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

Refer to NMFS No.:
WCR-2018-10345

March 7, 2019

Jamie Kingsbury
Forest Supervisor
Mt. Baker-Snoqualmie National Forest
2930 Wetmore Avenue, Suite 3A
Everett, Washington 98021

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Forest Service Road (FSR) Repair Projects at FSR 2000-35.4 and FSR 4036-0.1 on the Mt. Baker-Snoqualmie National Forest, Snohomish County, Washington, Sixth Field HUCs: 171100060103 - South Fork Sauk River, and 171100080202 - Upper South Fork Stillaguamish River.

Dear Ms. Kingsbury:

Thank you for your letter of July 18, 2018, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the U.S. Forest Service's (USFS) Repair Projects on FSR 2000-35.4 and FSR 4036-0.1 on the Mt. Baker-Snoqualmie National Forest (MBSNF).

The enclosed document contains the biological opinion (Opinion) prepared by NMFS pursuant to section 7(a)(2) of the ESA to assess the effects of the proposed action. In the Opinion, NMFS concluded that the proposed action is likely to adversely affect but not likely to jeopardize the continued existence of Puget Sound (PS) Chinook salmon and PS Sound steelhead. NMFS also concluded that the proposed action is likely to adversely affect, but is not likely to result in the destruction or adverse modification of designated critical habitat for both of those species.

As required by section 7 of the ESA, NMFS has provided an incidental take statement (ITS) with the Opinion. The ITS describes reasonable and prudent measures (RPM) NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action, and sets forth nondiscretionary terms and conditions that the USFS must comply with to meet those measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA's prohibition against the take of listed species.

NMFS also reviewed the likely effects of the proposed action on essential fish habitat (EFH), pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1855(b)), and concluded that the action would adversely affect the EFH of Pacific Coast Salmon. Therefore, we have included the results of that review in Section 3 of this document.

Please contact Donald Hubner in the North Puget Sound Branch of the Oregon/Washington Coastal Office at (206) 526-4359, or by electronic mail at Donald.Hubner@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Kim W. Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

cc: Richard Vacirca, USFS

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation

for the

FSR 2000-35.4 and FSR 4036-0.1 Repair Projects
Snohomish County, Washington
(Sixth Field HUCs: 171100060103 and 171100080202)

NMFS Consultation Numbers: WCR-2018-10345

Action Agency: U.S. Forest Service, Mt. Baker-Snoqualmie National Forest
U.S. Federal Highways Administration

Affected Species and Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Chinook salmon (*Oncorhynchus tshawytscha*) Puget Sound (PS)	Threatened	Yes	No	Yes	No
steelhead (*O. mykiss*) PS	Threatened	Yes	No	Yes	No

N/A = not applicable. The action area is outside designated critical habitat, or critical habitat has not been designated.

Affected Essential Fish Habitat (EFH) and NMFS' Determinations:

Fishery Management Plan That Describes EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service
West Coast Region

Issued By:

Kim W. Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

Date: March 7, 2019

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LIST OF ACRONYMS and ABREVIATIONS

BA – Biological Assessment
BMP – Best Management Practices
CFR – Code of Federal Regulations
dB – Decibel
DIP – Demographically Independent Population
DPS – Distinct Population Segment
DQA – Data Quality Act
EFH – Essential Fish Habitat
ERFO – Emergency Relief for Federally Owned Roads
ESA – Endangered Species Act
ESU – Evolutionarily Significant Unit
FHWA – Federal Highways Administration
FSR – Forest Service Road
HUC – Hydrologic Unit Code
ITS – Incidental Take Statement
LWD – Large Woody Debris
MBSNF – Mount Baker/Snoqualmie National Forest
mg/L – Milligrams per Liter
MPG – Major Population Group
MSA – Magnuson-Stevens Fishery Conservation and Management Act
NMFS – National Marine Fisheries Service
NTU – Nephlometric Turbidity Units
Opinion – Biological Opinion
OWCO – Oregon Washington Coastal Office
PAH – Polycyclic Aromatic Hydrocarbons
PBF – Physical or Biological Feature
PCB – Polychlorinated Biphenyl
PCE – Primary Constituent Element
PFMC – Pacific Fishery Management Council
PS – Puget Sound
PSSTRT – Puget Sound Steelhead Technical Recovery Team
PSTRT – Puget Sound Technical Recovery Team
QET – Quasi-Extinction Threshold
RL – Received Level
RM – River Mile
RMS – Root Mean Square
RPA – Reasonable and Prudent Alternative
RPM – Reasonable and Prudent Measure
SEL – Sound Exposure Level
SF – South Fork
SL – Source Level
TSS – Total Suspended Sediment
USFS – US Forest Service, US Department of Agriculture
USFWS – US Fish and Wildlife Service

VSP – Viable Salmonid Population
WCR – Westcoast Region (NMFS)
WDFW – Washington State Department of Fish and Wildlife

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 National Marine Fisheries Service (NMFS) prepared the biological opinion (Opinion) and incidental take statement portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 *et seq*.), and implementing regulations at 50 CFR 402.

We also completed an essential fish habitat (EFH) consultation on the proposed action, 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.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). A complete record of this consultation is on file at the Oregon Washington Coastal Office (OWCO) in Lacey, Washington.

1.2 Consultation History

On November 9, 2016, staff from the Mount Baker/Snoqualmie National Forest (MBSNF), US Fish and Wildlife Service (USFWS), and NMFS visited the project sites at Forest Service Road (FSR) 2000-35.4 and FSR 4036-0.1. On July 17, 2018, NMFS received the USFS's request for formal consultation, along with the final draft of the biological assessment (BA) for the proposed repairs at both project sites (USFS 2018a). Formal consultation was initiated on that date.

This Opinion is based on the review of the information and project drawings in the BA; supplemental materials and responses to NMFS questions; recovery plans, status reviews, and critical habitat designations for ESA-listed PS Chinook salmon and PS steelhead; published and unpublished scientific information on the biology and ecology of those species; and relevant scientific and gray literature (see Literature Cited).

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 (50 CFR 402.02). "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 (50 CFR 402.02).

The proposed action consists of the USFS performing road and embankment work within the MBSNF at Forest Service Road (FSR) 2000 near mile marker 35.4 (FSR 2000-35.4) and at FSR

4036-0.1 (Figure 1). The proposed action has been designed, and would be funded, by the Federal Highways Administration (FHWA) under the Emergency Relief for Federally Owned Roads (ERFO) program. No actions that would be interrelated or interdependent with the proposed action were identified by the USFS. However, the proposed action would create a revetment at the FSR 4036-0.1 site that would likely remain on the landscape for decades.

Figure 1. FSR 2000-35.4 and FSR 4036-0.1 project sites in the Mount Baker/Snoqualmie National Forest, in Snohomish County, Washington.

The FSR 2000-35.4 site is located in Snohomish County, about 17 miles south of Darrington, Washington. It is within the Upper Skagit River watershed (HUC-6 171100060103 - South Fork (SF) Sauk River and its tributaries), at the confluence of Chocwich Creek with the SF Sauk River. Between July 20 and August 30, workers would remove rock and wood slide debris from the streambeds of Chocwich Creek and the SF Sauk River and from the road. They would also repair about 60 feet of damaged road, and place large wood debris (LWD) along the streambank of SF Sauk River.

The FSR 4036.01 site is located in Snohomish County, about 7 miles east of Verlot, Washington. It is within the Upper SF Stillaguamish River watershed (HUC-6 171100080202 - Upper SF Stillaguamish River and its tributaries). Between August 1 and August 15, workers would install about 128 feet of log toe revetment along the SF Stillaguamish River, as well as shift the damaged section of road away from the river and repair it.

To reduce the potential for, and intensity of impacts on listed species and their habitat resources, the USFS's contractors are required to comply with the General Provisions and Conservation Measures, the best management practices (BMP), and the site-specific post-construction measures that are identified in the USFS BA for both project sites.

<u>FSR 2000-35.4:</u> At FSR 2000-35.4, the USFS's contractors would work from the road and the streambank. They would use construction equipment such as bull dozers, excavators, back hoes, loading trucks, and chain saws to remove slide debris and reestablish the Chocwich Creek channel close to its pre-slide alignment and dimensions (Figure 2). The contractors would first establish and mark project limits, then mobilize their equipment and materials, and install erosion and pollution prevention controls. They would also install temporary work area isolation with clean sandbags to divert stream flows. Prior to and during installation of the diversion and dewatering of the in the in-water work area, a qualified fish biologist will perform fish salvage activities to remove any fish that may become stranded.

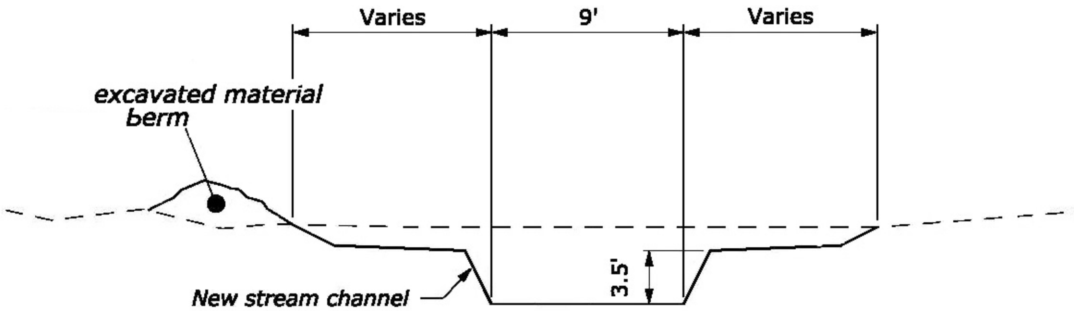

Figure 2. Cross-section drawing of Chocwich Creek upstream of the culvert at FSR 2000-35.4 (adapted from Plan FSR 2000 MP 35.3, USFS 2018b).

