and screw trap sub-yearling Chinook salmon mean length was 75.9 mm with a range of 60 mm to 84 mm (20 of 304 fish measured) and consisted entirely of parr migrants (Kinsel et al. 2008).

***Abundance, Productivity, and Diversity***

There is evidence that freshwater survival in Skagit River Chinook salmon populations, particularly egg-to-outmigrant survival, is affected primarily by peak flows throughout the basin and high sediment loads in specific watersheds (SRSC and WDFW 2005). Peak flows can adversely affect egg to fry survival by causing scour to incubating eggs and alevins in redds, and result in high mortality rates to fry. (DeVries 1997) conducted a literature survey that suggested the depth of Chinook salmon egg pockets may range from about 15 cm (top of pocket) to 50 cm (bottom of pocket). Scour that occurs deeper than the top of an egg pocket can mobilize and crush eggs. Flows that overtop a natural channel's banks generally have approximately a 1.5 to 2 year recurrence interval (Leopold et al. 1964). Evaluation of peak flows during egg incubation have demonstrated that Chinook salmon egg to fry survival in the Skagit River is negatively related to flood recurrence interval for flows greater than a 2-year event (Figure 2) (Kinsel et al. 2008). At flows less than a 2-year recurrence interval under the current flow regime, egg survival ranges from about 10 percent to 17 percent and appears unrelated to flow.

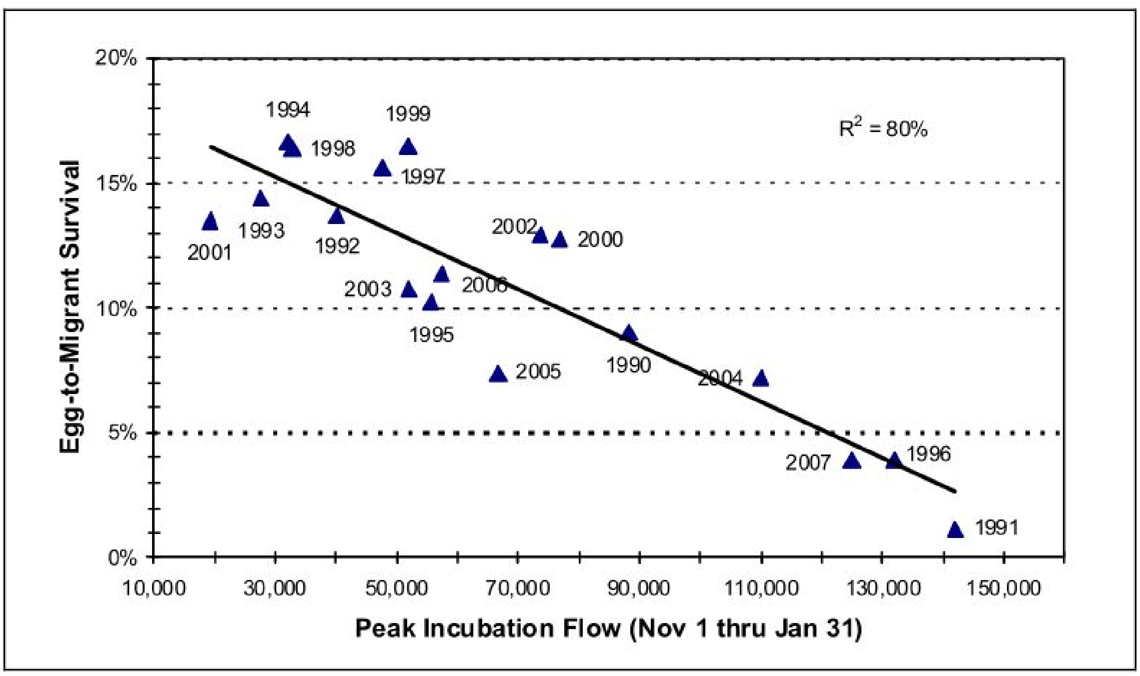


**Figure 2.** Egg to migrant fry survival at different peak flow levels of the Skagit River at the USGS gage in Sedro Woolley, WA.

(Beamer et al. 2005) estimated marine survival for each of the Chinook salmon life history forms under both low and high ocean survival conditions (Table 1) based upon a scales analyzed from returning adults. Ocean survival rates were highest for yearling smolts, and result of their larger size at outmigration. Survival rates of subyearling parr and tidal rearing outmigrants was less than half of that of yearling smolts, and survival was lower by an order of magnitude for fry migrants that do not use pocket estuary habitats. (SRSC and WDFW 2005) attribute the low ocean survival of sub-yearlings largely to a shortage of delta rearing habitat and loss of pocket estuaries, which can also be confounded by peak flow events.

**Table 1.** Estimated marine survival for four Chinook salmon life history strategies

| Life History Type | Low Survival (low regime) | Average Survival (low regime) | Average Survival (high regime) |
|---|---|---|---|
| Yearling Smolts | 0.251% | 1.191% | 3.494% |
| Parr migrants | 0.109% | 0.518% | 1.519% |
| Tidal delta rearing | 0.109% | 0.518% | 1.519% |
| Pocket estuary rearing fry migrants | 0.109% | 0.518% | 1.519% |
| Residual fry migrants (fry migrants that don't find pocket estuary habitat) | 0.013% | 0.060% | 0.175% |

Data source: Beamer et al. (2005).

Lower Skagit Fall Chinook Salmon, Upper Skagit Summer Chinook Salmon, and Lower Sauk Summer Chinook salmon populations are managed as a single unit for harvest by the fisheries co-managers (WDFW and treaty tribes). Consequently, some life history information, such as the age structure of returning adults, is only available for summer/fall run fish as a whole. The summer/fall Skagit River Chinook salmon spawn primarily at 4 years of age with significant numbers of 3-year-old and 5-year old fish (PSIT and WDFW 2009). Analysis of estimated age structure for the 1981 through 2001 brood years reported in (PSIT and WDFW 2009)indicated age 4 accounted for an average of 66.7 percent of the escapement, while age 2 and 3 accounted for about 23.5 percent and age 5 accounted for 9.8 percent. The age structure of returning adults appears to be highly variable from year to year. The proportion of age four fish in the management unit ranged from 43.2 percent to 83.9 percent over the 21-year period. The age structure reported in Puget Sound Indian Tribes (PSIT and WDFW 2009) is consistent with earlier analysis by (Orrell 1976) that found 4-year old fish accounted for 73.4 percent of the gill net sampling catch between 1965 and 1972 while 3-year old fish accounted for 9.6 percent, and 5-year old fish accounted for 16 percent. About 1.1 percent of the catch was 6-year old fish. (Orrell 1976) suggested that 2-year old (jacks) and 3-year old Chinook salmon were under-represented in the gill net catch because of the large mesh size used and this conclusion was supported by the fact that fish less than 60 cm in length, which is the smallest size caught by gill net, represented 27 percent of the Chinook salmon caught by seining near Hamilton (RM 40).

Analogous to the summer/fall Chinook salmon runs, the Upper Sauk Spring Chinook Salmon, Suiattle Spring Chinook Salmon, and the Upper Cascade Spring Chinook salmon populations are managed as a single unit by the fisheries co-managers. The spring Chinook salmon of the Skagit River basin, spawn primarily at 4 years of age with significant numbers of 2, 3, and 5-year-old fish (PSIT and WDFW 2009). Analysis of estimated age structure for the 1981 through 2001 brood years reported in (PSIT and WDFW 2009) indicated age 4 accounted for an average of 66.0 percent of the spring escapement, while age 2 and 3 accounted for about 10.1 percent and age 5 accounted for 23.7 percent. Compared to the summer/fall run Chinook salmon management unit, there is a higher proportion of age 5 fish and lower proportion of age 2 and 3 fish, while the proportion of age 4 fish are similar. This difference likely reflects the fact that a larger proportion of spring-run fish out-migrate as yearlings compared to summer/fall-run Chinook salmon.

The PSTRT generally adopted the long-term abundance and productivity recovery targets developed by the WDFW and treaty tribe's co-managers (NMFS 2006) (Table 2). The targets are based upon two particular points on a Beverton-Holt stock recruitment curve developed for each population under average marine survival conditions. The high productivity target is the spawners needed to obtain maximum sustainable yield (MSY) and the low productivity target is the number of spawners needed at the point where the unit replacement line (1.0 recruit per spawner) crosses the curve.

Recovery targets are defined for the six individual populations (Table 2). The Upper Skagit Summer Chinook salmon population accounts for about half of the summer/fall Chinook salmon stock with high productivity abundance targets under a recovered condition of 5,380 fish at the point of maximum sustainable yield and 26,000 fish at the equilibrium point (NMFS 2006). At MSY the Lower Skagit Fall Chinook salmon population is expected to account for just over a third (3,900 fish) and the Lower Sauk Summer Chinook salmon population accounts for just over one-eighth (1,400 fish) of the stock. High productivity targets are 3.0 recruits per spawner for the Lower Skagit Fall and Lower Sauk Chinook salmon populations and 3.8 recruits per spawner for the Upper Skagit Summer Chinook salmon population.

Escapement data indicate the Upper Skagit Summer Chinook salmon population has exceeded the high productivity target each year since 2000 with a mean escapement of 11,270 fish for return years 2005 to 2009 (Table 2). The escapement was also within the low productivity planning range during 2004, 2005, and 2006. In contrast, the Lower Skagit Fall Chinook salmon population has only exceeded the high productivity goal once (2002) since 2000 and mean escapement for return years 2005 to 2009 is 2,401 fish. Similarly, the Lower Sauk Summer Chinook salmon population has exceeded the high productivity goal once (2003) and mean escapement for return years 2005 to 2009 is 628 fish. There is an increasing trend in the proportion of the summer/fall stock that is derived from the Upper Skagit Summer Chinook salmon population with an average of 72.5 percent between 2005 and 2009. Based upon mean escapement values in (Ford et al. 2011), the upper Skagit Summer Chinook salmon population often provides over 25 percent of the wild Chinook salmon summer and fall escapement in Puget

Sound, demonstrating its importance to the ESU. Mean Skagit productivity from 2005 to 2009 is less than 1.0 recruit per spawner for each of the summer and fall populations (Table 2). Estimates of the Skagit summer/fall management unit for productivity has ranged from 0.7 to 9.3 recruits per spawner for brood years 1981 to 2001 with an average of 3.1 recruits per spawner, suggesting they may be near the high productivity targets. Productivity tends to vary substantially and is affected by cyclical changes in ocean conditions (Mantua et al. 1997). Both the Lower Skagit Fall and the Lower Sauk Summer Chinook salmon populations demonstrate a slight downward trend over the last ten years while the Upper Skagit Summer Chinook salmon population demonstrates no trend.

**Table 2.** Chinook salmon recovery spawner planning targets and recent escapement in number of fish.

| Chinook Salmon Population | Low Productivity Planning Target[1] (Range) | High Productivity Planning Target[2] (ret/spawner) | Geometric Mean 2005 to 2009 Escapement (Range) Production | Escapement (Range) Production | Trend 1974 – 2009 | Trend 1998-2009 | Percent Hatchery Fish |
|---|---|---|---|---|---|---|---|
| Lower Skagit Fall | 16,000 (16,000 - 22,000) | 3,900 (3.0) | 2,401 (1,053 – 3,508) | 0.78 | 0.98 | 0.99 | 0.2 |
| Upper Skagit Summer | 26,000 (17,000 - 35,000) | 5,380 (3.8) | 11,270 (5,290 – 16,608) | 0.92 | 1.01 | 1.00 | 2.0 |
| Lower Sauk Summer | 5,600 (5,600 - 7,800) | 1,400 (3.0) | 628 (250 – 1,095) | 0.67 | 0.97 | 0.98 | 0.0 |
| Upper Cascade Spring | 1,200 (1,200 - 1,700) | 290 (3.0) | 349 (223 – 478) | 0.86 | 1.04 | 1.03 | 0.3 |
| Upper Sauk Spring | 3,030 (3,000 - 4,200) | 750 (3.0) | 597 (282 – 1,043) | 1.29 | 1.01 | 1.07 | 0.0 |
| Suiattle Spring | 610 (600 - 800) | 160 (2.8) | 295 (108 – 518) | 0.64 | 0.98 | 0.95 | 0.0 |

Source: (Ford et al. 2011); 1, Low productivity targets are at the equilibrium (carrying capacity) point where productivity is 1.0 returns per spawner. 2, High productivity targets are at the point of maximum sustained yield (returns per spawner).

Targets for the Skagit River spring Chinook salmon populations based upon stock-recruitment models are substantially lower than for the fall/summer populations. The targets predicted by a population viability analysis (PVA) modeling conducted by NMFS suggest that numbers may need to be substantially higher than these levels for long-term population survival (NMFS 2006). Abundance and productivity targets under a recovered condition with average marine survival conditions for Upper Sauk Spring Chinook salmon are 750 fish at MSY and 3,030 recruits per spawner at the point of equilibrium (NMFS 2006). Targets for the Suiattle Spring Chinook salmon are 160 fish at MSY and 610 fish the point of equilibrium and for the Upper Cascade Spring Chinook salmon population targets are 290 fish at MSY and 1,200 recruits at the point of equilibrium (NMFS 2006). High productivity targets are 3.0 recruits per spawner for the Upper

Cascade and Upper Sauk spring Chinook salmon populations and 2.8 recruits per spawner for the Suiattle Spring Chinook salmon population.