Workers would then remove debris from the channel for about 150 feet upstream and 50 feet downstream of the of the existing bottomless culvert that passes under FSR 2000. They would also clear debris from the culvert. Upstream of the culvert, they would use excavated rocks to build about 130 feet of berm with groins along the west side of the creek's outer meander bend. They would also build a 10-foot long rock berm about 235 feet southwest of the culvert to block a small ditch that runs along the southeast side of the road (Figure 3).

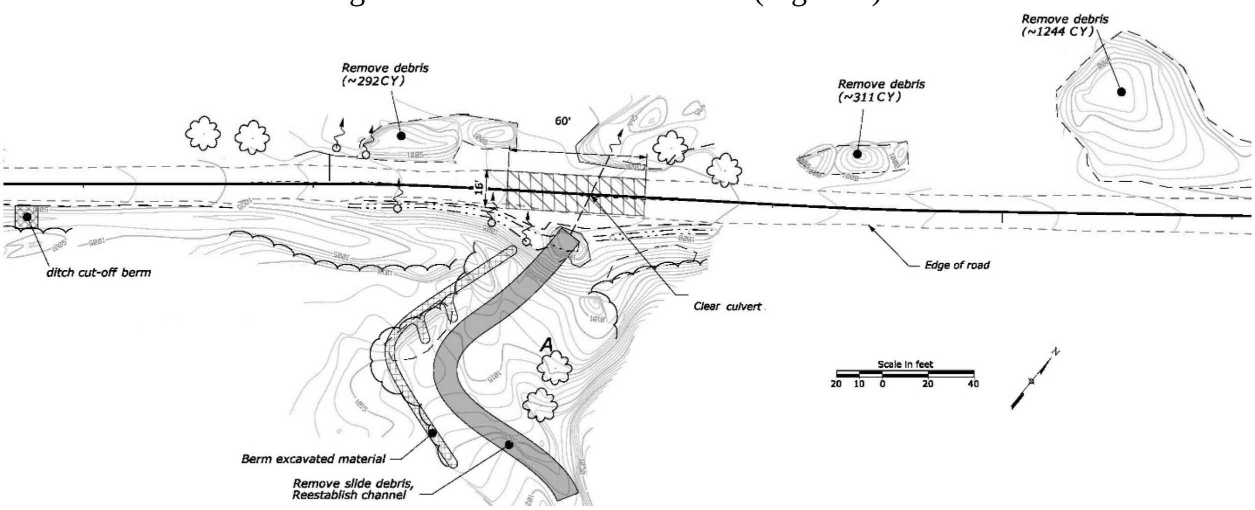

Figure 3. Overhead drawing of the Chocwich Creek project site at FSR 2000-35.4 (adapted from Plan FSR 2000 MP 35.3, USFS 2018b).

Construction crews would operate bucket excavators and other earthmoving equipment to remove rock and wood debris piles from the road and from 3 locations along the northwest side of the road. They would also perform roadwork to restore about 60 feet of damaged gravel roadbed adjacent to the culvert. At 2 sites slightly upstream of the culvert, where the river can be accessed without impacting riparian vegetation, LWD that is removed from the creek and road would be placed above and below the ordinary high water mark (OHWM) and left unanchored along the near bank of SF Sauk River. At the end of the project, workers would remove work area isolation structures, and restore disturbed areas to preconstruction conditions, including re-vegetation with a native seed mix and/or planting of native trees and shrubs that would be largely identical in type and number to those that were removed for construction.

FSR 4036-0.1: At FSR 4036-0.1, the USFS's contractors would work from the road and the streambank. They would use construction equipment such as excavators, back hoes, trucks, chain saws, and various other equipment and tools to construct a log toe revetment along about 128 feet of the SF Stillaguamish River streambank (Figure 4). The contractors would first establish and mark project limits, then mobilize their equipment and materials, and install erosion and pollution prevention controls. They would also install a temporary work area isolation berm to divert stream flows. Prior to and during installation of the diversion and dewatering of the in the in-water work area, a qualified fish biologist will perform fish salvage activities to remove any fish that may become stranded.

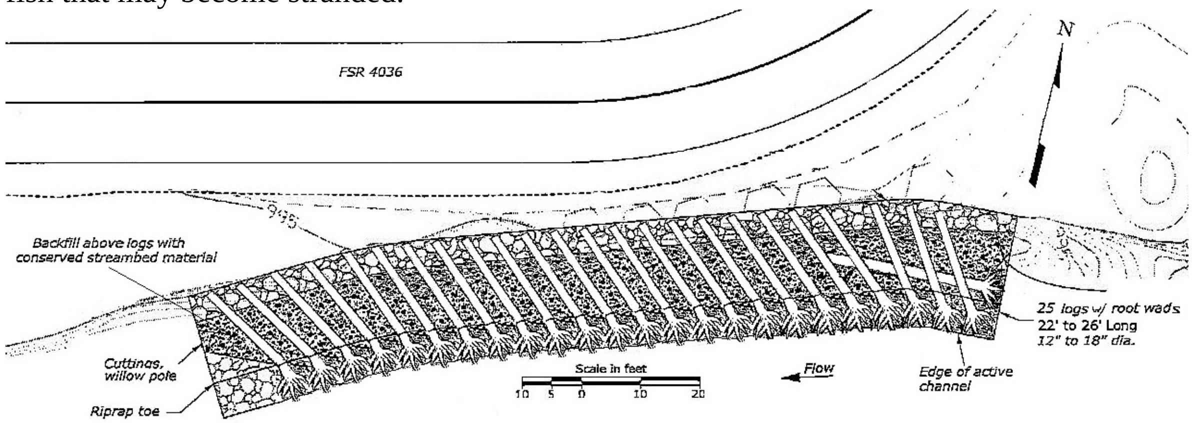

Figure 4. Overhead drawing of the planned revetment along the SF Stillaguamish River at FSR 4036-0.1 (adapted from figure 5 in USFS 2018a).

The contractors would then excavate the bank as needed, install a geotextile layer, and install a rip rap toe. They would install 25 ballasted logs with root wads extending beyond the revetment along its base and over the toe. They would install more rip rap over the logs to form a sloped revetment up to the road level. The logs and lower half of the rip rap would be covered by streambed material. The upper half would be covered by a layer of topsoil. About 115 native willow cuttings would be planted along the length of the revetment (Figure 5).

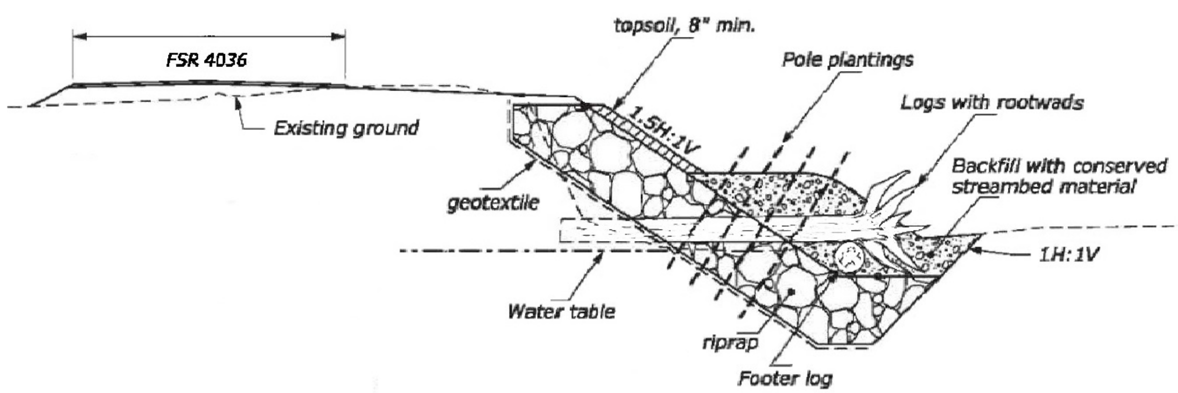

Figure 5. Cut-away drawing of the planned revetment along the SF Stillaguamish River at FSR 4036-0.1 (adapted from figure 6 in USFS 2018a).

Construction crews would perform roadwork to move FSR 4036 5 to 15 feet away from the river. They would obliterate the abandoned road section, and restore the road and its shoulder along the shifted alignment. At the end of the project, workers would remove the work area isolation berm, and restore disturbed areas to preconstruction conditions, including re-vegetation with a native seed mix and/or planting of native trees and shrubs that would be largely identical in type and number to those that were removed for construction.

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 upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provides an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1 Analytical Approach

This biological opinion includes both a jeopardy analysis and/or an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of" a listed species, which is "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). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214).

The designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7414) replace this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ''destruction or adverse modification'' analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or to cause the destruction or adverse modification of designated critical habitat:

- Identify the range-wide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Describe the environmental baseline in the action area.
- Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.
- Describe any cumulative effects in the action area.
- Integrate and synthesize the above factors by: (1) Reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.
- Reach a conclusion about whether species are jeopardized or critical habitat is adversely modified.
- If necessary, suggest a reasonable and prudent alternative (RPA) to the proposed action.

2.2 Range-wide Status of the Species and Critical Habitat

This Opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential PBFs that help to form that conservation value.

The project sites are located in freshwater streams that are occupied by the Puget Sound (PS) Chinook salmon (*Oncorhynchus tshawytscha*) Evolutionarily Significant Unit (ESU) and the PS steelhead (*O. mykiss*) Distinct Population Segment (DPS), which are both currently listed as threatened under the ESA. These streams are also designated as critical habitat for one or both species (70 FR 52630; September 2, 2005 and 81 FR 9252; February 24, 2016) (Table 1).

Table 1. ESA-listed marine species that may be affected by the proposed action.

ESA-listed marine species and critical habitat likely to be adversely affected (LAA)				
Species	**Status**	**Species**	**Critical Habitat**	**Listed / CH Designated**
Chinook salmon (*Oncorhynchus tshawytscha*) Puget Sound	Threatened	LAA	LAA	06/28/05 (70 FR 37160) / 09/02/05 (70 FR 52630)
steelhead (*O. mykiss*) Puget Sound	Threatened	LAA	LAA	05/11/07 (72 FR 26722) / 02/24/16 (81 FR 9252)

The summaries that follow describe the status of the ESA-listed species, and their designated critical habitats, that occur within the action area and are considered in this opinion. More detailed information on the biology, habitat, and conservation status and trend of these listed resources can be found in the recovery plans and other sources at:

http://www.nmfs.noaa.gov/pr/species/fish/ and, and in the listing regulations and critical habitat designations published in the Federal Register and are incorporated here by reference.

Listed Species

Viable Salmonid Population (VSP) Criteria: For Pacific salmonids, we commonly use four VSP criteria (McElhany *et al*. 2000) to assess the viability of the populations that constitute the species. These four criteria (spatial structure, diversity, abundance, and productivity) encompass the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, they maintain a population's capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment.

"Spatial structure" refers both to the spatial distributions of individuals in the population and the processes that generate that distribution. A population's spatial structure depends on habitat quality and spatial configuration, and the dynamics and dispersal characteristics of individuals in the population.

"Diversity" refers to the distribution of traits within and among populations. These range in scale from DNA sequence variation in single genes to complex life history traits.

"Abundance" generally refers to the number of naturally-produced adults that return to their natal spawning grounds.

"Productivity" refers to the number of naturally-spawning adults produced per parent. When progeny replace or exceed the number of parents, a population is stable or increasing. When progeny fail to replace the number of parents, the population is in decline.

For species with multiple populations, we assess the status of the entire species based on the biological status of the constituent populations, using criteria for groups of populations, as described in recovery plans and guidance documents from technical recovery teams. Considerations for species viability include having multiple populations that are viable, ensuring that populations with unique life histories and phenotypes are viable, and that some viable populations are both widespread to avoid concurrent extinctions from mass catastrophes and spatially close to allow functioning as metapopulations (McElhany *et al*. 2000).

The summaries that follow describe the status of the ESA-listed species, and their designated critical habitats, that occur within the geographic area of this proposed action and are considered in this opinion. More detailed information on the status and trends of these listed resources, and their biology and ecology, are in the listing regulations and critical habitat designations published in the Federal Register.

2.2.1 Puget Sound (PS) Chinook Salmon

The PS Chinook salmon evolutionarily significant unit (ESU) was listed as threatened on June 28, 2005 (70 FR 37160). We adopted the recovery plan for this ESU in January 2007. The recovery plan consists of two documents: the Puget Sound salmon recovery plan (SSPS 2007) and a supplement by NMFS (2006). The recovery plan adopts ESU and population level viability criteria recommended by the Puget Sound Technical Recovery Team (PSTRT) (Ruckelshaus *et al*. 2002). The PSTRT's biological recovery criteria will be met when all of the following conditions are achieved:

- The viability status of all populations in the ESU is improved from current conditions, and when considered in the aggregate, persistence of the ESU is assured;
- Two to four Chinook salmon populations in each of the five biogeographical regions of the ESU (Table 1) achieve viability, depending on the historical biological characteristics and acceptable risk levels for populations within each region;
- At least one population from each major genetic and life history group historically present within each of the five biogeographical regions is viable;
- Tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations are functioning in a manner that is sufficient to support an ESU-wide recovery scenario; Production of Chinook salmon from tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations occurs in a manner consistent with ESU recovery; and
- Populations that do not meet all the Viable Salmon Population (VSP) parameters are sustained to provide ecological functions and preserve options for ESU recovery.

<u>General Life History:</u> Adult Chinook salmon spawn in freshwater streams, depositing fertilized eggs in gravel "nests" called redds. The eggs incubate for three to five months before juveniles hatch and emerge from the gravel. Juveniles spend from three months to two years in freshwater before migrating to the ocean to feed and mature. Chinook salmon spend from one to six years in the ocean before returning to their natal freshwater streams where they spawn and then die.

Chinook salmon are divided into two races, stream-types and ocean-types, based on the major juvenile development strategies. Stream-type juveniles rear in freshwater for a year or more before entering marine waters. Conversely, ocean-type juveniles tend to leave their natal streams early during their first year of life, and rear in estuarine waters as they transition into their marine life stage.

Chinook salmon are further grouped into "runs" that are based on the timing of adults that return to freshwater. Early- or spring-run chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and finally spawn in the late summer and early autumn. Late- or fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas, and spawn within a few days or weeks. Summer-run fish show intermediate characteristics of spring and fall runs, without the extensive delay in maturation exhibited by spring-run Chinook salmon.

<u>Spatial Structure and Diversity:</u> The PS Sound Chinook salmon ESU includes all naturally spawning populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington. The ESU also includes the progeny of numerous artificial propagation programs (NWFSC 2015). The PSTRT identified 22 extant populations, grouped into five major geographic regions, based on consideration of historical distribution, geographic isolation,

dispersal rates, genetic data, life history information, population dynamics, and environmental and ecological diversity. The PSTRT distributed the 22 populations among five major biogeographical regions, or major population groups (MPGs), that are based on similarities in hydrographic, biogeographic, and geologic characteristics (Table 2).

Hatchery-origin spawners are present in high fractions in most populations within the ESU, with the Whidbey Basin the only MPG with consistently high fractions of natural-origin spawners. Between 1990 and 2014, the fraction of natural-origin spawners has declined in many of the populations outside of the Skagit watershed (NWFSC 2015).

Table 2. Extant PS Chinook salmon populations in each biogeographic region (Ruckelshaus *et al*. 2002, NWFSC 2015).

Biogeographic Region	Population (Watershed)
Strait of Georgia	North Fork Nooksack River
	South Fork Nooksack River
Strait of Juan de Fuca	Elwha River
	Dungeness River
Hood Canal	Skokomish River
	Mid Hood Canal River
Whidbey Basin	Skykomish River
	Snoqualmie River
	North Fork Stillaguamish River
	South Fork Stillaguamish River
	Upper Skagit River
	Lower Skagit River
	Upper Sauk River
	Lower Sauk River
	Suiattle River
	Upper Cascade River
Central/South Puget Sound Basin	Cedar River
	North Lake Washington/ Sammamish River
	Green/Duwamish River
	Puyallup River
	White River
	Nisqually River

<u>Abundance and Productivity:</u> Available data on total abundance since 1980 indicate that abundance trends have fluctuated between positive and negative for individual populations, but productivity remains low in most populations, and hatchery-origin spawners are present in high fractions in most populations outside of the Skagit watershed. Available data now show that most populations have declined in abundance over the past 7 to 10 years. Further, escapement levels for all populations remain well below the PSTRT planning ranges for recovery, and most populations are consistently below the spawner-recruit levels identified by the PSTRT as consistent with recovery (NWFSC 2015). The current information on abundance, productivity, spatial structure and diversity suggest that the Whidbey Basin MPG is at relatively low risk of extinction. The other four MPGs are considered to be at high risk of extinction due to low

abundance and productivity (NWFSC 2015). The most recent 5-year status review concluded that the ESU should remain listed as threatened (NMFS 2017).

Limiting Factors: Factors limiting recovery for PS Chinook salmon include:

- Degraded floodplain and in-river channel structure
- Degraded estuarine conditions and loss of estuarine habitat
- Riparian area degradation and loss of in-river large woody debris
- Excessive fine-grained sediment in spawning gravel
- Degraded water quality and temperature
- Degraded nearshore conditions
- Impaired passage for migrating fish
- Severely altered flow regime

PS Chinook Salmon within the Action Area: The PS Chinook salmon that occur in the FSR 2000-35.4 action area are from the Upper Sauk River MPG (NWFSC 2015; WDFW 2018a; USFS 2018a). Between 1959 and 2015, the abundance within this population has fluctuated between about 109 and 3,345 individuals, with a relatively flat general trend. About 743 natural spawners were estimated in 2015 (WDFW 2018b). No hatcheries are associated with this population, and natural-origin spawners account for over 90 percent of the population (NWFSC 2015; WDFW 2018b). Both spring- and fall-run fish may be present in the action area (WDFW 2018a; USFS 2018a). Spawning of spring-run fish is documented within the action area in the mainstem SF Sauk River. No fall-run spawning has been documented in the area, but fall-run fish may utilize the rearing and migratory habitat that is present in the action area. Adults of this MPG typically enter the area from April to August. Spawning of spring-run fish typically occurs mid-August through early-September. Juvenile rearing occurs year-round. Juvenile outmigration generally occurs between March and late-July.