The Upper Sauk River accounts for the highest proportion (about 41% since 1998) of the Skagit River basin spring Chinook salmon production. The geometric mean escapement for return years 2005 to 2009 is 597 fish for the Upper Sauk Spring, 295 fish for Suiattle Spring, and 349 fish for the Cascade River Spring Chinook salmon populations. From 2000 to 2008, the Suiattle Spring Chinook salmon population has exceeded its high productivity target eight times, while the Upper Cascade Spring Chinook salmon population has exceeded its target six times, and the Upper Sauk Spring Chinook salmon population has exceeded its target twice. All of the spring Chinook salmon populations in the Skagit River basin are considerably below the low productivity planning targets and ranges. Mean Skagit productivity from 2005 to 2009 is less than 1.0 recruits per spawner for the Cascade and Suiattle spring Chinook salmon populations (Table 2). The Sauk River Spring Chinook salmon population is the only Skagit River Chinook salmon population with average productivity greater than 1.0 return per spawner in recent years. Trend analysis for returns over the last 10 years indicate an increasing trend for the Upper Cascade and Upper Sauk Spring Chinook salmon populations and a declining trend for the Suiattle Spring Chinook salmon population. Skagit River spring Chinook salmon productivity for brood years 1981 to 2001 averaged 2.6 recruits per spawner (PSIT and WDFW 2009). (WDFW 2002b) reported that smolt-to-adult survival (SAR) for the Skagit River spring Chinook salmon yearlings released by the Marblemount hatchery averaged 0.51 percent for brood years 1990 and 1993 through 1997 while SARs of fingerling releases from brood years 1993 through 1997 averaged 0.49 percent. Poaching is considered a substantial problem for the Suiattle Spring Chinook salmon population that reduces escapement levels (SRSC and WDFW 2005).

Spatial, temporal, and genetic diversity is important for maintaining population viability because it reduces the risk that stochastic events such as landslides, droughts, or floods will adversely affect all components of a population, it allows populations to use a wider range of habitat patches, and genetic diversity allows the population to adapt to changing environmental conditions (McElhany et al. 2000). Diversity in the Skagit River Chinook salmon populations is expressed primarily through a combination of their age of outmigration and age of return, but also through the spatial variability of habitat used by spawners and juveniles. Because all of the populations have multiple life history strategies during outmigration (including fry, delta rearing, parr rearing, and yearling) and variable ages of return (primarily ages 2 through 5, plus the occasional age 6 fish), they express a diverse life history that helps them to persist in the event of relatively low survival in any particular location or period over their life cycles.

ESU spawning escapements are improved relative to the 1998 status review (Ford 2011), and population trends remain similar to 1998. Recent trends for all Skagit Chinook stocks has been negative, measured as recruits per spawner (Ford 2011), with populations remaining well below technical recovery team (TRT) recovery escapement goals. They have declined in abundance since the 2005 review, and trends since 1995 have remained mostly flat (Ford 2011). Overall, new information on abundance, productivity, spatial structure, and diversity since the 2005 review does not indicate a change in the biological risk since the last biological review team (BRT) review.

## Puget Sound Steelhead

NMFS listed Puget Sound steelhead as threatened on May 11, 2007. The Distinct Population Segment (DPS) includes all naturally spawned anadromous winter-run and summer-run steelhead populations in streams in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive). The majority of hatchery stocks are not part of this DPS because they are more than moderately diverged from the local native populations. Resident *O mykiss* (rainbow trout) occur within the range of Puget Sound steelhead but are not part of the DPS due to marked differences in physical, physiological, ecological, and behavioral characteristics (NMFS 2006a). The Puget Sound steelhead DPS includes more than 50 stocks of summer and winter-run fish.

There are two genetically distinct forms of *O mykiss,* inland and coastal (Scott and Gill 2008). Skagit River steelhead belong to the coastal form found west of the Cascade Mountains. Populations have been defined based upon run timing (winter, summer) and geographic location. The (WDFW 2002a) identifies three winter steelhead stocks in the Skagit River (Mainstem Skagit, Sauk, Cascade) and three summer steelhead stocks (Finney Creek, Sauk, Cascade). There is virtually no information on Finney Creek summer steelhead population (WDFW and WWTIT 1994; WDFW 2002a). The Puget Sound Steelhead BRT reported on 22 steelhead populations in the Puget Sound ESU (NMFS 2005); with most of these based upon salmon and steelhead stock inventory (SASSI) designations (WDFW 2002a).

The Skagit River winter steelhead population spawns in the mainstem between RM 22.5 and 94.1 plus most accessible tributaries. The (WDFW 2002a) reports that winter steelhead also spawn in the Sauk River and Cascade River, but the spawning areas are continuous from the mainstem Skagit River. In the Sauk River, spawning occurs from its confluence with the Skagit River to RM 41, portions of the South Fork Sauk River, the Suiattle River, the White Chuck River, and a number of tributaries. The spawning distribution in the Cascade River is unknown.

### *Life History, Spatial Structure, and Diversity*

Skagit River winter steelhead enter the river beginning in November (NMFS 2005). Spawning occurs from March through June with peak spawning occurring during May. Fry emergence peaks in early August (WDFW 2004). About 82 percent of winter steelhead in the river undergo smoltification and outmigration at age 2 and about 18 percent outmigrate at age 3 (NMFS 2005). Outmigration occurs primarily from late April through early June (WDFW 2004).

Most (about 57%) Skagit River winter steelhead spend one winter in the ocean before returning to the river the following winter to spawn (Scott and Gill 2008). A substantial proportion (about 42%) also return after two winters in the ocean, with the remainder (about 1%) returning after three winters. In combination with the age at outmigration, the highest proportion (about 44%) of returning adult winter steelhead are age 4 (primarily 2.2 [2 years freshwater, 2 years saltwater]), followed by about 26% age 5 (primarily 2.3). Most Skagit River winter steelhead die after spawning. However, a small, but significant number of steelhead return to the ocean as kelts and may be repeat spawners. Scott and Gill (2008) reported that up to 14 percent of the Skagit River winter steelhead run may be repeat spawners with an average of 6 percent.

General habitat use during freshwater rearing by steelhead is described in (Scott and Gill 2008). Steelhead may use a variety of habitat types, but often use higher velocity water and migrate farther into headwaters than other salmon, which is why steelhead are more widely distributed in the higher gradient tributaries within the Skagit Basin than Chinook, coho, pink, or chum salmon. As steelhead juveniles grow, they tend to move away from stream edges and towards faster moving water and may move downstream to larger streams if crowding occurs. During winter, many steelhead juveniles will move back into smaller tributaries to avoid high flows and utilize structures such as boulders, large woody debris (LWD) jams, root-wads, and undercut banks as cover.

The Skagit River steelhead smolt outmigration occurs during the spring with peak densities typically occurring in late April and early May (Kinsel et al. 2008). Tracking of acoustic-tagged Skagit River steelhead juveniles indicate they spend relatively little time in the Skagit River delta (Connor et al. 2009). Wild steelhead migrate through the lower river and estuary over a few hours to less than a week while hatchery smolts remain in the river about 2-3 weeks. After leaving the river, most smolts head north through Deception Pass and then out the Strait of Juan de Fuca. However, some smolts will travel a longer route south around Whidbey Island and through Possession Sound and Admiralty Inlet. The total travel time to the Pacific Ocean is two to three weeks. Sampling in a number of pocket estuaries by the Skagit River System Cooperative (e.g., Beamer et al. 2004;Beamer 2007; Beamer et al. 2007;) have captured few steelhead, which generally supports the tracking study conclusion that juvenile steelhead move rapidly from the Skagit River to the Pacific Ocean.

Hatchery steelhead in this region are widespread, spawn naturally throughout the region, and are largely derived from a single stock (Chambers Creek). With two exceptions (unrelated to Chambers Creek stock) hatchery steelhead are not part of the listed ESU in Puget Sound. The proportion of spawning escapement comprised of hatchery fish has ranged from less than 1 percent (Nisqually River) to 51 percent (Morse Creek) during the period 1984-92 (Busby et al. 1996). In general, hatchery proportions are higher in drainages entering Hood Canal and the Strait of Juan de Fuca than in those entering Puget Sound proper. Most of the hatchery fish in this region originated from stocks indigenous to the DPS, but are generally not native to local river basins (NMFS 2007).

There is very little information on Skagit River steelhead egg to fry or fry to smolt survival rates in the Skagit River. Similar to Chinook salmon described above, it is generally understood that river flows and fine sediment are important factors that may adversely affect these life stages (Bjornn and Reiser 1991). However, the magnitude and frequency of adverse effects of peak flows and scour on steelhead are likely to be less than for Chinook salmon because of the location and timing of spawning and incubation. Considering both fall- and spring-run fish, spawning and incubation of Chinook salmon eggs occurs during mid-July through January (WDFW and WWTIT 1994; SRSC and WDFW 2005) and during the latter part of this period floods from rain-on-snow events can be severe. In contrast, steelhead eggs incubation occurs during the spring and early summer when flows are primarily from annual winter snow pack melt.  For the 67 water years from 1942 to 2008, annual peak flow events occurred 12 times (18%) between April and August during the steelhead incubation period while 47 (70%) occurred during the Chinook salmon incubation period (Oct 22 to February 15 according to (Kinsel et al. 2008).  Furthermore, the median peak flow events that occurred during the steelhead incubation period were 43,600 cfs (maximum 92,300 cfs), while the median during the Chinook salmon incubation period was 71,600 cfs (maximum 152,000 cfs).  Consequently, incubating Chinook salmon eggs and alevins are more likely to be severely affected from peak flows than steelhead.  On the other hand, steelhead juveniles typically have a longer freshwater residence period than Chinook salmon juveniles, especially those Chinook that outmigrate as sub-yearlings, and thus may have a higher risk of being affected by natural and human-caused disturbances in the freshwater system.

***Abundance and Productivity***

On a relative basis, the Skagit River supports one of the strongest runs of winter steelhead in the Puget Sound DPS.  Most Puget Sound steelhead populations, including the Skagit River, have had severe declines in recent years (NMFS 2005).  The 2001 to 2005 geometric mean Skagit River escapement was 5,798 fish with a range of 4,242 to 7,332 fish (Figure 3).  Although relatively strong compared to other Puget Sound populations, recent escapement levels are substantially lower than occurred in the 1980s and continue to show a downward trend.  (NMFS 2005) estimated a population growth rate of 0.997 for Skagit River winter steelhead return years 1995-2004, while (Scott and Gill 2008) estimated growth at 1.01 (return years analyzed were not reported).  Growth rates of less than one indicate declining population abundance.  The mean number of recruits per spawner between 1995 and 2004 was 1.46, but the trend in recruits per spawner had a significant negative slope because the number of recruits per spawner was less than one for many of the years (NMFS 2005).  The (Scott and Gill 2008) consider the relative risk of extinction for Skagit winter steelhead to be low.

Diversity in the Skagit River winter steelhead population is expressed primarily through their age of return and relatively high spatial diversity due to spawning in a number of tributaries.  While the current spawning distribution appears to be broad, habitat conditions in many tributary streams have declined compared to historical conditions because of land use practices.  Nevertheless, compared to other Puget Sound watersheds, the Skagit River basin generally has a higher level of habitat diversity (WDFW 2008).  Because the population includes a mix of ages when smoltification occurs, a mix of ages when maturation occurs, a modest level of repeat spawners, and a broad number of spawning tributaries, the population expresses a relatively diverse life history that helps it to persist in the event of relatively low survival in any particular location or period over the life cycle.