The PS Chinook salmon that occur in the FSR 4036-0.1 action area are fall-run fish from the SF Stillaguamish MPG (NWFSC 2015; WDFW 2018a; USFS 2018a). Between 1986 and 2017, the abundance within this population has fluctuated between about 15 and 353 spawners, with a negative general trend. About 133 total spawners were estimated in 2017 (WDFW 2018b). Prior to about 2008 to 2012, natural-origin fish accounted for nearly 100 percent of the population (NWFSC 2015; WDFW 2018b). Since then, hatchery-origin fish have accounted for an ever-increasing proportion of the population such that they accounted for about 60 percent of the return in 2017 (WDFW 2018b). Most documented spawning for this MPG is limited to areas well downstream of the action area (WDFW 2018a). However, there are a few records of Chinook spawning within the action area (USFS 2018a). Spawning typically occurs between mid-September and mid-October in the SF Stillaguamish River. Additionally, the action area provides rearing and migratory habitat.

2.2.2 Puget Sound (PS) Steelhead

The PS steelhead distinct population segment (DPS) was listed as threatened on May 11, 2007 (72 FR 26722). The recovery plan for this DPS is under development. In 2013, the Puget Sound Steelhead Technical Recovery Team (PSSTRT) identified 32 demographically independent populations (DIPs) within the DPS, based on genetic, environmental, and life history characteristics. Those DIPs are distributed among three geographically-based major population groups (MPGs); Northern Cascades, Central and South Puget Sound; and Hood Canal and Strait de Fuca (Myers *et al.* 2015) (Table 3).

Table 3. PS steelhead Major Population Groups (MPGs), Demographically Independent Populations (DIPs), and DIP Viability Estimates (Modified from Figure 58 in Hard *et al.* 2015).

Geographic Region (MPG)	Demographically Independent Population (DIP)	Viability
Northern Cascades	Drayton Harbor Tributaries Winter Run	Moderate
	Nooksack River Winter Run	Moderate
	South Fork Nooksack River Summer Run	Moderate
	Samish River/Bellingham Bay Tributaries Winter Run	Moderate
	Skagit River Summer Run and Winter Run	Moderate
	Nookachamps River Winter Run	Moderate
	Baker River Summer Run and Winter Run	Moderate
	Sauk River Summer Run and Winter Run	Moderate
	Stillaguamish River Winter Run	Low
	Deer Creek Summer Run	Moderate
	Canyon Creek Summer Run	Moderate
	Snohomish/Skykomish Rivers Winter Run	Moderate
	Pilchuck River Winter Run	Low
	North Fork Skykomish River Summer Run	Moderate
	Snoqualmie River Winter Run	Moderate
	Tolt River Summer Run	Moderate
Central and South Puget Sound	Cedar River Summer Run and Winter Run	Low
	North Lake Washington and Lake Sammamish Winter Run	Moderate
	Green River Winter Run	Low
	Puyallup River Winter Run	Low
	White River Winter Run	Low
	Nisqually River Winter Run	Low
	South Sound Tributaries Winter Run	Moderate
	East Kitsap Peninsula Tributaries Winter Run	Moderate
Hood Canal and Strait de Fuca	East Hood Canal Winter Run	Low
	South Hood Canal Tributaries Winter Run	Low
	Skokomish River Winter Run	Low
	West Hood Canal Tributaries Winter Run	Moderate
	Sequim/Discovery Bay Tributaries Winter Run	Low
	Dungeness River Summer Run and Winter Run	Moderate
	Strait of Juan de Fuca Tributaries Winter Run	Low
	Elwha River Summer Run and Winter Run	Low

In 2015, the PSSTRT concluded that the DPS is at “very low” viability; with most of the 32 DIPs and all three MPGs at “low” viability based on widespread diminished abundance, productivity, diversity, and spatial structure when compared with available historical evidence (Hard *et al*. 2015). Based on the PSSTRT viability criteria, the DPS would be considered viable when all three component MPG are considered viable. A given MPG would be considered viable when: 1) 40 percent or more of its component DIP are viable; 2) mean DIP viability within the MPG exceeds the threshold for viability; and 3) 40 percent or more of the historic life history strategies (i.e., summer runs and winter runs) within the MPG are viable. For a given DIP to be considered viable, its probability of persistence must exceed 85 percent, as calculated by Hard *et al*. (2015), based on abundance, productivity, diversity, and spatial structure within the DIP.

General Life History: PS steelhead exhibit two major life history strategies. Ocean-maturing, or winter-run fish typically enter freshwater from November to April at an advanced stage of maturation, and then spawn from February through June. Stream-maturing, or summer-run fish typically enter freshwater from May to October at an early stage of maturation, migrate to headwater areas, and hold for several months prior to spawning in the following spring. After hatching, juveniles rear in freshwater from one to three years prior to migrating to marine habitats (two years is typical). Smoltification and seaward migration typically occurs from April to mid-May. Smolt lengths vary between watersheds, but typically range from 4.3 to 9.2 inches (109 to 235 mm) (Myers *et al*. 2015). Juvenile steelhead are generally independent of shallow nearshore areas soon after entering marine water (Bax *et al*. 1978, Brennan *et al*. 2004, Schreiner *et al*. 1977), and are not commonly caught in beach seine surveys. Recent acoustic tagging studies (Moore *et al*. 2010) have shown that smolts migrate from rivers to the Strait of Juan de Fuca from one to three weeks. PS steelhead feed in the ocean waters for one to three years (two years is again typical), before returning to their natal streams to spawn. Unlike Chinook salmon, most female steelhead, and some males, return to marine waters following spawning (Myers *et al*. 2015).

Spatial Structure and Diversity: The PS steelhead DPS includes all naturally spawned anadromous 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 DPS also includes six hatchery stocks that are considered no more than moderately diverged from their associated natural-origin counterparts (USDC 2014). PS steelhead are the anadromous form of *O. mykiss* that occur below natural barriers to migration in northwestern Washington State (NWFSC 2015). Non-anadromous ‘‘resident’’ *O. mykiss* (a.k.a. rainbow trout) occur within the range of PS steelhead but are not part of the DPS due to marked differences in physical, physiological, ecological, and behavioral characteristics (Hard *et al*. 2015). As stated above, the DPS consists of 32 DIP that are distributed among three geographically-based MPG. An individual DIP may consist of winter-run only, summer-run only, or a combination of both life history types. Winter-run is the predominant life history type in the DPS (Hard *et al.* 2015).

Abundance and Productivity: Available data on total abundance since the late 1970s and early 1980s indicate that abundance trends have fluctuated between positive and negative for individual DIP. However, low productivity persists throughout the 32 DIP, with most showing downward trends, and a few showing sharply downward trends (Hard *et al.* 2015, NWFSC 2015). Since the mid-1980s, trends in natural spawning abundance have also been temporally variable for most DIP but remain predominantly negative, and well below replacement for at least 8 of the DIP (NWFSC 2015). Smoothed abundance trends since 2009 show modest increases for 13 DIP. However, those trends are similar to variability seen across the DPS, where brief periods of increase are followed by decades of decline. Further, several of the upward trends are not statistically different from neutral, and most populations remain small. Nine of the evaluated DIP had geometric mean abundances of fewer than 250 adults, and 12 had fewer than 500 adults (NWFSC 2015). Over the time series examined, the over-all abundance trends, especially for natural spawners, remain predominantly negative or flat across the DPS, and general steelhead abundance across the DPS remains well below the level needed to sustain natural production into the future (NWFSC 2015). The PSSTRT recently concluded that the PS steelhead DPS is currently not viable (Hard *et al.* 2015). The DPS's current abundance and productivity are considered to be well below the targets needed to achieve delisting and recovery. Growth rates are currently declining at 3 to 10% annually for all but a few DIPs, and the extinction risk for most populations is estimated to be moderate to high. The most recent 5-year status review concluded that the DPS should remain listed as threatened (NMFS 2017).

<u>Limiting Factors:</u> Factors limiting recovery for PS steelhead include:

- The continued destruction and modification of steelhead habitat
- Widespread declines in adult abundance (total run size), despite significant reductions in harvest in recent years
- Threats to diversity posed by use of two hatchery steelhead stocks (Chambers Creek and Skamania)
- Declining diversity in the DPS, including the uncertain but weak status of summer run fish
- A reduction in spatial structure
- Reduced habitat quality through changes in river hydrology, temperature profile, downstream gravel recruitment, and reduced movement of large woody debris
- In the lower reaches of many rivers and their tributaries in Puget Sound where urban development has occurred, increased flood frequency and peak flows during storms and reduced groundwater-driven summer flows, with resultant gravel scour, bank erosion, and sediment deposition
- Dikes, hardening of banks with riprap, and channelization, which have reduced river braiding and sinuosity, increasing the likelihood of gravel scour and dislocation of rearing juveniles

<u>PS Steelhead within the Action Area:</u> The PS steelhead that occur in the FSR 2000-35.4 action area are fish from the Sauk River Summer Run and Winter Run DIP (NWFSC 2015; WDFW 2018a; USFS 2018a). The viability of this DIP is considered moderate. WDFW reports that this is a native stock with wild production and no associated hatcheries (WDFW 2018c). No specific abundance numbers are available. However, the 2015 status review reported that since 2010 the DIP has shown a positive abundance trend, but that the population also has a relatively low abundance (NWFSC 2015). Summer-run adults typically enter the river from July to October, and spawn in the mainstem of the Sauk River and the lower reaches of Chocwich Creek between early-March and late-June (USFS 2018a). Winter Run adults typically enter the river between January and March, and spawn between mid-March and mid-June (Myers *et al*. 2015; USFS 2018a). Juveniles are present year round. They likely utilize the lower reaches of Chocwich Creek and the Sauk River mainstem for one to three years for rearing, and for seaward migration between April and mid-May (Myers *et al*. 2015).

The PS steelhead that occur in the FSR 4036-0.1 action area are from the SF Stillaguamish River Winter Run DIP (NWFSC 2015; WDFW 2018a; USFS 2018a). The viability of this DIP is considered low. Between 1985 and 2018, the abundance has fluctuated between about 120 and 2,226 spawners, with a negative general trend. About 422 total spawners were estimated in 2018.

Hatchery fish are present, but no estimates of their proportion within the DIP were given (WDFW 2018c). The 2015 status review reported that natural productivity has been well below replacement for some time, and that the probability that abundance would decline to the quasi-extinction threshold (QET) level within 100 years is between 90 and 100 percent (NWFSC 2015). Winter-run adults typically enter the river from early-November through April. Spawning occurs between mid-March and mid-June, well downstream of the action area. WDFW reports spotty documented presence of winter-run steelhead in the SF Stillaguamish River up and downstream of the project site (WDFW 2018a), and the USFS estimates that adults hold in deeper holes within the project area (USFS 2018a). Juveniles rear in the river for one to three years, and are therefore present in the watershed year-round. They tend to smoltify and make their seaward migration between April and mid-May (Myers *et al*. 2015).

Critical Habitat

This section describes the status of designated critical habitat that would be affected by the proposed action by examining the condition and trends of physical or biological features (PBFs) that are essential to the conservation of the listed species throughout the designated areas. The PBFs are essential because they support one or more of the species' life stages (e.g., sites with conditions that support spawning, rearing, migration and foraging). The proposed project would affect critical habitat for PS Chinook salmon and PS steelhead.

Puget Sound Chinook Salmon Critical Habitat: NMFS designated critical habitat for PS Chinook salmon on September 2, 2005 (70 FR 52630). That critical habitat is located in 16 freshwater subbasins and watersheds between the Dungeness/Elwha Watershed and the Nooksack Subbasin, inclusively, as well as in nearshore marine waters of the Puget Sound that are south of the US-Canada border and east of the Elwha River, and out to a depth of 30 meters. Although offshore marine is an area type identified in the final rule, it was not designated as critical habitat for PS Chinook salmon.

PS steelhead critical habitat: Critical habitat for PS steelhead was designated in 18 freshwater subbasins between the Strait of Georgia Subbasin and the Dungeness-Elwha Subbasin, inclusively. No marine waters were designated as critical habitat for PS steelhead.

The PBFs of salmonid critical habitat include: (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: (i) Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation; (5) Nearshore marine areas free of obstruction and excessive predation with: (i) Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and (6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation. The PBF for PS Chinook salmon and PS steelhead critical habitat are listed in Table 4.

Table 4. Physical or biological features (PBFs) of designated critical habitat for PS Chinook salmon and PS steelhead, and the corresponding life history events. Although nearshore and offshore marine areas were identified in both respective FR, no offshore marine areas were designated as critical habitat for PS Chinook salmon, and neither was designated as critical habitat for PS steelhead.

Physical or Biological Features		
Site Type	**Site Attribute**	**Life History Event**
Freshwater spawning	Water quantity Water quality Substrate	Adult spawning Embryo incubation Alevin growth and development
Freshwater rearing	Water quantity and Floodplain connectivity Water quality and Forage Natural cover	Fry emergence from gravel Fry/parr/smolt growth and development
Freshwater migration	(Free of obstruction and excessive predation) Water quantity and quality Natural cover	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Estuarine	(Free of obstruction and excessive predation) Water quality, quantity, and salinity Natural cover Forage	Adult sexual maturation and “reverse smoltification” Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Nearshore marine	(Free of obstruction and excessive predation) Water quality, quantity, and forage Natural cover	Adult growth and sexual maturation Adult spawning migration Nearshore juvenile rearing
Offshore marine	Water quality and forage	Adult growth and sexual maturation Adult spawning migration Subadult rearing

Major tributary river basins in the Puget Sound basin include the Nooksack, Samish, Skagit, Sauk, Stillaguamish, Snohomish, Lake Washington, Cedar, Sammamish, Green, Duwamish, Puyallup, White, Carbon, Nisqually, Deschutes, Skokomish, Duckabush, Dosewallips, Big Quilcene, Elwha, and Dungeness rivers and Soos Creek. Critical habitat throughout the Puget Sound basin has been degraded by numerous activities, including hydropower development, loss of mature riparian forests, increased sediment inputs, removal of large woody debris (LWD) from the waterways, intense urbanization, agriculture, alteration of floodplain and stream morphology (i.e., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, dredging, armoring of shorelines, marina and port development, road and railroad construction and maintenance, logging, and mining. Changes in habitat quantity, availability, and diversity, and flow, temperature, sediment load and channel instability are common limiting factors of critical habitat throughout the basin.

Land use practices have likely accelerated the frequency of landslides delivering sediment to streams. Fine sediment from unpaved roads also contributes to stream sedimentation. Unpaved roads are widespread on forested lands in the Puget Sound basin, and to a lesser extent, in rural residential areas. Historical logging removed most of the riparian trees near stream channels. Subsequent agricultural and urban conversion permanently altered riparian vegetation in the river valleys, leaving either no trees, or a thin band of trees. The riparian zones along many agricultural areas are now dominated by alder, invasive canary grass and blackberries, and provide substantially reduced stream shade and LW recruitment (SSPS 2007).

Diking, agriculture, revetments, railroads and roads in lower stream reaches have caused significant loss of secondary channels in major valley floodplains in this region. Confined main channels create high-energy peak flows that remove smaller substrate particles and LWD. The loss of side-channels, oxbow lakes, and backwater habitats has resulted in a significant loss of juvenile salmonid rearing and refuge habitat.

Wetlands play an important role in hydrologic processes, as they store water which ameliorates high and low flows. The interchange of surface and groundwater in complex stream and wetland systems helps to moderate stream temperatures. Thousands of acres of lowland wetlands across the region have been drained and converted to agricultural and urban uses, and forest wetlands are estimated to have diminished by one-third in Washington State (FEMAT 1993; Spence *et al*. 1996; SSPS 2007).

Loss of riparian habitat, elevated water temperatures, elevated levels of nutrients, increased nitrogen and phosphorus, and higher levels of suspended sediment, presumably from urban and highway runoff, wastewater treatment, failing septic systems, and agriculture or livestock impacts, have been documented in many Puget Sound tributaries (SSPS 2007).

Peak stream flows have increased over time due to paving (roads and parking areas), reduced percolation through surface soils on residential and agricultural lands, simplified and extended drainage networks, loss of wetlands, and rain-on-snow events in higher elevation clear cuts (SSPS 2007). In urbanized Puget Sound, there is a strong association between land use and land cover attributes and rates of coho spawner mortality likely due to runoff containing contaminants emitted from motor vehicles (Feist *et al*. 2011).

Dams constructed for hydropower generation, irrigation, or flood control have substantially affected PS Chinook salmon populations in a number of river systems. The construction and operation of dams have blocked access to spawning and rearing habitat (*e.g*., Elwha River dams block anadromous fish access to 70 miles of potential habitat) changed flow patterns, resulted in elevated temperatures and stranding of juvenile migrants, and degraded downstream spawning and rearing habitat by reducing recruitment of spawning gravel and LW to downstream areas (SSPS 2007). These actions tend to promote downstream channel incision and simplification (Kondolf 1997), limiting fish habitat. Water withdrawals reduce available fish habitat and alter sediment transport. Hydropower projects often change flow rates, stranding and killing fish, and reducing aquatic invertebrate (food source) productivity (Hunter 1992).

Juvenile mortality occurs in unscreened or inadequately screened diversions. Water diversion ditches resemble side channels in which juvenile salmonids normally find refuge. When diversion headgates are shut, access back to the main channel is cut off and the channel goes dry. Mortality can also occur with inadequately screened diversions from impingement on the screen, or mutilation in pumps where gaps or oversized screen openings allow juveniles to get into the system. Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects are major habitat problems in many Puget Sound tributary basins (SSPS 2007).