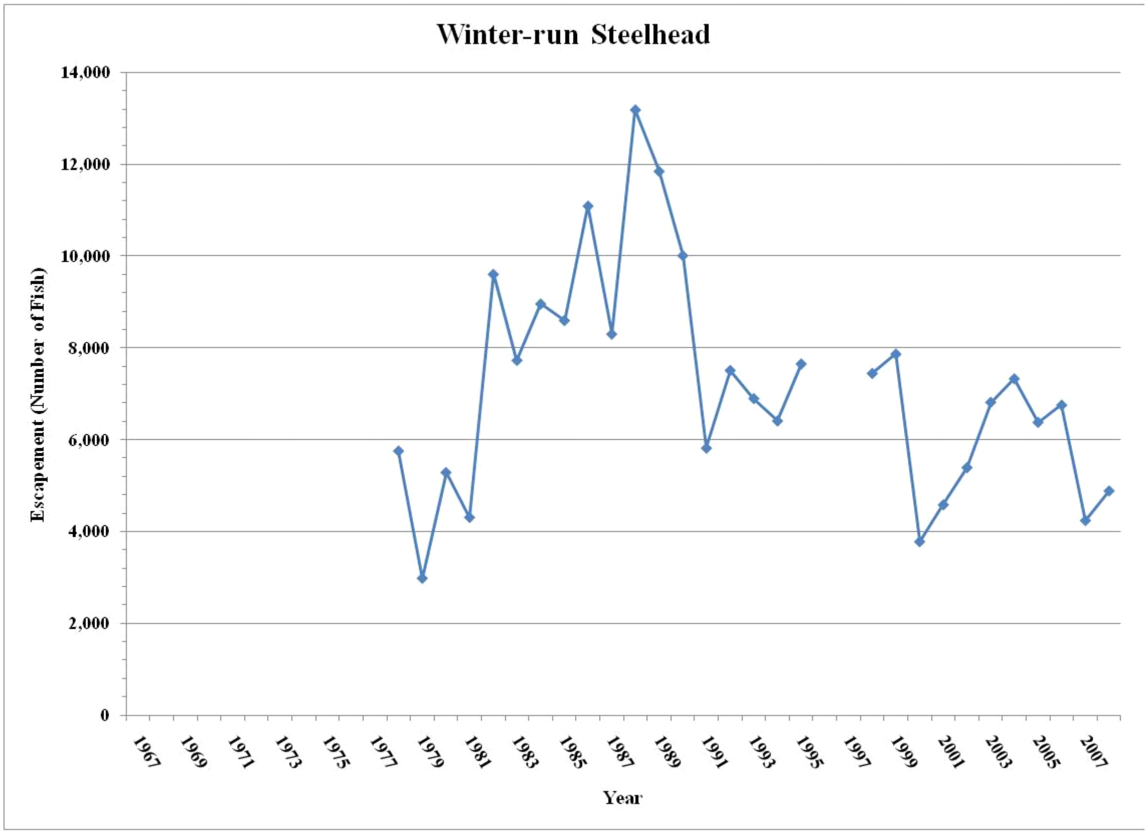


**Figure 3**. Skagit wild steelhead escapement

The Puget Sound steelhead TRT has not finalized viability criteria for this DPS. Due to declines in population abundance and productivity, the DPS continues to exhibit a widespread declining trend, including the Skagit population. Geometric mean population growth rate of the DPS is declining 3 to 10% annually (Ford 2011). The PS steelhead DPS remains at a moderate to high risk of extinction.

**Rangewide Status of Critical Habitat for Skagit Chinook Salmon**

NMFS designated critical habitat for PS Chinook salmon on September 2, 2005, effective January 2, 2006 (NMFS 2006a). Designated critical habitat for PS Chinook includes all of the mainstem Skagit River from its mouth in Skagit Bay upstream to Gorge Dam, as well as the accessible reaches of most tributaries to the Skagit. Exceptions include stream reaches along Washington State Department of Natural Resources (DNR) lands covered by DNR’s Habitat Conservation Plan (HCP), a short stretch of the lower Sauk River adjacent to the Sauk-Suiattle Tribe’s reservation, and the Baker River sub-basin.

In our September 2, 2005 critical habitat designation (NMFS 2005c), NMFS further defined PCEs for listed salmon and steelhead as sites essential to support one or more life stages of the ESU (sites for spawning, rearing, migration, and foraging). These sites in turn contain physical or biological features essential to the conservation of the ESU or DPS (for example, adequate spawning gravels, water quality and quantity, side channels, forage species). Specifically, the PCEs and physical/biological features of critical habitat are:

1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;

2) Freshwater rearing sites with:

   (i) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility,

   (ii) Water quality and forage supporting juvenile development; and

   (iii) Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

4) Estuarine areas free of obstruction and excessive predation with:

   Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh and saltwater, natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and juvenile and adult forage, including aquatic invertebrates and fishes supporting growth and maturation.

5) Nearshore marine areas free of obstruction and excessive predation with:

   Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.

6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

The action area for this consultation serves as spawning and rearing habitat and as a migration corridor for both juvenile and adult PS Chinook. As described in the introduction to this section, habitat in this area is altered from its natural functional condition. Project operations significantly affect the functional value of this habitat. Flow management maintains very high quality spawning and egg incubation conditions. Rearing conditions are generally good, but are compromised due to daily flow fluctuations at times. The status of PS Chinook critical habitat is discussed in more detail later under the environmental baseline and the effects of the project.

### *Recovery Plan*

The Shared Strategy for Puget Sound published a Puget Sound Chinook Salmon Recovery Plan in December 2007 (NMFS 2007). This plan identifies the Skagit River basin as one of five biogeographical regions within the Puget Sound ESU to have unique physical and habitat features that have affected the common evolution of groups of Chinook salmon. NMFS recently completed a review of the ongoing implementation of the recovery plan (Judge 2011) identifying progress through 2010 toward implementing the plan including actions within the action area for this consultation. Recovery actions that have been completed are part of the environmental baseline for this consultation.

## Rangewide Status of Critical Habitat for Skagit Steelhead

Proposed critical habitat for PS steelhead is currently under review by NMFS. Steelhead use most of the same habitat areas as Chinook salmon, although run timing, time of spawning, and length of freshwater residence are different. Steelhead are not estuary reliant like PS Chinook. When PS steelhead critical habitat is designated, it is likely, therefore, to include about the same area as was designated for Chinook, although the estuary may not be included. Our analysis of effects on steelhead includes project effect on possible steelhead PCEs to provide an understanding of the probable effects to potentially designated steelhead critical habitat.

### 2.2.1 CLIMATE CHANGE

Unless otherwise cited, the following section is adapted from (NMFS 2008b).

Ongoing and future climate change has the potential to alter aquatic habitat throughout the Pacific Northwest region. These effects would be expected to be evidenced by alterations of water yields, peak flows, and stream temperatures. Other effects, such as increased vulnerability to catastrophic wildfires, may occur as climate change alters the structure and distribution of forest and aquatic systems. Given the increasing certainty that climate change is occurring and accelerating (IPCC 2007; Battin et al. 2007), one can no longer, assume that climate conditions in the future will resemble those in the past.

In Washington State, most models predict warmer air temperatures, increases in winter precipitation, and decreases in summer precipitation. Average temperatures are likely to increase between 1.7°C and 2.9°C (3.1°F and 5.3°F) by 2040 (Casola et al. 2005). Warmer air temperatures will lead to more precipitation falling as rain rather than snow. As the snow pack diminishes, seasonal hydrology will shift to more frequent and severe early large storms, changing streamflow timing and increasing peak river flows, which may limit salmon survival (NMFS 2008).

In a study to predict impacts of climate change on salmon habitat in the region, model results indicate a large negative effect on freshwater salmon habitat driven by increased winter peak flows that scour the streambed and destroy salmon eggs (Battin et al. 2007). Higher water temperatures, lower spawning flows, and higher magnitude of winter peak flows are all likely to decrease salmon productivity in the northwest and in hydrologically similar watersheds throughout the region. This is expected to make recovery targets for these salmon populations more difficult to achieve. Recommendations to mitigate the adverse impacts of climate change on salmon include 1) restoring connections to historical floodplains and freshwater and estuarine habitats to provide refugia for fish and storage for excess floodwaters; 2) protecting and restoring riparian vegetation to ameliorate stream temperature increases; and 3) purchasing or applying easements to lands that provide important cold water or refuge habitat (ISAB 2007; Battin et al. 2007).

Higher ambient air temperatures will likely cause water temperatures to rise (ISAB 2007, page 16). Salmon and steelhead require cold water for spawning and incubation. Suitable spawning habitat is often found in accessible higher elevation tributaries and headwaters of rivers. In addition, as climate change progresses and stream temperatures warm, thermal refugia will be essential to persistence of many salmonid populations[2]. Thermal refugia provide important patches of suitable habitat for salmon and steelhead that will allow them to undertake migrations through or to make foraging forays into areas with greater than optimal temperatures. To avoid waters above summer maximum temperatures, juvenile rearing may increasingly be found only at the confluence of colder tributaries or other areas of cold-water refugia.

There is still a great deal of uncertainty associated with the timing, location and magnitude of future climate change. It is also likely that the intensity of effects will vary by region (ISAB 2007); however, several studies indicate that climate change has the potential to affect ecosystems in nearly all tributaries throughout the state (ISAB 2007; Battin et al. 2007; Rieman et al. 2007). The effects from future land use changes combined with climate change may further hinder salmon survival and recovery. Additionally, these effects may reduce prey availability for Southern Resident killer whales.

## 2.3 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, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). The environmental baseline includes the effects of both human and natural factors affecting the present status of the species, but does not incorporate impacts specific to the proposed action (continued operation under the new license and amending the license of the Skagit River Hydroelectric Project). As the action being considered in this Opinion includes the new license for the Skagit project, issued in 1995, the effects of this action, up to the date of issuance of this opinion, are part of the environmental baseline. However, future impacts resulting from the future existence and operation of the project and other activities authorized pursuant to the proposed action are not part of the environmental baseline. Rather, the environmental baseline describes the current status of the species, and the factors currently affecting the species, within the action area. The resulting

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[2] Thermal refugia are stream areas where lower water temperatures, caused by inflows from groundwater or cooler tributaries, can be found. Such areas can attract and aggregate fish.

"snapshot" of the species' health within the action area provides the relevant context for evaluating the anticipated effects of the proposed actions on the ESU's and DPS' likelihood of survival and recovery relative to their biological requirements.

Below we present a more detailed description of specific elements of the environmental baseline within the project action area.

### 2.3.1 OVERVIEW OF THE ENVIRONMENTAL BASELINE

The Skagit River Basin contains five major man-made dams and reservoirs, with three of them comprising the Skagit River Hydroelectric Project. The operation of the dams significantly modifies the basin's seasonal, and sometimes its daily, hydrograph. As the major tributaries enter the Skagit, the effects of Skagit project operations are substantially attenuated downstream of the Sauk River.

***Water Quality Standards and Conditions***

The Washington Department of Ecology (WDOE) has established water quality standards for designated uses within the Skagit basin, including standards for fish spawning and rearing. The upper Skagit River is in good condition relative to the standards. With one exception, long–term monitoring records do not indicate any violations of water quality standards downstream of the Skagit project. Water quality impairment occurs in a number of tributary streams, mostly in the lower basin, for summer water temperatures and fecal coliform.

Summer water temperatures become warm in Ross Reservoir, but the reservoir stratifies with warmer water in the epilimnion (near surface) portion of the reservoir and cooler water in the hypolimnion (deep) with a zone of rapid temperature transition between the two, known as a thermocline. Water intakes at the dam are deep and draw water from beneath the thermocline. Water at this depth is usually around 10º C or less (R2 Resource Consultants 2009). The maximum water temperatures recorded at the Ross intakes were 17º C and 16º C during August of 1972 and 1973 respectively.

Temperatures in the Skagit River are warmest in July, August, and September. Average daily temperatures of the Skagit River typically range between 8º C and 11º C in July, while average daily temperatures in August and September typically range from 10 ºC to 11º C. Maximum daily temperatures of the Skagit River at Marblemount usually do not exceed 14º C during the warmest periods of the year.

Turbidity in reservoir areas upstream of the Project is influenced by seasonal runoff of silt and glacial flour and rain-on-snow events. Suspended sediments are carried by waters through the Project reservoirs and into the Skagit River below Gorge Powerhouse. Measurements from the south end of Ross Reservoir taken from March to December 1973 showed that maximum turbidity (Secchi depth: 3.3 m) occurred in late May, resulting from high spring flows. Mid-July to December Secchi depth readings varied from 7.5 to 11.7 m. During the previous year, 1972, the minimum depth of water transparency was recorded on June 30 at a Secchi depth of 1.4 m (Seattle City Light 1974). The project does not appear to exacerbate turbidity and suspended sediments, and the section of the Skagit River downstream of the Gorge powerhouse complies with WDOE standards.

Supersaturation with atmospheric gas, primarily nitrogen, can occur when water spills over high dams, but this does not appear to be a problem for this Project. Total dissolved gas (TDG) monitoring conducted on July 10, 1997, revealed nitrogen saturation did not exceed the water quality standard of 110% saturation. Five spill conditions were tested in 1997 and readings for TDG were taken in the Ross Dam forebay and downstream of the Gorge Dam powerhouse. The highest measurement, 110.4 percent of saturation, was taken downstream of the Gorge Dam powerhouse. However, a lower reading of 107.4 percent of saturation was taken on the opposite bank from water flowing through the bypass reach. The three Projects (Ross, Gorge, and Diablo) were not determined to have an additive effect on nitrogen saturation (Parametrix 1997). During spill events, the shallow and turbulent bypass reach gives supersaturated water an opportunity to de-gas over the 2.7-mile reach.