The nearshore marine habitat has been extensively altered and armored by industrial and residential development near the mouths of many of Puget Sound's tributaries. A railroad runs along large portions of the eastern shoreline of Puget Sound, eliminating natural cover along the shore and natural recruitment of beach sand (SSPS 2007).

Degradation of the near-shore environment has occurred in the southeastern areas of Hood Canal in recent years, resulting in late summer marine oxygen depletion and significant fish kills. Circulation of marine waters is naturally limited, and partially driven by freshwater runoff, which is often low in the late summer. However, human development has increased nutrient loads from failing septic systems along the shoreline, and from use of nitrate and phosphate fertilizers on lawns and farms. Shoreline residential development is widespread and dense in many places. The combination of highways and dense residential development has degraded certain physical and chemical characteristics of the near-shore environment (HCCC 2005; SSPS 2007).

Critical Habitat within the Action Area: Critical habitat has been designated for PS Chinook salmon, in the SF Sauk River to about 1,100 yards up-stream past the FSR 2000-35.4 project site, but not into Chocwich Creek. Critical habitat has also been designated for PS Chinook salmon, in the Upper SF Stillaguamish River well up- and downstream from the FSR 4036-0.1 project site. The Physical or Biological Features (PBFs) for PS Chinook salmon critical habitat include freshwater spawning sites, freshwater rearing sites, and freshwater migration corridors in both action areas (WDFW 2018a; USFS 2018a).

Critical habitat for PS steelhead has been designated in the SF Sauk River well up- and downstream of the FSR 2000-35.4 project site, and into Chocwich Creek to the culvert under FSR 2000. Critical habitat has also been designated for PS steelhead, in the Upper SF Stillaguamish River well up- and downstream from the FSR 4036-0.1 project site. The PBFs for PS steelhead critical habitat include freshwater spawning sites, freshwater rearing sites, and freshwater migration corridors in both action areas (WDFW 2018a; USFS 2018a).

2.3 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). As described in subsection 1.3, the FSR 2000-35.4 and FSR 4036-0.1 projects would occur on the SF Sauk and Upper SF Stillaguamish Rivers, respectively. As described in the Effects of the Action Section (2.5), construction-related effects would be limited to the in-water area within 300 feet of the project sites. Therefore, the action area for the FSR 2000-35.4 project is considered to be Chocwich Creek and the SF Sauk River within 300 feet of its confluence with the creek. Hydrological impacts from a revetment may extend to the nearest bends in the river. The longest distance to the nearest river bend from the FSR 4036-0.1 project site is about 350 yards downstream from the site. Therefore, the action area for that project is considered to be the Upper SF Stillaguamish River within 350 yards either side of the revetment.

2.4 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).

Environmental conditions in the SF Sauk River watershed: The FSR 2000-35.4 project site is located at the confluence of Chocwich Creek with the SF Sauk River at river mile (RM) 2.04, within the SF Sauk River sub-watershed of the Upper Skagit River watershed. The SF Sauk flows about 12 miles north to its confluence with the North Fork Sauk River, includes about 20 tributary streams, and drains about 123 square miles of the western Cascade Mountains. Average annual precipitation within the watershed is over 100 inches per year, with the majority falling between October and March. Most of the watershed's topography is considered extremely steep, but the lower 3 miles is relatively flat, with a 1 to 4% gradient (USFS 2018a).

Historic land management activities within the Sauk River watershed have included logging, mining, road building, and recreation. Logging has been the dominant land use, peaking between the 1940's and 1980's. However, harvests have been relatively low, at about 4.5% of the watershed, and current harvest activities are limited to commercial thinning. Overall, vegetation conditions in the SF Sauk River drainage are considered good; consisting of about 65% late seral forest. However, riparian conditions are considered moderately degraded since about 30% of the riparian growth has been removed from the mainstem, and the majority of the dominant riparian vegetation is considered immature forest with a canopy cover of 60%. Large woody debris (LWD) levels in the SF Sauk River are low, with a low recruitment potential due to the immature riparian forest.

The SF Sauk River is considered a Class AA stream with good water quality. Water quantity is rated as good, and temperatures are rated as fair to good. Floodplain conditions in the SF Sauk River are also considered good, and road density is low (0.4 miles per square mile in the upper watershed). More than half of the channels in the SF Sauk River are considered stable, but 15 to

20% are deep glacial terraces showing instability due to past forest management, road density, and natural events. Pool habitat in the lower SF Sauk River is considered poor to fair. There are no known significant barriers to anadromous fish passage between the project area and the mouth of the Skagit River at Skagit Bay, about 110 miles downstream.

Based on a 2017 survey of the project area, the aquatic habitat downstream of the culvert in Chocwich Creek consists primarily of low gradient (3 to 4%) pool-riffle that serves as off-channel rearing habitat. The substrate just below the culvert is dominated by gravel and sand, with more cobble and small boulders prevalent close to the confluence of the SF Sauk River. Several small pieces of LWD are present in the creek just downstream of the culvert with several pieces pinned in slide debris. Upstream of the culvert, the stream gradient is about 25%, and the creek is choked by slide debris. Canopy cover is 100% downstream, and 85% upstream of the culvert. The water temperature was 11℃. Riparian vegetation along the stream banks is dominated by red alder and big-leaf maple, with immature western red cedar and western hemlock. The outer riparian zone is dominated by western red cedar and western hemlock. The understory is dominated by salmonberry, stink currant, Devil's club, red elderberry, western sword fern, pig-a-back plant, and lady fern (USFS 2018a).

The past and ongoing anthropogenic impacts described above have reduced the FSR 2000-35.4 action area's ability to support PS Chinook salmon and PS steelhead, but the area continues to provide spawning, rearing, and migratory habitat for both of these species.

<u>Environmental conditions in the SF Stillaguamish River watershed:</u> The FSR 4036.01 project is located on the Upper SF Stillaguamish River near RM 55.3. The SF Stillaguamish River originates at about 6,000 feet, at the top of Del Campo Peak. It drains about 255 square miles of the western Cascade Mountains, and flows about 52 miles westward to its confluence with the North Fork Stillaguamish River. The upper 3 miles of the river flows through ravines and small canyons over steep mountainous terrain. The valley floor begins to flatten and widen slightly at about RM 67. The average annual precipitation within the watershed ranges from about 60 inches in the lowlands, to 160 inches in some of the upper elevations. The majority falls between October and May (USFS 2018a).

Prior to 1954, when a fish ladder was constructed at about RM 34.5, Granite Falls formed a barrier to most anadromous fish migration into the Upper SF Stillaguamish River. Since then, self-sustaining runs above the falls have been marginally successful. A combination of factors that include an inadequate entrance and heavy sediment build up at the mouth continue to limit fish passage through the ladder.

Aquatic habitats within the Upper SF Stillaguamish River watershed have been degraded by historic land management activities that have included logging, mining, road building, and recreation. Logging has been the dominant land use, and was particularly intense in the 1960's through 1980's, including clear-cutting of large areas, and the removal of riparian buffers along many stream channels within the watershed. Currently, vegetation in the drainage consists primarily of second growth western hemlock, Douglas-fir, red alder with occasional western red cedar, Sitka spruce, or big-leaf maple. Vine maple, huckleberries, and salmonberry are common shrubs.

The watershed has a history of rain-on-snow events that combined with reduced forest cover and riparian buffers has caused a combination of landslides and bank erosion that has resulted in a widened and aggraded channel with high levels of sedimentation. The Upper SF Stillaguamish River is generally a transport reach with relatively simple morphology, uniform channel geometry, and low levels of LWD and pool habitat.

Based on a 2017 survey of the project area, the aquatic habitat at the project site consists of relatively low gradient (2 to 3%) pool-riffle habitat. A large scour pool is located at the upstream end of the bank failure, grading into riffle along the bank, then another pool at the end of the eroded bank. The substrate is dominated by small boulder and large cobble with gravel and sand along the stream margins and at pool tail outs. A large downstream pool has a clay layer. LWD jams are present on a channel bar along the bank, across the river downstream from the project site. The predominant riparian trees along the stream banks are red alder, Sitka spruce, western red cedar, western hemlock, and big-leaf maple. The understory consists mostly of Scouler's willow, black cottonwood saplings, and salmonberry. However, the canopy cover over the riffle immediately adjacent to the eroded bank is only about 8%. The Water temperature was 15℃ (USFS 2018a).

The past and ongoing anthropogenic impacts described above have reduced the FSR 4036.01 action area's ability to support PS Chinook salmon and PS steelhead, but the area continues to provide rearing and migratory habitat for both of these species, and spawning habitat for PS Chinook salmon.

<u>Climate Change:</u> Climate change has affected the environmental baseline of aquatic habitats across the region and within the action area. However, the effects of climate change have not been homogeneous across the region, nor are they likely to be in the future. During the last century, average air temperatures in the Pacific Northwest have increased by 1 to 1.4° F (0.6 to 0.8 °C), and up to 2° F (1.1 °C) in some seasons (based on average linear increase per decade; Abatzoglou *et al*. 2014; Kunkel *et al*. 2013). Recent temperatures in all but two years since 1998 ranked above the 20th century average (Mote *et al*. 2013). Warming is likely to continue during the next century as average temperatures are projected to increase another 3 to 10° F (1.7 to 5.6° C), with the largest increases predicted to occur in the summer (Mote *et al*. 2014).

Decreases in summer precipitation of as much as 30% by the end of the century are consistently predicted across climate models (Mote *et al*. 2014). Precipitation is more likely to occur during October through March, less during summer months, and more winter precipitation will be rain than snow (ISAB 2007; Mote *et al*. 2013 and 2014). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007; Mote *et al*. 2014). Models consistently predict increases in the frequency of severe winter precipitation events (i.e., 20-year and 50-year events), in the western United States (Dominguez *et al*. 2012). The largest increases in winter flood frequency and magnitude are predicted in mixed rain-snow watersheds (Mote *et al*. 2014).

The combined effects of increasing air temperatures and decreasing spring through fall flows are expected to cause increasing stream temperatures; in 2015 this resulted in 3.5-5.3°C increases in Columbia Basin streams and a peak temperature of 26°C in the Willamette (NWFSC 2015).

Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua *et al*. 2009).

Higher temperatures will reduce the quality of available salmonid habitat for most freshwater life stages (ISAB 2007). Reduced flows will make it more difficult for migrating fish to pass physical and thermal obstructions, limiting their access to available habitat (Isaak *et al*. 2012; Mantua *et al*. 2010). Temperature increases shift timing of key life cycle events for salmonids and species forming the base of their aquatic foodwebs (Crozier *et al*. 2011; Tillmann and Siemann 2011; Winder and Schindler 2004). Higher stream temperatures will also cause decreases in dissolved oxygen and may also cause earlier onset of stratification and reduced mixing between layers in lakes and reservoirs, which can also result in reduced oxygen (Meyer *et al*. 1999; Raymondi *et al*. 2013; Winder and Schindler 2004). Higher temperatures are likely to cause several species to become more susceptible to parasites, disease, and higher predation rates (Crozier *et al*. 2008; Raymondi *et al*. 2013; Wainwright and Weitkamp 2013).

As more basins become rain-dominated and prone to more severe winter storms, higher winter stream flows may increase the risk that winter or spring floods in sensitive watersheds will damage spawning redds and wash away incubating eggs (Goode *et al*. 2013). Earlier peak stream flows will also alter migration timing for salmon smolts, and may flush some young salmon and steelhead from rivers to estuaries before they are physically mature, increasing stress and reducing smolt survival (Lawson *et al*. 2004; McMahon and Hartman 1989).

The adaptive ability of these threatened and endangered species is depressed due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. Without these natural sources of resilience, systematic changes in local and regional climatic conditions due to anthropogenic global climate change will likely reduce long-term viability and sustainability of populations in many of these ESUs (NWFSC 2015). New stressors generated by climate change, or existing stressors with effects that have been amplified by climate change, may also have synergistic impacts on species and ecosystems (Doney *et al*. 2012). These conditions will possibly intensify the climate change stressors inhibiting recovery of ESA-listed species in the future.

2.5 Effects of the Action on Species and Designated Critical Habitat

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species, 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). Direct effects are caused by exposure to action-related stressors that occur at the time of the action. Indirect effects are effects caused by the proposed action that occur later in time but are still reasonably certain to occur.

As described in Section 1.3, the USFS's project would remove rock and wood slide debris from the streambeds of Chocwich Creek and the SF Sauk River, repair about 60 feet of damaged road, and place LWD along the streambank of SF Sauk River at the FSR 2000-35.4 site. It would also install about 128 feet of log toe revetment along the SF Stillaguamish River, and shift the road away from the river at the FSR 4036.01 site. Work at both sites includes work area isolation with fish removal, as well as planting of native riparian vegetation.

Work would be done between July 20 and August 30 for the FSR 2000-35.4 project, and between August 1 and August 15 for the FSR 4036.01 project. Work at both sites would include heavy equipment such as excavators and trucks that would be operated from the road and/or riverbanks above the waterline, as well as handheld power tools. The USFS's contractors are required to comply with the General Provisions and Conservation Measures, the BMP, and the site-specific post-construction measures that are identified in the USFS BA.

As described in Section 2.2, PS Chinook salmon and PS steelhead inhabit the action areas for both project sites. Additionally, critical habitat has been designated for both species at both sites. The planned work windows at both sites overlap with returning adults and rearing juveniles of both species. The FSR 2000-35.4 work window also overlaps with spring-run Chinook salmon spawning in the SF Sauk River.

Construction is likely to cause direct effects through fish salvage activities, construction-related noise and activity, and water quality impacts. It may also cause indirect effects through impacts on riparian vegetation. The new revetment along FSR 4036.01 would likely remain on the landscape for decades. The revetment is reasonably certain to cause effects on the species and critical habitats identified above through structure-related impacts on biological and hydrological processes.

2.5.1 Effects on List Species

Construction-related Fish Salvage:

Fish salvage during work area isolation is likely to adversely affect juvenile PS Chinook salmon and PS steelhead, but would cause minor effects on adults of both species should they be present during construction.

After installation of the work area isolation barrier, and prior to dewatering, a trained biologist or technician would make several passes through the isolation area with a fine-mesh herding net to drive fish out from behind the isolation barrier and into the river. Any adult fish that may be present are extremely likely to leave the area during herding, as are most juvenile fish that may be present. Exposure to herding may cause short-term minor effects on the normal behaviors of exposed fish, but it is extremely unlikely to cause detectable effects on their fitness.

Small fish that remain within the isolation barrier after multiple passes with the herding net would likely be exposed to electrofishing, capture with dip nets, and possible entrainment or impingement from dewatering pumps. The risk of entrainment or impingement during the de-watering of the isolation areas is considered extremely unlikely because most few if any fish would be remain in the affected area, and the pump intakes would be isolated and screened to prevent entrainment or impingement of fish. However, any fish that remain in the isolation area following dewatering would likely die from dehydration and asphyxiation.

Captured fish would experience stress and may experience trauma and mortality. Capture and handling of fish causes physiological stress responses (Moberg 2000; Shreck 2000). Fish may also experience stress and injury from overcrowding in traps. Contact with nets may cause scale and skin damage. Electrofishing causes effects that range from increased respiratory action to mortality under certain conditions (Dalbey *et al*. 1996; Emery 1984; Snyder 2003). Small fish can also experience physical trauma if care is not taken during the various handling and transfer processes once captured.

The primary contributing factors to stress and mortality from handling are: (1) Water temperature difference between the stream and the holding buckets; (2) dissolved oxygen levels; (3) the amount of time that fish are held out of the water; and (4) physical trauma. Stress from handling increases rapidly if water temperature exceeds 18ºC (64ºF), or if dissolved oxygen is below saturation. Debris buildup in traps can also injure or kill fish. Common BMP related to fish capture and relocation reduce the potential for most of these consequences, and reduce resulting stress (Portz 2007).

Dalbey *et al*. (1996), Emery (1984), and Snyder (2003) describe responses that range from muscular contractions to mortality from exposure to electrofishing. Depending on the pulse train used, and the intensity and duration of exposure, muscular contractions may cause a lactic acid load and oxygen debt in muscle tissues (Emery 1984), it can cause internal hemorrhage and spinal fractures in 12 to 54% of the exposed fish, and acute mortality in about 2% (Dalbey *et al*. 1996). Severe interruption of motor function can stop respiration, and combinations of lactic acid load and oxygen debt may be irreversible, causing delayed mortality in apparently healthy fish. Obvious physical injuries often lead to reduced long-term growth and survival, whereas uninjured to slightly injured fish showed long-term growth and survival rates similar to unexposed fish of similar age (Dalbey *et al*. 1996). To reduce the effects of electrofishing, the USFS's contractors would use electrofishing only after multiple net passes within the isolation area yield no fish, and they would adhere to the BMP identified in the BE.

The USFS estimates that a maximum of 12 juvenile Chinook salmon and 20 juvenile steelhead may be exposed to salvage activities at the FSR 2000-35.4 site, and 20 juvenile Chinook salmon and 35 juvenile steelhead may be exposed to salvage activities at the FSR 4036.01 site. A recent Opinion completed for restoration activities in the Pacific Northwest Region (NMFS 2013) estimated that up to 5% of the captured fish would be seriously injured or killed by the activity.

Based on the USFS estimates and the expectation that 5 percent of the captured fish may be killed, fish salvage may kill up to 1 juvenile Chinook salmon and 1 juvenile steelhead at the FSR 2000-35.4 site, and 1 juvenile Chinook salmon and 2 juvenile steelhead at the FSR 4036.01 site. The remaining fish would likely experience sub-lethal effects that are unlikely to affect their fitness or survival. The fish that may be injured or killed by this stressor would comprise such small subsets of their respective cohorts, that their loss would cause no detectable population-level effects.