Dissolved oxygen concentrations at the intake and tailrace of Ross Reservoir met or exceeded standards at all depths during sampling in summer 1972-73 (Seattle City Light 1974). Dissolved oxygen samples were also taken at eight stations upstream of Ross Dam during fall 1973, at 10-m depth intervals. While surface waters generally met dissolved oxygen standards, some samples taken from deep waters were at or below water quality standards. The lowest recorded dissolved oxygen concentration (6.7 parts-per-million [ppm]) was found nine miles upstream of the dam, in the hypolimnion at a depth of 55 m (3 m off the bottom) on November 7, 1973 (Seattle City Light 1974). Dissolved oxygen concentrations increased, and the depth of the thermocline decreased steadily with the onset of cool weather and the mixing of waters. Although dissolved oxygen concentrations in the hypolimnion may seasonally fall below water quality standards, the concentrations in the epilimnion are generally at or above dissolved oxygen standards. The lowest surface dissolved oxygen concentration was 9.0 mg/L measured mid-lake near Devils Creek in July 1973 (Seattle City Light 1974). These declines in dissolved oxygen concentrations are associated with periodic seasonal declines that result from thermal stratification, and this section of the Skagit is not 303(d) listed for dissolved oxygen. Dissolved oxygen measurements taken during 2009 indicate there is complete saturation in Ross Lake throughout the water column (Seattle City Light 2010).

The Project has minimal impact on the water quality of the upper Skagit River. This river drains mountainous and glacial areas located mainly within national park and wilderness areas, and water flowing through the Project remains clean and cold throughout the year. This section of the Skagit River is not listed on the State’s list of impaired water bodies.

### 2.3.2 STATUS OF INSTREAM FISH HABITAT

Gorge Dam is located at RM 97 while the Gorge Powerhouse is at RM 94.3. There are no minimum flow requirements within the 2.7-mile long Gorge bypass reach and flows are generally low except during spill events. Gorge Dam has blocked anadromous fish access since 1927. The amount of useable fish habitat lost due to construction of the project is small. Natural barriers blocked the upstream passage of anadromous fish through the project area. These natural barriers include numerous falls, bedrock cascades, and velocity barriers in the 2.7-mile reach located between Gorge Powerhouse and Gorge Dam, and a narrow bedrock constriction and falls located near Diablo Dam. While some historical use of areas upstream from the gorge by steelhead is suggested by anecdotal information gathered at the time of construction (~1927), the preponderance of evidence indicates limited historical anadromous fish use of the Skagit River watershed upstream from the present location of the Gorge powerhouse (Envirosphere 1988). In the 1991 Skagit FSA, intervenors agreed that fish passage and flows in the bypass reach were not needed as long as SCL complied with the provisions of the Skagit FSA, which provides substantial benefits to the river environment downstream from the Gorge powerhouse. Flow in the bypass reach primarily derives from groundwater seepage and four small non-fish bearing tributaries that drain into the bypass reach. Intervenors in the Skagit FSA also agreed they would not object if the bypass reach were reclassified, such that less restrictive water quality standards would apply. The bypass reach has a special condition status granted by the State designating that water temperatures should not exceed 21ºC. Monitoring by SCL documents compliance with this status (Envirosphere 1988).

Downstream of the Gorge powerhouse, the Skagit Hydroelectric Project primarily affects habitat conditions in the 27-mile reach extending to the Sauk River (Connor and Pflug 2004); (Graybill et al. 1979). Mean annual flow in the Skagit River increases 36 percent (4,480 cfs to 6,110 cfs) between Newhalem and Marblemount (above the Cascade River confluence) and 147 percent (to 15,090 cfs) below the Baker River. The average annual flow of the Sauk River near Sauk is 4,342 cfs (1929 to 2009).

The Skagit Hydroelectric Project has the potential to primarily affect the following habitat components that influence PCEs:

- Coarse sediment supply
- Large woody debris (LWD) supply
- Instream flows
- Riparian vegetation
- Floodplain connectivity
- Aquatic productivity

***Coarse Sediment Supply*** *(PCE 1)*
Ross, Diablo, and Gorge dams retain bedload material derived from the upper Skagit River and its tributaries. Although the dams clearly disrupt bedload transport from areas upstream of the project to areas downstream from the project, large amounts of gravel move into the river each year from tributaries providing abundant spawning gravel in the river below the project.

The degree to which bedload recruitment and transport are balanced is unknown, but annual spawner and redd surveys suggest appropriate-sized substrate is widely available below the project. The Skagit Chinook Recovery Plan (SRSC and WDFW 2005) does not consider the Upper Skagit Summer Chinook salmon population to be limited by spawning gravel availability.

***LWD Supply and Riparian Conditions*** *(PCE 2)*
Ross, Diablo, and Gorge dams block the transport of LWD from upstream locations. No information is currently available on the quantity of LWD in the mainstem Skagit River between

Gorge Powerhouse and the Sauk River confluence, but a study is being conducted by the Skagit River System Cooperative. Although there is no LWD inventory information available, the loss of LWD natural transport from areas upstream of Ross, Diablo, and Gorge dams plus low riparian function screening indices from (Beamer et al. 2000) suggests instream LWD levels downstream of Gorge Dam are likely near the low end of the range observed by Fox and Bolton (2007) within western Washington streams and unlikely to exceed levels considered adequate for proper function by (NMFS 1996) and (USFWS (1998).

***Instream Flows*** *(PCEs 1, 2, 3, 4)*
Dams and reservoirs are often constructed and operated to manipulate instream flows for flood control and shaping hydroelectric production. SCL's three dams on the Skagit River are operated as a single project. The objective of flow manipulation is to store water on a seasonal or daily basis and then release it later for beneficial uses that could include power production, flood control, irrigation, fish protection, and recreation. However, instream flow manipulations can have adverse and beneficial effects on fish and other aquatic life. The types of adverse effects to fish from fluctuating flows downstream of dams were described by (Hunter 1992):

- Changes in the amount of habitat
- Stranding, especially of fry and juveniles
- Increased juvenile emigration
- Increased predation
- Desiccation of eggs
- Decreased abundance and diversity of macroinvertebrates
- Interruption of spawning

The effects of power generation and flood control operations at the Skagit project have potential effects on PS Chinook salmon and PS steelhead in the mainstem Skagit River. The effects of flow fluctuations at the Skagit project continue downstream and are typically observed as river level changes at the U.S. Geological Survey (USGS) gage near Concrete (RM 54.1) about 6 to 8 hours after the Skagit Project flow change depending on the background flow level. Due to the 40-mile travel distance between the Skagit project and the Skagit River near Concrete gage, the wave exhibited by load-following operations at the Skagit project attenuates with downstream distance. The combination of wave attenuation and operational restrictions associated with the new license tends to reduce the amplitude of the Skagit project flow changes and broadens or increases the width of the wave trough as it passes downstream. By the time Skagit Project flow reductions reach the Baker River confluence, these reductions may or may not coincide with flow reductions caused by the Baker Project.

Studies conducted during the 1970s and 1980s (Graybill et al. 1979; Stober et al. 1982; R.W. Beck, R.W., 1989; Monk 1989; Thompson 1970; Woodin 1984) documented flow fluctuations from the Project adversely affected egg, embryo, and fry survival and affected the abundance of aquatic insects (Gislason 1985). Stranding of salmon and steelhead fry occurs in potholes and on gravel bars, particularly for salmon fry when downramping occurred during daylight hours (Beck, R.W., 1989).

Resource agency recommendations for flows were made for the Skagit project as a whole, rather than separate requirements for each of the three facilities, to provide maximum benefit for fish. The Skagit FSA resulted in a number of major changes to project operations under the original license that were intended to reduce or eliminate the negative impacts of flows on salmon and steelhead in the upper Skagit River by implementing the flow measures agreed to in the FSA and additional voluntary measures. These operational changes, which occurred in two phases, resulted in the current operations that mitigate many of the historical adverse effects of flow manipulation by the project.

**FSA Measures**:

- Salmon spawning and redd protection from dewatering (Section 2.3.1)
- Salmon fry protection from trapping and stranding (Section 2.3.2)
- Steelhead spawning and redd protection from dewatering (Section 2.3.3)
- Steelhead fry protection from trapping and stranding (Section 2.3.4)

**Voluntary Measures**:

- Variable seasonal measures implemented as part of Adaptive Management (Section 2.3.5)
- Steelhead and Chinook salmon yearling protection from trapping and stranding (Section 3.3.1)
- Salmon fry protection start date (Section 3.3.1)
- Chum salmon spawning start date (Section 3.3.1)

Analysis of the abundance and distribution of Chinook salmon, pink salmon, and chum salmon in the reach between the Sauk River and the Gorge powerhouse indicates that the instream flow measures have had the intended beneficial effects on the salmon population spawning in the reach (Connor and Pflug 2004). Spawner abundance of all three species progressively increased in an upstream direction following implementation of flow measures and increases were greatest in the reach immediately downstream of the Gorge powerhouse, suggesting the effects of flow manipulation diminish because of unregulated flow inputs from the Cascade River and Sauk River.

Salmonid habitat derives benefits and losses associated with managing instream flow. That is, while in any given year peak flows are inversely related to egg/fry survival, periodic bedload movement also improves spawning habitat conditions by reducing embeddedness and imbrication of the substrate. Adverse conditions for one-year class can improve conditions for the next.

***Floodplain Connectivity*** *(PCE2)*

Instream flow forms and maintains channel morphology and riparian conditions. Small and moderate-sized stream discharges (less than or equal to flows with a 2-year recurrence interval) are contained within the channel, while larger discharges that occur less frequently exceed the channel capacity and overflow onto the floodplain. During floods, water is stored in sloughs and side channels, or seeps into floodplain soils recharging groundwater storage. This stored groundwater slowly drains back to the channel, providing a source of cool inflow during the summer (Naiman et al. 1992).

Side channels to the Skagit River provide important habitats to rearing PS Chinook and steelhead. The Skagit is a large river, and much of the stream cross section consists of deep and high velocity current. Both Chinook and steelhead typically spawn in the main channel, but extensive juvenile rearing occurs in the shallower and slower velocity side channels. Species other than Chinook and steelhead also spawn in the side channel habitat.

Under existing conditions, SCL and Corps' flood control operations can affect the formation and quality of off-channel and side-channel habitat within the floodplain. Winter and spring run-off floodwaters are partially stored in the project reservoirs, limiting the magnitude of once ordinary floods. This flow control coincides with less and lower quality side- and off-channel habitat in the existing environment.

(SRSC and WDFW 2005) estimated about 31 percent of floodplain areas upstream of tidal influence are impaired as a result of hydromodification and other floodplain structures that constrain the lateral movement of the river. The highest proportion of impairment (48%) in the mainstem reach was between the Sauk River and Cascade River and the highest amount of floodplain area impaired in the lower Skagit River (2,391 hectares).

Based upon floodplain road density and the percent and amount of channel length modified, (Smith, C.J. 2003) assigned ratings of good, fair or poor to Skagit River subbasins. The lower Skagit River subbasin floodplain condition was rated poor due to the presence of an extensive network of dikes and loss of wetlands, the upper Skagit River and Sauk River subbasins floodplain conditions upstream of the Sauk River were rated fair due to moderate levels of hydromodification and the presence of roads within the floodplain, and the Baker River subbasin floodplain condition was rated poor because of the inundation of the lower Baker River floodplain by Shannon and Baker lakes. Smith (2003) concluded that the creation of off-channel habitat and improvements to existing off-channel habitat from enhancement projects by SCL and other entities upstream of the Sauk River has resulted in current amounts of floodplain and off-channel habitats being equivalent to, or higher than, historical levels.

***Aquatic Productivity*** *(PCE 2)*
Relatively little information is available regarding the production of periphyton and benthic macroinvertebrates (BMI) in the Skagit River basin. Ecology (Undated) has collected BMI samples in seven tributary streams in the basin: Bacon Creek, Diobsud Creek, Finney Creek, Illabot Creek, Jackman Creek, Pressentin Creek, and O'Toole Creek. Most of the samples had species richness and diversity values that would be considered representative of degraded conditions. The multiple years of sampling within Diobsud Creek and O'Toole Creek suggests substantial annual or site variability may occur in the BMI community. Information collected on substrate type suggested materials were substantially finer during 1999, with larger proportions of fine gravel and sand. The sampling by Ecology provides some understanding of the BMI community and conditions within tributaries, but conditions within the mainstem river are unknown.

***Spawning Habitat*** *(PCE 1)*
Spawning habitat for PS Chinook and PS steelhead in the Skagit River basin ranges from poor to good, depending on location. Sufficient quantities of suitably sized substrate are not lacking, but

the quality is poor in some areas as a result of fine sediment resulting from natural glacial sources and from forest land use practices. Spawning habitat in the lower Sauk River is poor due to glacial- and land use- caused sedimentation (SRSC and WDFW 2005). Steelhead spawning areas substantially overlap those of Chinook but includes more extensive use of tributaries. The best Sauk River spawning habitat occurs upstream of the confluence of the Suiattle River, and the most productive Skagit River spawning habitat is from the confluence of the Sauk River upstream to Gorge powerhouse.

***Rearing Habitat*** *(PCE 2)*
(SRSC and WDFW 2005) identified a number of limiting factors within the river basin that could affect the quality and quantity of fry and juvenile rearing habitat: degraded riparian zones, dam operations, sedimentation and mass wasting, high water temperature, hydromodification, water withdrawal, and loss and reduced connectivity of delta habitat. As a general trend, degradation and loss of rearing habitat is highest in the delta region and gradually improves in an upstream direction as the number and severity of the limiting factors decline.

The amount of specific habitat survey information in the basin is sparse and primarily from smaller tributary streams; however, it is likely to be representative of rearing habitat conditions elsewhere in the basin where similar land use practices (primarily forestry, but some livestock production as well) have historically occurred. Smith (2003) summarized the results of watershed analyses conducted by the Washington Department of Natural Resources (WDNR) in the Hansen (lower Skagit subbasin) and Jordan-Boulder (upper Skagit subbasin) and the United States Forest Service (USFS) in the Sauk River and Finney Creek/Lower Skagit River. With few exceptions tributary streams in the lower Skagit subbasin and Jordan-Boulder were considered to have poor rearing conditions because of high sediment loads, low levels of instream LWD, and poor riparian conditions. High sediment loads and low levels of LWD were implicated in reduced pool habitat. In contrast, conditions were mixed in the Sauk River subbasin with some streams in poor condition, while others were in fair to good condition. Pool habitat in the mainstem Sauk River, often of high habitat value to juvenile salmon due to low water velocities, was rated poor from RM 31.9 to 39.7, poor to fair in the South Fork Sauk River with one short good section, and poor in most tributary streams. A decline in pool habitat from surveys conducted 1984 to the early 1990s was cited as a concern.

***Migration Corridors*** *(PCE 3)*
With the exception of about 20 miles of spawning habitat inundated by the Baker River Hydroelectric Project and a the 2 mile reach upstream of Gorge Dam, Chinook salmon and steelhead have access to nearly all of the historical spawning areas available. However, similar to the juvenile rearing habitat described above, the condition of migration corridors are impaired in some areas from loss of off-channel habitat, hydromodification, reduced riparian function and LWD recruitment, and high sediment loads. Many of the smaller tributaries used by steelhead, but not Chinook, are partially limited by migration barriers, primarily culverts at road crossings (Smith, C.J. 2003).

### 2.3.3 SUMMARY

Baseline conditions in the action area, among the best remaining salmonid habitat in the Puget Sound region (NMFS 2005b), is nonetheless impaired in part in the action area by the following:

1. Habitat is eliminated, cut off, or blocked;
2. Habitat is degraded by fine sediments;
3. Reduced or altered flows (water withdrawals, water storage facilities, and fluctuating flows);
4. Reduced channel migration, complexity, and flood-plain function;
5. Altered channel morphology (increased width-to-depth ratios);
6. Reduced riparian vegetation (quantity and quality);
7. Water quality is seasonally degraded;
8. Elevated late summer and fall temperatures.

This section describes an environmental baseline of lower tributary and mainstem conditions that range from highly functional to severely degraded.

## 2.4 EFFECTS OF THE ACTION ON THE SPECIES AND ITS DESIGNATED CRITICAL HABITAT

"Effects of the action" means 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 that action, that will be added to the environmental baseline (50 CFR 402.02). NMFS did not identify any interrelated or interdependent effects of the action in this consultation. 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 those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated actions are "those that are part of a larger action and depend on the larger action for their justification." Interdependent actions are "those that have no independent utility apart from the action under consideration." 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 analysis.

### 2.4.1 METHOD OF ANALYSIS

In this step of our analysis, we evaluate the effects of the proposed action on the environment, including the geographic distribution, nature, intensity, timing, frequency, and or duration of the effect. We then look at effects on individual fish and on the affected population(s). Finally, we consider effects on the essential features of any designated critical habitat within the action area.

FERC’s proposed action is to amend the Skagit River Hydroelectric Project license and to allow continued operation and maintenance of the three project dams and reservoirs along with the addition of a second power tunnel at Gorge Dam and powerhouse in accordance with its new license issued in 1995 (FERC 1995). The licensee also proposes to add four voluntary flow measures as mandatory measures for the remainder of the license term. There are additional conservation measures proposed by SCL to protect or improve critical habitat or otherwise benefit the listed species.

All of the effects of the project included in the Environmental Baseline, as modified by changes in operation under the new license, are expected to continue.

## 2.4.2 ANALYSIS OF EFFECTS

### 2.4.2.1 PUGET SOUND CHINOOK SALMON

The new FERC operating license incorporates all of the key terms and conditions of the FSA. While the continued existence of the project has negative effects on fish, the purpose of the FSA is to provide increased protection of spawning salmon, including PS Chinook. The direct effect of operating the Skagit project modifies the seasonal and often the daily hydrograph. Winter floodwaters and especially spring runoff are stored in Ross Reservoir to be released during the winter months for energy generation. Consequently average daily flows are higher than historic levels during late summer (August and September) and the winter months, and average daily flows in May through July are lower (Figure 4). This effect is most noticeable immediately downstream of Gorge powerhouse and attenuates downstream with distance, particularly after the confluence of the Cascade and Sauk Rivers.

The other chronic effect is diurnal flow fluctuation caused by load following. This causes the river level to rise and fall in the morning and late evening, respectively. In effect, this makes fry colonization and early rearing habitat (depth < 1’ and velocity < 1 fps) a moving target throughout the day. Juvenile fish (fry) stranding studies by (Thompson 1970); (Wooden 1984), and (Beck, R.W., 1989) demonstrated that without stream flow downramping restrictions, it was common for river stage levels to recede more rapidly than the salmon fry could keep up with, resulting in stranding mortality on many of the Skagit’s large wide gravel bars. The FERC license addresses this by adopting the FSA downramping restrictions.

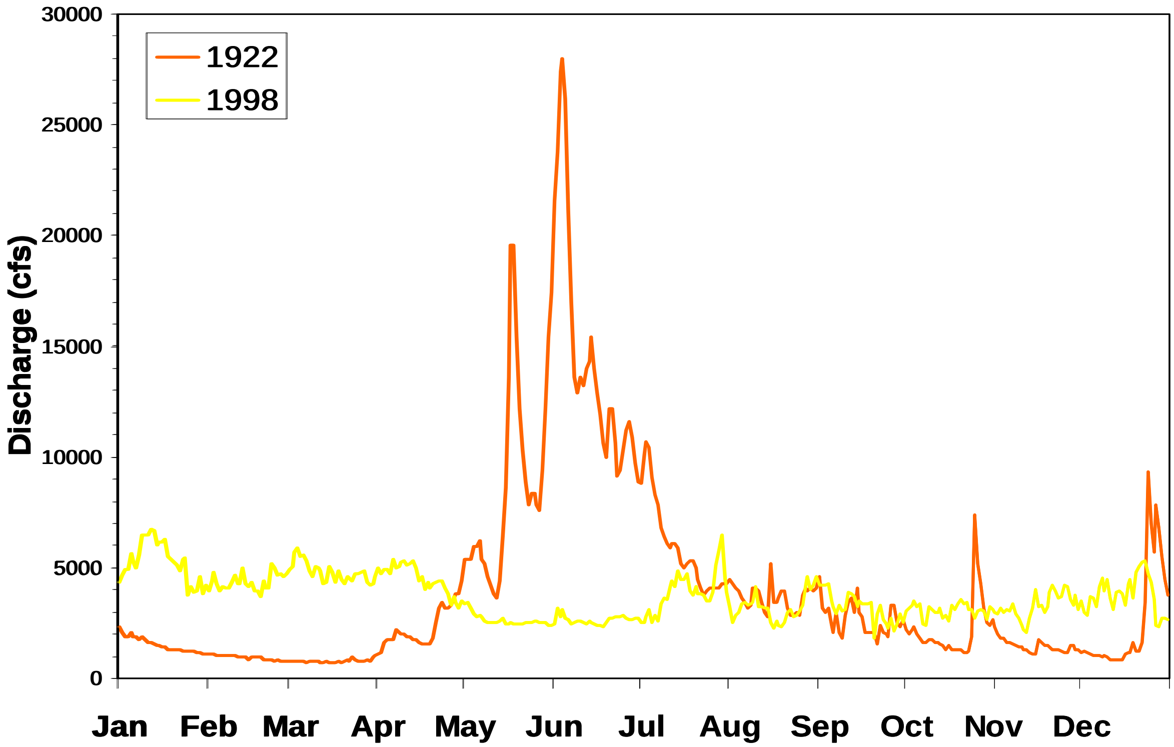


**Figure 4**. Skagit Flows at Newhalem with and without Project.

### *Spawning, Incubation, and Early Juvenile rearing*

Although the dams reduce gravel recruitment into the reach below Gorge powerhouse, flow management largely offsets the reduction in sediment supply by reducing the frequency and magnitude of peak flow events, thereby reducing the rate of downstream transport of spawning gravels. Also, several tributary streams downstream from Gorge Dam contribute gravel to the mainstem Skagit such that substantial numbers of salmon, including PS Chinook, spawn in the project affected reach, almost to the tailrace of Gorge powerhouse.

Based upon the results of hydrological, instream flow, redd protection, and fry stranding models, flow management measures meet or exceed the conditions specified by the Skagit FSA(Beck, R.W., 1989). These flow measures protect the eggs, alevins, and fry of PS Chinook salmon from dewatering during their incubation and early rearing period, and reduce the potential for entrapment and stranding of salmon fry on gravel bars in the river.

According to the Skagit FSA, implementation of the flow and non-flow mitigation measures "resolves all issues related to the effects on fisheries resources of the Project, as currently constructed, for the period May 12, 1981 through the duration of this Agreement." In addition, "The Parties stipulate that this Agreement constitutes adequate fish protection and compensation for fishery losses caused by the Project, as currently constructed, for the period May 12, 1981 through the duration of this Agreement." (Seattle City Light 1991). Agencies, including NMFS, and Tribes were signatories to this settlement agreement. The FSA terms and conditions were incorporated into the FERC license.

The terms of the license requires SCL to propose to the Flow Plan Coordinating Committee (NMFS is on this committee) at regular meetings a spawning flow. The spawning flow is a calculated average of flows during the Chinook spawning period (late August through October). The spawning flow is associated with an incubation flow that can subsequently protect the preponderance of Chinook redds through egg incubation and fry emergence (Section 6 of the Anadromous Fish Flow Plan, (Seattle City Light 1991).

In addition to affecting PS Chinook through daily and seasonal flow regulation, the Skagit project stores winter flood water, significantly reducing peak flood discharges. There is evidence that freshwater survival in Skagit River Chinook salmon populations, particularly egg-to-outmigrant survival, is affected primarily by peak flows throughout the basin and high sediment loads in specific watersheds (SRSC and WDFW 2005). Peak flows can adversely affect egg to fry survival by scouring incubating eggs and alevins in redds, and increasing fry mortality rates. High sediment loads can adversely affect the quality of spawning gravels through delivery of fine sediments and by altering channel morphology, which can contribute to scour.

Evaluation of peak flows during egg incubation have demonstrated that Chinook salmon egg to fry survival in the Skagit River is negatively related to flood recurrence interval for flows greater than a 2-year event (Figure 2)(Kinsel et al. 2008). During years in which peak flows do not exceed the 2-year recurrence interval flood under the current flow regime, egg survival ranges from about 10 percent to 17 percent and appears unrelated to flow (Zimmerman et al. In Prep).

Poor egg-to-outmigrant survival because of peak flow events is considered a major factor limiting Chinook salmon production in the Skagit River (SRSC and WDFW 2005). The flood control and fish management flows of the Skagit Hydroelectric Project substantially reduce the magnitude of peak flow events in the Skagit River, particularly in the 25-mile section of the river between Gorge Powerhouse and the Sauk River confluence. The large volume of flood storage reduces peak flows provided by Ross Reservoir and SCL attempts to prevent flows from exceeding 18,000 cfs during the Chinook egg incubation period to minimize redd scour. Flows higher than this guideline occur because of natural tributary inflows downstream of the project, and during flood fight efforts when the project is under the control of the U.S. Army Corps of Engineers (Corps).

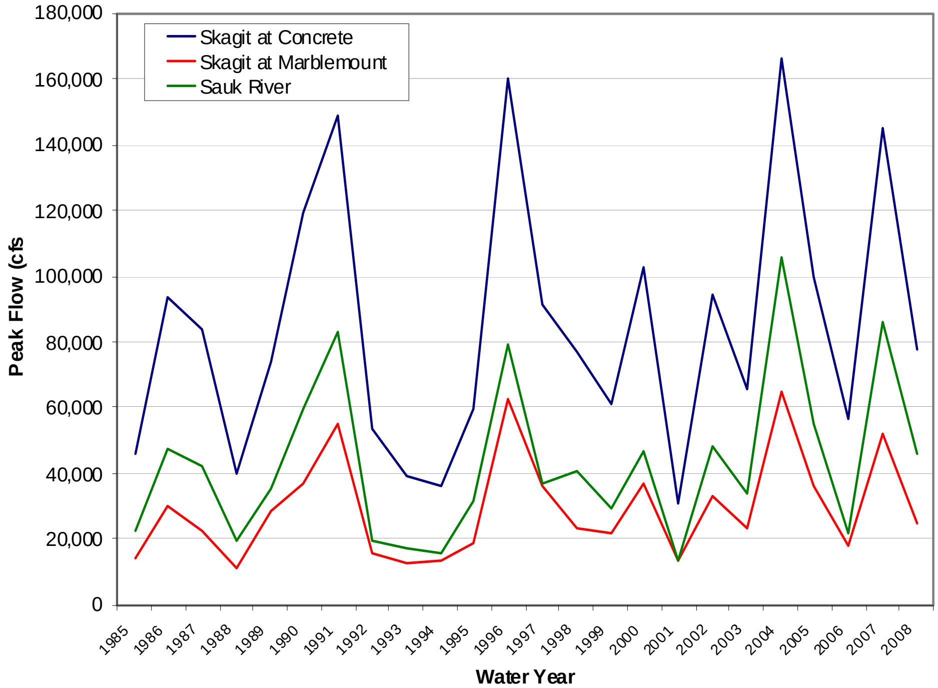


**Figure 5**. Annual peak flows (instantaneous) of the Skagit River at Marblemount and Concrete, and the lower Sauk River.

As a result of lower precipitation levels in the upper basin and SCL's flow management measures, peak flows in the upper Skagit River are considerably smaller in magnitude than peak flows in the Sauk River and lower Skagit River for the same flood events (Figure 5). Precipitation levels are substantially lower in the upper basin compared to the Sauk River Basin because of rain shadow effects caused by the Cascade Range (Pacific International Engineering 2008). Peak flows in the upper Skagit River at Marblemount have exceeded 40,000 cfs four times during the past 25 years, have exceed 60,000 cfs only twice during this period (1996 and 2003 flood events). The average annual peak flow of the upper Skagit River at Marblemount since 1985 has been 29,400 cfs (drainage area = 1,381 sq-mi). In comparison, peak flows of the unregulated Sauk River have exceeded 40,000 cfs 10 times during the past 25 years, have exceeded 80,000 cfs three times during this period, and exceeded 100,000 cfs during the 2003 flood. The average annual peak flow of Sauk River since 1985 has been 43,200 cfs (drainage area =714 sq-mi, roughly half that of the upper Skagit). Finally, peak flows in the lower Skagit River at Concrete have exceeded 40,000 cfs 18 times since 1985, and have exceeded 100,000 cfs six times during this period. The average annual peak flow of the lower Skagit River at Concrete since 1985 has been 84,200 cfs (drainage area = 2,737 sq-mi).

The effects of SCL's flow management measures on peak flows can be shown more directly by comparing peak flows occurring under existing conditions (i.e., with project flows) with natural peak flows (i.e., without project flows) that have been calculated for the same time period.

For the last 25 years, the Skagit Hydroelectric Project has reduced peak flows in the upper Skagit River by an average of 38 percent, with peak daily flows of 21,500 cfs occurring with the project, and peak daily flows of 34,600 cfs calculated for natural (without project) conditions. The reductions in peak flows by the project have been greatest during major flood events, which occurred during the 1991, 1996, 2004 and 2007 water years. During these major flood years, peak daily flows averaged 44,500 cfs under flood and fish protection measures implemented by SCL, but would have averaged 70,000 cfs under natural (without project) conditions.

The negative relationship between peak flows and egg-to-outmigrant Chinook survival has been well documented in the Skagit River (SRSC and WDFW 2005); (Kinsel et al. 2008). This relationship has been evaluated in the upper Skagit River using the updated data from the WDFW smolt trap located in the lower Skagit River (Zimmerman et al. In Prep). The negative relationship between peak flows in the upper Skagit River and egg-to-outmigrant survival measured at the smolt trap is highly significant (Figure 6), showing that peak flows in the upper Skagit have a major influence on the total number of Chinook smolts migrating out of the Skagit basin.

Using this relationship, the effects of peak flow reduction measures by the Skagit project on Chinook salmon egg-to-outmigrant survival for the entire Skagit basin can be calculated. The peak flow reduction measures by the Skagit Hydroelectric Project provide a major benefit to the eggs, alevins, and fry of Chinook salmon, increasing average egg-to-outmigrant survival rates from 7.3 percent under natural (without project) conditions to 10.8 percent (Figure 6). The peak flow reductions result in a 48 percent increase in the freshwater survival of Chinook salmon for the Skagit River basin.

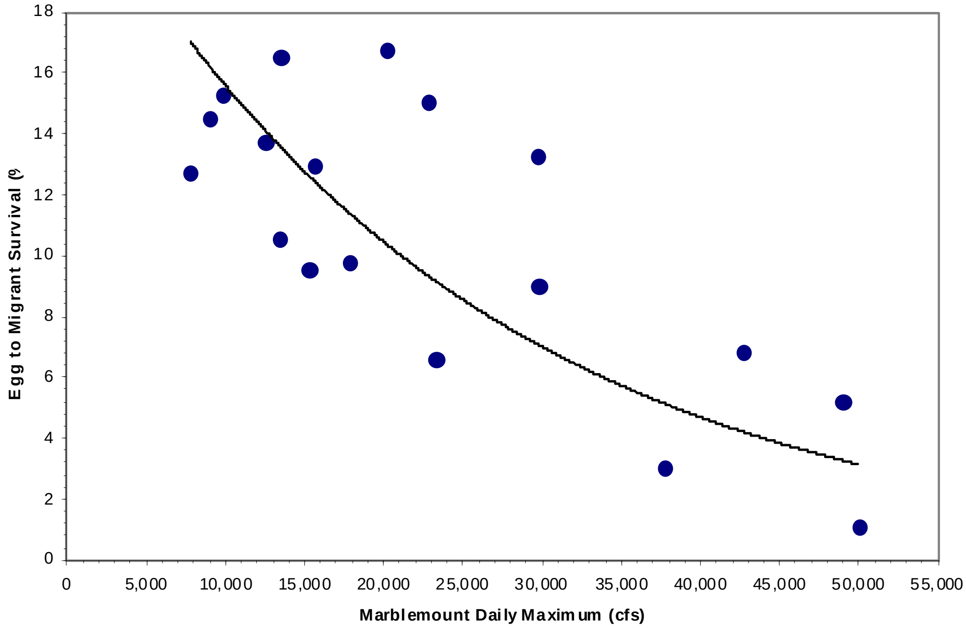


**Figure 6.** Relationship between peak flows for the Skagit River at Marblemount and egg-to-smolt survival for Chinook salmon in the Skagit River basin.

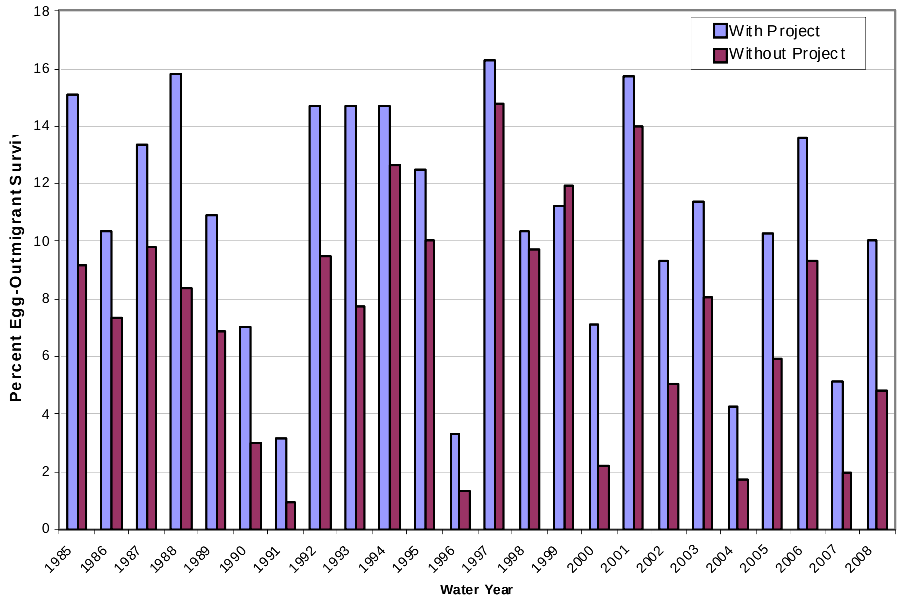


**Figure 7.** Comparison of egg-to-outmigrant survival rates for Chinook salmon in the Skagit Basin predicted under existing (with project) and natural (without project) conditions.

The positive effects of peak flow reductions in the upper Skagit River on Chinook egg-to-outmigrant survival are most evident during major flood years (Figure 8). During major floods occurring during 1991, 1996, 2004 and 2007 (water year), reductions in peak flows in the upper Skagit River resulted survival rates that were up to 3.5 times those calculated under natural (without project) conditions. During these major flood years, freshwater survival rates of Chinook in the Skagit were predicted to be 2.8 times greater on average than natural survival rates.

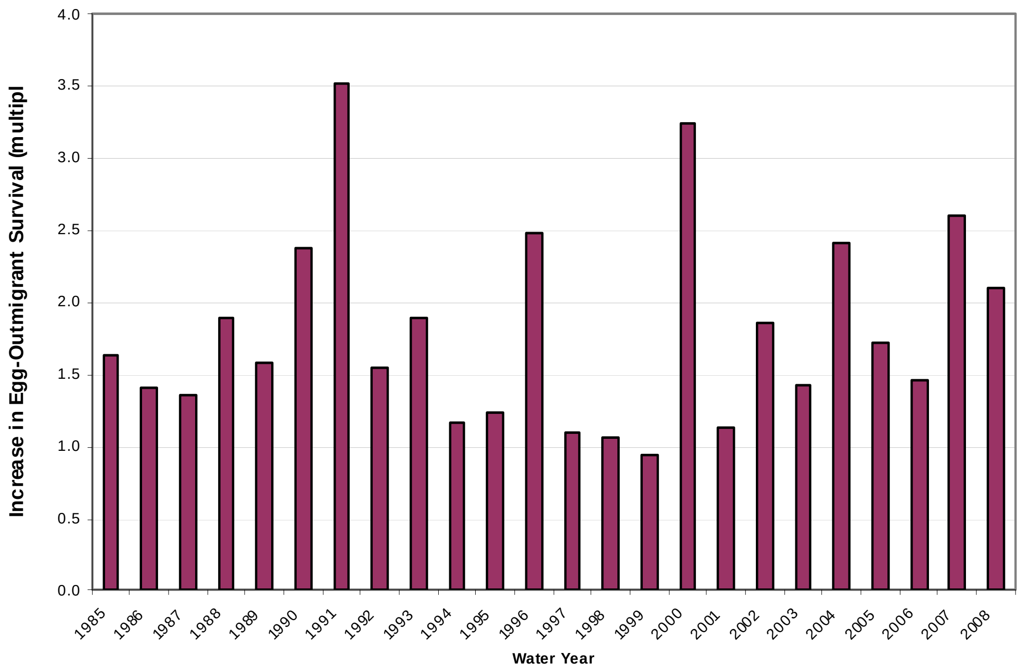


**Figure 8.** Predicted increases in egg to outmigrant survival rates for Chinook salmon resulting from the fish management flows at the Skagit Hydroelectric Project

#### 2.4.2.1.1 PUGET SOUND CHINOOK SALMON DESIGNATED CRITICAL HABITAT

The PCEs of critical habitat that occurs within the action area for this consultation are "freshwater spawning sites, incubation, and larval development, rearing sites, and migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival." Project effects on freshwater juvenile and adult migration corridors including obstructions, predation, and water quality and quantity are summarized in Table 4.

Gorge Dam blocks access to a small amount of historical habitat. Lack of access is mitigated with improved spawning, egg incubation conditions downstream, and non-flow measures supporting Skagit Chinook research.

As described above in the environmental baseline section, Skagit River water quality is good to excellent in the project action area. The proposed action of adding the second Gorge power tunnel has the potential to temporarily increase turbidity if excavated material enters the reservoir and river. Pollution or water contamination could occur should a gas or oil spill introduce those chemicals into the river; however, preventative and containment measures will be used to minimize this possibility. No substantial adverse effects on water quality or direct take are likely from development of the second power tunnel.

**Table 3.** Project effects on PS Chinook critical habitat

| PCE feature | Project effect |
|---|---|
| Support spawning, incubation, & larval development. | Managed spawning and incubation flows and downramping rates during juvenile rearing. Adding the second power tunnel is not expected to affect this PCE. |
| Freshwater rearing sites with:<br>(i)Water quantity and floodplain connectivity;<br>(ii)Water quality and forage<br>(iii)Natural cover, shade, submerged & overhanging wood, log jams, etc. | The action area contains a mix of connected and unconnected floodplain. The new license has established off-channel habitats connected to the Skagit River. The proposed action to add a second power tunnel at Gorge Dam has the potential to release sediment to the downstream river channel and cause a temporary increase in turbidity. Water quality and quantity are otherwise unaffected. |
| Freshwater migration corridors free of obstruction and excessive predation. | Project operations have no identified effect on the Chinook migration corridor, and adding the second Gorge power tunnel is not expected to have any effect on the migration corridor. |
| Estuarine, nearshore marine & offshore marine areas. | These are outside the project action area, and no project effect on them is identified. |

### 2.4.3 PUGET SOUND STEELHEAD

The new FERC operating license incorporates all of the key terms and conditions of the FSA. The new license provides increased protection of spawning steelhead, including PS steelhead. The direct effect of operating the Skagit project modifies the seasonal and often the daily hydrograph. Winter floodwaters and especially spring runoff are stored in Ross Reservoir to be released during the winter months for energy generation. Consequently, average daily flows are higher than historical levels during late summer (August and September) and the winter months, and average daily flows in May through July are lower. This effect is most noticeable immediately downstream of Gorge Powerhouse and attenuates downstream with distance, particularly after the confluence of the Cascade and Sauk Rivers (Figure 4).

The other chronic effect is flow fluctuation caused by load following. This causes the river level to rise and fall in the morning and late evening, respectively. In effect, this can make steelhead fry colonization and early rearing habitat (depth < 1’ and velocity < 1 fps) a moving target throughout the day. Juvenile fish (fry) stranding studies by (Beck, R.W., 1989) demonstrated that without stream flow downramping restrictions, it was common for river stage levels to recede more rapidly than the steelhead fry could or would keep up with, resulting in stranding mortality on many of the Skagit’s large wide gravel bars. Inclusion of downramping limits developed during the FSA process in the new FERC license has reduced the potential for entrapment and stranding of steelhead fry on gravel bars in the river.

***Spawning, Incubation, and Early Juvenile rearing***

Although the dams reduce gravel recruitment into the reach below Gorge powerhouse where steelhead spawn, flow management largely offsets the reduction in gravel recruitment from upstream areas by reducing the frequency and magnitude of peak flow events thereby reducing the rate of downstream transport of spawning gravels.

Based upon the results of hydrological, instream flow, redd protection, and fry stranding models, flow management measures meet or exceed the conditions specified by the Skagit FSA (Beck, R.W., 1989). Skagit steelhead spawn primarily in April into early June, with a peak in May. The spring runoff begins in May, with the highest sustained stream flows in June. So steelhead eggs and alevins incubate during the ascending curve of the seasonal hydrograph and complete incubation and emergence during the descending limb. Under natural unregulated flow conditions, some unknown proportion of steelhead redds likely would have become dewatered, resulting in a loss of eggs and or fry. The FSA flow measures keep at least 97% of the redds watered through the incubation and emergence cycle, protecting the eggs, alevins, and fry of PS steelhead from dewatering during their incubation and early rearing period, and minimize the stranding of steelhead fry on gravel bars in the river.

The license terms require SCL to propose to the Flow Plan Coordinating Committee (NMFS is on this committee) at regular meetings a steelhead season spawning flow. The spawning flow is a calculated average of flows during the steelhead spawning period. The spawning flow is associated with an incubation flow that can subsequently protect the preponderance of steelhead redds through egg incubation and fry emergence (Section 6 of the Anadromous Fish Flow Plan, Seattle City Light 1991).

***Rearing and Migration within the Action Area***

The Skagit River Hydroelectric Project, with its conservation measures, is operated to facilitate upstream and downstream migration of steelhead downstream from the project and to limit adverse effects during rearing (e.g. ramping limits to reduce entrapment and stranding).

***Water Quality***

Steelhead require specific water quality characteristics that include cool water with moderate to high levels of dissolved oxygen. As describes above in the environmental baseline, Skagit River water quality is good to excellent in the action area. As previously mentioned, the proposed action of adding the second Gorge power tunnel has the potential to temporarily increase turbidity if excavated material enters the reservoir and river. Pollution or water contamination could occur should a gas or oil spill introduce those chemicals into the river; however, preventative and containment measures will be employed to minimize this possibility. No direct take is estimated from development of the second power tunnel.

***Water Quantity***

Water quantity, although modified in terms of seasonal and daily delivery, is partially regulated by the FSA and FERC license to satisfy steelhead spawning, incubation, rearing, and migration requirements.

#### 2.4.3.1 PUGET SOUND STEELHEAD CRITICAL HABITAT

NMFS has not yet designated critical habitat for PS steelhead.

## 2.5 CUMULATIVE EFFECTS

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Guidance for determining cumulative effects in the Endangered Species Consultation Handbook (USFWS and NMFS 1998) states the following:

"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."

Notable activities that meet state, tribal or local agency involvement include Washington State legislation to enhance salmon recovery through tributary enhancement programs, Washington's Total Maximum Daily Load (TMDL) development and implementation, tribal efforts to restore native culturally important fish populations and public land use in the action area.

***Washington State***

Several legislative measures have been passed in the State of Washington to facilitate the recovery of listed species and their habitats, as well as the overall health of watersheds and ecosystems. The 1998 Salmon Recovery Planning Act provides the basis for developing watershed restoration projects and establishes a funding mechanism for local habitat restoration projects. The Salmon Recovery Planning Act also created the Governor's Salmon Recovery Office, to coordinate and assist in the development of salmon recovery plans.

The Statewide Strategy to Recover Salmon is also designed to improve watersheds, while the 1998 Watershed Planning Act encourages voluntary water resource planning by local governments, citizens, and Tribes in regards to water supply, water use, water quality, and habitat at the water resource inventory area (WRIA) level. The Salmon Recovery Funding Act established a board to approve localized salmon recovery funding activities.

WDFW and Tribal co-managers implemented the Wild Stock Recovery Initiative in 1992 and completed comprehensive management plans that identify limiting factors and habitat restoration activities. These plans also include actions in the harvest and hatchery components. Although the Washington legislature amended the Shoreline Management Act to increase protection of shoreline fish habitat, a recent court challenge will delay implementation and possibly require additional amendments. Washington's Forest and Fish Policy is designed to establish criteria for non-Federal and private forest activities that will improve environmental conditions for listed species, primarily to minimize impacts to fish habitat through protection of riparian zones and instream flows. These actions are likely to gradually improve habitat productivity and capacity and result in long-term benefits, although little may be seen in the near term.

***Tribes***

The Swinomish Indian Tribal Community, Sauk-Suiattle Indian Tribe, and the Upper Skagit Indian Tribe are treaty tribes and co-managers with Washington State of salmon harvest under a draft Harvest Management Plan (PSIT and WDFW 2009). Harvest significantly affects the abundance of salmon and steelhead in the basin, and consequently the number of fish potentially affected by project operations. The plan notes that recovery to substantially higher abundance is primarily dependent on restoration of habitat function. The Harvest Management Plan is designed such that harvest will not significantly reduce the likelihood of survival and recovery of the ESU.

***Summary of Cumulative Effects***

Several activities by state, tribal and private entities were identified that have the potential to benefit PS Chinook salmon and PS steelhead in the action area and throughout their ranges. However, these programs have already been enacted and their effects to date are reflected in the current status of the species and the environmental baseline. It is possible, perhaps likely, that as these programs mature additional benefits would accrue to the Skagit populations and range-wide status of the PS Chinook salmon ESU and the PS steelhead DPS, however, such potential benefits from these cumulative effects are speculative. Because the potential benefits of these programs are speculative, we do not consider there to be any cumulative effects in reaching our conclusions in this opinion.

## 2.6 INTEGRATION AND SYNTHESIS

The Integration and Synthesis section is the final step of NMFS' assessment of the risk posed to species and critical habitat as a result of carrying out the proposed action. In this section, we add the effects of the action (Section 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5) to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) result in appreciable reductions in the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species.

These assessments are made in full consideration of the status of the species and critical habitat (Section 2.2).

### 2.6.1 CURRENT RANGEWIDE STATUS OF PS CHINOOK SALMON AND PS STEELHEAD

PS Chinook salmon and PS steelhead are listed as Threatened (NMFS 2011). None of the extant Skagit Chinook populations are meeting the viable salmonid population (VSP) criteria for abundance and productivity. Numbers of natural origin spawners in the upper Skagit River have decreased in recent years compared to the period 2000-2005, after increasing somewhat in the previous 5-year period. PS steelhead are similar to Chinook in that the most recent estimates of natural origin spawners (Ford et al. 2011) continue the declining trend established earlier, with an average annual growth rate of -3.9%. Productivity remains low, but the BRT is confident that a 90% decline of this population will not happen within the next 30 years. Beyond that, the risk level is highly uncertain.

### 2.6.2 ENVIRONMENTAL BASELINE

Habitat within the action area for PS Chinook salmon and PS steelhead has been modified by anthropogenic actions such as urban development, forest practices, grazing, hydroelectric energy development and generation, water storage projects, and agricultural runoff. These changes are associated with the loss of or degradation of important spawning and rearing habitat and the loss of or degradation of migration corridors.

Under the environmental baseline, the status of critical habitat in portions of the action area has become degraded.

### 2.6.3 EFFECTS OF THE PROPOSED ACTION

#### 2.6.3.1 EFFECTS OF THE PROPOSED ACTION ON PS CHINOOK SALMON AND DESIGNATED CRITICAL HABITAT

The Skagit project affects the viability of the Skagit River spawning population as described below.

***Water Quality***

Skagit River water quality in the project area is generally good to excellent. There are no dissolved gas issues caused by project operations, and the small water temperature modifications caused by the project have had no apparent harm to either listed species. As no changes in water quality are anticipated under the proposed action, no adverse water-quality-caused effects on either species are likely to occur.

### *Blocked Habitat*

Gorge Dam blocks access to upstream habitats. Available evidence indicates that the historical accessibility and use of this habitat was slight and the effect of blockage inconsequential to PS Chinook salmon (see Section 2.3 Environmental Baseline).

### *Water Quantity*

Water quantity is modified by project storage of the spring snowmelt runoff and winter storms that can cause flooding in the Skagit valley. Skagit River stream flows are lower in the spring and higher in the late summer, fall, and winter immediately downstream of the project than would occur absent the project. However, project flows are managed to protect PS Chinook spawning, incubation, and early juvenile rearing. The project's attenuation of winter peak flows benefits PS Chinook incubation through fry life stages.

### 2.6.3.2 EFFECTS OF THE PROPOSED ACTION ON PS STEELHEAD AND DESIGNATED CRITICAL HABITAT

The Skagit project is operated to provide protective spawning and incubation stream flows and early juvenile rearing. Moderating winter floods also benefits steelhead, although not to the same extent as Chinook, since steelhead are not spawning nor incubating during the winter. As previously noted, PS steelhead critical habitat has not been designated. However, the Skagit project is operated to provide the same benefits to PS steelhead as are provided to PS Chinook and its designated critical habitat.

## 2.6.4 CUMULATIVE EFFECTS

None of the cumulative effects identified are sufficiently likely to occur to be considered in this opinion (see Section 2.5).

## 2.6.5 SUMMARY—INTEGRATION AND SYNTHESIS

### 2.6.5.1 SUMMARY FOR PS CHINOOK SALMON AND DESIGNATED CRITICAL HABITAT

The PS Chinook ESU is listed as threatened. Abundance and productivity have decreased in recent years. While continued existence of the project negatively affects fish, adding the likely effects of the proposed action to the environmental baseline would improve spawning through emergence success by protecting redds and reducing the limiting effects of peak flows. Diurnal flow fluctuations associated with load-following operations within the limits included in the new license likely has a small negative effect on fry through juvenile survival, and the loss of access to habitats upstream of Gorge powerhouse in the upper Skagit watershed inconsequentially reduces the space available to the species. Overall, the proposed action likely improves the survival of PS Chinook salmon.

#### 2.6.5.2 SUMMARY FOR PS STEELHEAD AND DESIGNATED CRITICAL HABITAT

The PS steelhead DPS is listed as Threatened. Abundance has decreased in recent years and productivity has declined. Population diversity is degraded slightly by the presence of hatchery-origin spawners, causing some introgression. Diurnal flow fluctuations associated with load-following operations has a negative effect on fry through juvenile survival, and the loss of access to habitat upstream of Gorge powerhouse in the upper Skagit watershed inconsequentially reduces the space available to the species. Overall, the proposed action likely improves the survival of PS steelhead.

## 2.7 CONCLUSION

After reviewing the current status of the listed species (high risk for PS Chinook and PS steelhead), the environmental baseline within the action area (degraded), the effects of the proposed action (continuation of baseline conditions, including reduced peak flood flows, with improved spawning, incubation, and juvenile rearing survival, load-following, and habitat blockage), and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of PS Chinook or PS steelhead or to destroy or adversely modify PS Chinook designated critical habitat.

By improving incubation through emergence survival and minimizing historical adverse effects (e.g. entrapment and stranding) of the Skagit Project, the proposed action is consistent with the Puget Sound salmon recovery plan (NMFS 2006).

## 2.8 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by regulation to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. For purposes of this consultation, we interpret "harass" to mean an intentional or negligent action that has the potential to injure an animal or disrupt its normal behaviors to a point where such behaviors are abandoned or significantly altered.[3] Section 7(b)(4) and Section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency

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[3] NMFS has not adopted a regulatory definition of harassment under the ESA. The World English Dictionary defines harass as "to trouble, torment, or confuse by continual persistent attacks, questions, etc." The U.S. Fish and Wildlife Service defines "harass" in its regulations as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3).

The interpretation we adopt in this consultation is consistent with our understanding of the dictionary definition of harass and is consistent with the U.S. Fish and Wildlife interpretation of the term.

action is not considered to be prohibited taking under the ESA, if that action is performed in compliance with the terms and conditions of this incidental take statement.

### 2.8.1 AMOUNT OR EXTENT OF TAKE

Take of listed PS Chinook and PS steelhead is described in detail in section 2.4. Each element of the proposed action expected to have incidental take is summarized in Table 5.

**Table 4.** Summary of Anticipated Incidental Take

| Project action | Estimated take |
|---|---|
| Spawning flows | -None- |
| Incubation flows | < 2% Chinook redds dewatered*<br>> <3% steelhead redds dewatered* |
| Flow fluctuations (downramping) | < 12,300 or < 0.5%, whichever is smaller, Chinook fry annually, no adults*<br>< 23,000 or < 0.5%, whichever is smaller, steelhead fry annually, no adults* |
| Second power tunnel construction | Potential small take due to sediment release, <10,000 eggs, alevins, and fry. |

*Calculated from (Beck, R.W., 1989) and the FSA (Seattle City Light 1991).

### 2.8.2 EFFECT OF THE TAKE

NMFS determined in this Opinion that the level of anticipated take associated with the continued existence and operation of the Skagit River Hydroelectric Project would not be likely to jeopardize the continued existence of PS Chinook salmon or PS steelhead nor adversely modify PS Chinook designated critical habitat. Direct losses of eggs, alevins, and fry are mitigated by higher protection levels to redds than is calculated to occur under natural, unregulated flows. FERC's proposed action to amend the license to Seattle City Light is consistent with the FSA, which includes conservation measures that have shown to increase survival of both species.

The incidental take shown in Table 4 is the maximum amount of incidental take that NMFS estimates will occur as a result of the proposed action. This incidental take, which is exempted by this statement, would be exceeded if the licensee fails to execute the measures in strict accordance with the license (FERC 1995). If take exceeds the amount or extent specified herein, NMFS will evaluate conditions using the best available science and determine whether reinitiation of consultation is required.

### 2.8.3 REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

"Reasonable and prudent measures" are nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02). "Terms and conditions" implement the reasonable and prudent measures (50 CFR 402.14). These must be carried out for the exemption in section 7(o)(2) to apply.

The following reasonable and prudent measures (RPMs )are necessary and appropriate to minimize the effect of anticipated incidental take of PS Chinook salmon and PS steelhead. FERC must require the licensee to minimize incidental take as follows:

1. Minimize incidental take from the operation of the project by requiring the licensee to adhere to all the measures in the FSA as approved and adopted by the Commission in 1995 (FERC 1995) and incorporated the existing and extended into the proposed amended license.
2. Minimize incidental take by incorporating into the Skagit project license the additional flow management measures described in section 3.3.1 of the biological evaluation (Seattle City Light 2010).
3. Minimize incidental take from in-water and near-water construction activities by using BMPs for the proposed action to avoid or minimize adverse effects to water quality and aquatic resources.
4. FERC must include the standard license reopener clause in any license issued for this project to ensure continuing agency discretion throughout the life of the license as may be necessary to protect species listed under the ESA.

To be exempt from the prohibitions of Section 9 of the ESA, FERC must ensure that Seattle City Light fully carries out the conservation measures in the amended license to be issued by FERC. FERC must include in the license the following terms and conditions that carry out the RPMs listed above. Partial compliance with these terms and conditions may result in more take than anticipated, and invalidate this take exemption. These terms and conditions constitute no more than a minor change to the proposed action because they are consistent with the basic design of the proposed action.

***To carry out RPM #1, FERC or its Licensee must undertake the following***:

1. Require the Licensee to monitor fish populations and habitat as described in the provisions of the FSA that relate to Puget Sound Chinook and Puget Sound steelhead (including, but not limited to aquatic habitat conditions [e.g., flows and habitat restoration], construction, monitoring, and fish sampling) for this project. The Licensee must report all incidental take that occurs during these activities to NMFS. The Licensee must report the results of monitoring fish and water quality annually to NMFS. This may be concurrent with the Project annual reports to FERC and shall be provided to NMFS by March 31 each year for take, which occurred in the prior calendar year. Listed fish must be handled with extreme care and kept in water, with adequate circulation, to the maximum extent possible during sampling and monitoring. When a mix of species are captured or collected, ESA-listed fish must be processed first, to the extent possible, to minimize stress. Listed fish must be transferred using a sanctuary net (which holds water during transfer) whenever practical to prevent the added stress of being dewatered. Require the Licensee to monitor juvenile and adult mortality to ensure that incidental take levels are not exceeded. The Licensee must develop the monitoring measures in conjunction with NMFS, and receive our approval of the monitoring plan.

Incidental take should be reported to:

National Marine Fisheries Service
Hydropower Division, FERC and Water Diversions
Attention: Keith Kirkendall, Branch Chief
1201 NE Lloyd Blvd., Suite 1100
Portland, OR 97232

***To carry out RPM #2, FERC or its Licensee must undertake the following:***

1. Require the Licensee to further protect steelhead and Chinook salmon yearlings by limiting downramping rates to < 3,000 cfs/hr from October 16 to January 31 each year.

2. Require the Licensee to further minimize Chinook salmon fry stranding by implementing all salmon fry protection period measures for spawning flow, incubation flow, and downramping rate on the date specified in the license each year.

***To carry out RPM #3, FERC or its Licensee must undertake the following:***

1. Require the Licensee to use best management practices in all construction work, including adhering to certain timing restrictions. Spill control equipment must be on site and in quantities sufficient to effectively contain and recover accidental release of chemicals. Project personnel must be familiar with spill control equipment operation and procedures prior to the initiation of work. Instream work shall be conducted according to BMPs, consistent with WDFW's Hydraulic Code (RCW 77-55) by conforming to a Hydraulic Project Approval (HPC) (WAC 220-110) obtained from WDFW. In the event that the regulations are significantly modified or repealed during the license term, the terms in effect in 2012 shall continue in force for the term of the license to protect fish and their habitat.

## 2.9 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

NMFS has no conservation recommendations to make at this time.

## 2.10 REINITIATION OF CONSULTATION

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 on listed species or designated 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 on the listed species or critical habitat not considered in this opinion, or 4) a new species is listed or critical habitat designated that may be affected by the action.

In instances where the amount or extent of incidental take is exceeded, FERC and the Licensee must consult with NMFS to determine whether specific actions will be taken to address such events, including but not limited to ceasing or modifying the causal activity.

## 2.11 "NOT LIKELY TO ADVERSELY AFFECT" DETERMINATION

**Southern Resident Killer Whale**

***Species Determination***

The final rule listing Southern Resident (SR) killer whales as endangered identified several potential factors that may have caused their decline or may be limiting recovery. These are: quantity and quality of prey, toxic chemicals which accumulate in top predators, and disturbance from sound and vessel traffic. The rule also identified oil spills as a potential risk factor for this species. The final recovery plan includes more information on these potential threats to SR killer whales (NMFS 2008c).

The SR killer whales spend considerable time in the Georgia Basin from late spring to early autumn, with concentrated activity in the inland waters of Washington State around the San Juan Islands, and then move south into Puget Sound in early autumn. While these are seasonal patterns, SR killer whales have the potential to occur throughout their range (from central California north to the Queen Charlotte Islands) at any time during the year.

SR killer whales consume a variety of fish and one species of squid, but salmon, and Chinook salmon in particular, are their primary prey (NMFS 2008c). Ongoing and past diet studies of Southern Residents conduct sampling during spring, summer and fall months in inland waters of Washington State and British Columbia (i.e., Ford and Ellis 2006; Hanson et al. 2010 ). Therefore, our knowledge of diet is specific to inland waters. Less is known about diet of Southern Residents off the Pacific Coast. However, chemical analyses support the importance of salmon in the year-round diet of Southern Residents (Krahn et al. 2002; Krahn et al. 2007). The predominance of Chinook salmon in the Southern Residents' diet when in inland waters, even when other species are more abundant, combined with information indicating that the killer whales consume salmon year round, makes it reasonable to expect that Southern Residents predominantly consume Chinook salmon when available in coastal waters.

The SR killer whale does not occur within the Skagit River or the action area for this consultation and therefore, direct effects of the proposed action are not anticipated. The proposed action may indirectly affect SR killer whales by reducing their prey (PS Chinook). The proposed action is not anticipated to affect prey quality; however, the project may affect the quantity of prey available to Southern Residents.

The objective of the Skagit FSA is to mitigate any effect to the natural abundance in terms of survival through the action area for each species including PS Chinook salmon. The 1991 FSA and the proposed amended license will continue to positively affect the recovery of PS Chinook salmon and should benefit killer whales in the long term. Although take of listed Chinook occurs under the Skagit license, the abundance of Chinook is actually enhanced.  Therefore, effects to the quality and quantity of killer whale prey are insignificant or discountable.  To the extent there is an affect on killer whale prey, it is positive rather than negative.  This Biological Opinion concludes that the proposed action is not likely to jeopardize the continued existence of PS Chinook or PS steelhead or to destroy or adversely modify PS Chinook designated critical habitat. Therefore, the net effect of the proposed action on SR killer whale prey is insignificant and NMFS concurs with FERC's determination that the proposed license may affect, but is not likely to adversely affect killer whales.

***Southern Resident Critical Habitat Determination***

Critical habitat for the SR killer whale includes approximately 2,560 square miles of Puget Sound, excluding areas with water less than 20 feet deep relative to extreme high water.  The proposed action has no effect in this area.  Therefore, NMFS finds that the proposed license has no effect on SR killer whale critical habitat.

# 3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT CONSULTATION

The consultation requirement of Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions, or proposed actions that may adversely affect EFH. The MSA (Section 3) defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” Adverse effects include the direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside EFH, and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that may be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by FERC and descriptions of EFH for Pacific coast salmon (PFMC 1999) contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC) and approved by the Department of Commerce.

## 3.1 ESSENTIAL FISH HABITAT AFFECTED BY THE PROJECT

The PFMC designated EFH for Chinook salmon, coho salmon, and Puget Sound pink salmon (PFMC 1999). The proposed action and action area for this consultation are described in Sections 1.3 and 1.4 of this document. The action area includes areas designated as EFH for adult, fry, juvenile, and smolt life history stages of Chinook salmon *(Oncorhynchus tshawytscha)*. No Habitat Areas of Particular Concern have been identified in the action area.

## 3.2 ADVERSE EFFECTS TO ESSENTIAL FISH HABITAT

Based on information provided in the Biological Assessment (BA) (Seattle City Light 2010) and the analysis of effects presented in the ESA portion of this document, NMFS concludes that the proposed action will adversely affect EFH designated for Pacific Coast by diurnally fluctuating flows which would diminish the value of the habitat to rearing salmon and by blockage which we have determined to be inconsequential. The project also provides beneficial effects on Chinook salmon EFH by reducing peak flow-induced scour, which improves the survival of incubating eggs and alevins.

## 3.3 ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS

NMFS expects that the conservation measures required in our ITS (Section 2.8 above) are necessary and sufficient to conserve EFH. Consequently, NMFS adopts these terms and conditions as our EFH conservation recommendations as shown in Table 5.

**Table 5**. Project effects and conservation recommendations

| Project Effect | Conservation Recommendation |
|---|---|
| Redd scour | Minimize flood flows |
| Modify seasonal hydrograph | No CR |
| Fry stranding | 1. Restrict downramping<br>2. Release incubation flows that protect eggs and alevins |

NMFS expects that full implementation of these EFH conservation recommendations, combined with the mitigative measures included in the proposed action, will protect, by avoiding or minimizing the adverse effects described in Section 3.2 above, in the mainstem Skagit River habitat used by PS Chinook salmon.

## 3.4 STATUTORY RESPONSE REQUIREMENT

As required by Section 305(b)(4)(B) of the MSA, the Federal agency (in this case FERC) must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation from NMFS. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH conservation recommendations, unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, mitigation, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NMFS' Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects [50 CFR 600.920(k)(l)].

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

## 3.5 SUPPLEMENTAL CONSULTATION

FERC must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations [50 CFR 600.920(l)].

# 4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) (the Data Quality Act) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these Data Quality Act (DQA) components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

## 4.1 UTILITY

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this opinion is FERC. Other interested users could include Seattle City Light, local Native American tribes, agencies of the State of Washington, Whatcom and Skagit counties, conservation organizations, and citizens in affected areas. Individual copies of this opinion were provided to FERC. This opinion will be posted on the NMFS Northwest Region web site (http://www.nwr.noaa.gov). The format and naming adheres to conventional standards for style.

## 4.2 INTEGRITY

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

## 4.3 OBJECTIVITY

Information Product Category: Natural Resource Plan.

**Standards:** This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA Regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

**Best Available Information:** This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this biological opinion/EFH consultation contain more background on information sources and quality.

**Referencing:** All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

**Review Process:** This consultation was drafted by NMFS staff with training in ESA and MSA implementation and reviewed in accordance with Northwest Region ESA quality control and assurance processes.

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