Construction-related Noise and Activity:

Exposure to construction-related noise is likely to adversely affect PS Chinook salmon and PS steelhead. Studies indicate the effects on fish that are exposed to noise vary with the frequency, intensity, and duration of the exposure, the hearing characteristics of the exposed fish, and the context under which the exposure occurs. At low levels, effects may include the onset of behavioral disturbances such as acoustic masking (Codarin *et al*. 2009), startle responses and altered swimming (Neo *et al*. 2014), abandonment or avoidance of the area of acoustic effect (Picciulin *et al*. 2010; Mueller 1980; Sebastianutto *et al*. 2011; Xie *et al*. 2008) and increased vulnerability to predators (Simpson *et al*. 2016). At higher intensities and/or longer exposure durations, the effects may rise to include temporary hearing loss (Scholik and Yan 2002) and increased stress (Graham and Cooke 2008). At even higher levels, exposure may lead to physical injury that can range from the onset of permanent hearing damage (a.k.a. permanent threshold shift or PTS) and mortality.

Elevated in-water noise from excavation and installation of rock rip rap is likely to cause detectable effects in exposed fish. The best available information to describe the in-water noise levels that are likely to be caused by this project is a recent study that measured the in-water noise from excavator dredging of rocks (Reine *et al*. 2012). They report that the source level (sound level at 1 meter from the source) for the excavator bucket scooping rocks was about 179 dB_{RMS}. Based on the relationship between dB_{RMS}, dB_{peak}, and dB_{SEL} for impulsive sources, dB_{peak} is often about 16 dB higher than dB_{RMS}, while dB_{SEL} is typically about 10 dB lower. Based on this, NMFS estimates that excavation and rip rap installation could cause sound levels of up to 194 dB_{peak} and 169 dB_{SEL}.

The criteria currently used by NMFS to estimate the onset of injury for fish exposed to high intensity impulsive sounds uses two metrics: 1) exposure to 206 dB_{peak}; and 2) exposure to 187 dB SEL_{cum} for fish 2 grams or larger, or 183 dB SEL_{cum} for fish under 2 grams; or exposure above 150 dB_{SEL}. Any RL below 150 dB_{SEL} is considered “Effective Quiet”. The distance from a source where the RL drops to 150 dB_{SEL} is considered the maximum distance from that source where fishes can be affected by the noise, regardless of accumulation of the sound energy (Stadler and Woodbury 2009). Therefore, when there is a difference between the ranges to the isopleths for effective quiet and SEL_{cum}, the shorter range shall apply.

The maximum expected peak source level is well below the 206 dB_{peak} threshold. The number of impulsive events that may occur from a day’s worth of construction is impossible to estimate, but the number is likely to be enormous. Therefore, the SEL_{cum} threshold would likely exceed that of effective quiet. If not, the use of effective quiet would over-estimate the area of effect. Therefore, use of effective quiet to estimate the range of acoustic effects for this project would be protective of listed fish.

A commonly used formula to estimate sound attenuation with distance due to the combination spreading, scattering, and absorption is: RL = SL – #Log(R) (RL = received level (dB), SL = source level (dB), # = spreading coefficient (typically between 10 and 20), and R = range in meters). In the absence of site-specific information, NMFS typically uses the practical spreading loss coefficient of -15 for work in shallow water with relatively low spreading loss, but higher rates of scattering and absorption. Applying 169 dB_{SEL} SL to the formula suggests that sound levels above the 150 dB_{SEL} effective quiet threshold would extend to about 61 feet (18.5 m) around excavation and rip rap installation (area of acoustic effect).

The most likely effect of exposure to construction-related noise would be temporary minor behavioral effects, such as avoidance of the area within about 61 feet around the individual project sites. Although the exposure may delay the migration of adults past the project sites, exposure would cause no measurable effects on the fitness of exposed adults, and avoidance of the areas would not affect access to or from spawning habitat due to the project locations and the timing of the work.

The exposure is extremely unlikely to cause any measurable effects on the fitness of exposed adults. The most likely effect of exposure would be temporary avoidance of the affected area. However, some adult spring-run Chinook salmon may avoid spawning habitat within the area of acoustic effect during debris removal in the SF Sauk River (FSR 2000-35.4 site). The impact that the avoidance may have on the spawning success for affected individuals is uncertain, but would likely be too small to cause any detectable population-level effects.

The juvenile Chinook salmon and steelhead that may be present during construction are more likely to remain in familiar rearing habitats than to migrate past the area like most returning adults. Juveniles that are within the area of acoustic effect are likely to experience behavioral disturbance, such as acoustic masking, startle responses, altered swimming patterns, avoidance, and increased risk of predation. Individuals that remain within the area of acoustic effect long enough to accumulate sound energy in excess of the 183/187 dB SEL_{cum} threshold may also experience some level of auditory- and non-auditory tissue injury, which could reduce their likelihood of survival. The number of individuals of either species that may be impacted by this stressor is unquantifiable with any degree of certainty. However, given the small amount of habitat that would be affected at both sites, and the expectation that the density of stream-type juvenile Chinook salmon and juvenile steelhead in the area is low, the numbers of fish that may be affected by this stressor would comprise such small subsets of their respective cohorts, that their loss would cause no detectable population-level effects.

Construction-related Water Quality Impacts:

Exposure to construction-related degraded quality would cause minor effects in PS Chinook salmon and PS steelhead. Water quality would be temporarily affected by increased turbidity that may also reduce dissolved oxygen (DO) levels. It may also be affected by the introduction of toxic materials.

Turbidity: Turbidity plumes are likely to be caused by bottom sediments that are mobilized by in-water work during installation and removal of work area isolation barriers, debris removal, revetment construction, and possible project site runoff. However, those plumes would likely be localized and short-lived, and consist of low concentrations of total suspended sediments (TSS).

The intensity of turbidity is typically measured in Nephlometric Turbidity Units (NTU), which describes the opacity caused by the suspended sediments. Whereas, TSS concentrations are typically measured in milligrams per liter (mg/L). A strong positive correlation exists between turbidity and the concentration of TSS (mg/L). Depending on the particle sizes, NTU values roughly equate to the same number of mg/L for TSS concentration (i.e. 10 NTU = ~ 10 mg/L TSS, and 1,000 NTU = ~ 1,000 mg/L TSS) (Campbell Scientific Inc. 2008; Ellison *et al*. 2010). Therefore, the two units of measure can be easily compared.

Water quality is considered adversely affected by suspended sediments when turbidity is increased by 20 NTU for a period of 4 hours or more (Berg and Northcote 1985; Robertson *et al*. 2006). The effects on fish exposed to suspended sediments are somewhat species and size dependent. In general, severity typically increases with sediment concentration and duration of exposure, and decreases with the increasing size of the fish. At concentration levels of about 700 to 1,100 mg/l, minor physiological stress is reported in juvenile salmon only after about three hours of continuous exposure (Newcombe and Jensen 1996).

No specific information is available to describe the intensity and duration of the turbidity plumes that are likely to be cause by the installation and removal of the work area isolation barriers. Bloch (2010) described the turbidity plumes that were caused by the removal of hollow 30-inch steel piles in Lake Washington. Turbidity was caused by sediments that adhered to the piles as they were drawn up and through the water column, with much of the mobilized sediments being material that fell out of the hollow piles. Turbidity reached a peak of about 25 NTU (~25 mg/L) above background levels at 50 feet from the pile, and about 5 NTU (~5 mg/L) above background at 100 feet. Turbidity returned to background levels within 30 to 40 minutes. Pile installation created much lower turbidity. The installation and removal of work area isolation barriers for this project is likely to mobilize far less sediment than the piles described above, because it would involve no digging of the substrate.

Debris removal, bank excavation, and revetment construction could mobilize large amounts of sediments. However, that work would be done behind dewatered work area isolation barriers that would contain the vast majority of mobilized sediments. Further, the project includes required turbidity monitoring, with shut-down and correction required if turbidity exceeds State standards. The project also includes required measures to protect against mobilized sediments reaching the rivers due to erosion and runoff from upland work. At most, the USFS estimates that detectable turbidity would be limited to the stream reach within 300 feet downstream of the project sites.

Should any PS Chinook salmon or PS steelhead be exposed to project-related turbidity, the duration of their exposure would likely be measured in minutes, and the plume concentrations would most likely be too low to cause more than temporary, non-injurious behavioral effects such as avoidance of the plume, mild gill flaring (coughing), and slightly reduced feeding rates. None of the potential responses, individually, or in combination would affect the fitness or normal behaviors in exposed fish.

<u>Dissolved Oxygen (DO):</u> Mobilization of anaerobic sediments can decrease dissolved oxygen (DO) levels (Hicks *et al*., 1991; Morton 1976). The impact on DO is a function of the oxygen demand of anaerobic sediments that may be present, the amount of material suspended in the water, the duration of suspension, and the water temperature (Lunz and LaSalle 1986; Lunz *et al*. 1988). Impacts tend to be more severe lower in the water column (LaSalle 1988). Avoidance of

water with DO levels below 5.5 mg/l has been observed in salmon (Hicks 1999). Avoidance could drive fish from preferred forage areas or from shelter and thereby increase the risk of predation. Reduced DO can also affect swimming performance in salmonids (Bjornn and Reiser 1991), which may reduce an affected fish's ability to forage and to escape predation.

As described above, the vast majority of sediment mobilization would occur behind the work area isolation barriers that would exclude fish. Very little of the sediment-affected water is likely to leak past the barrier. Further, well-oxygenated water in the stream flow outside of the barriers would quickly dilute the small volumes of affected water that may leak past the barriers. This suggests that DO reductions would likely be too small and short-lived to cause detectable effects on the fitness or normal behaviors in fish that may be exposed to the affected water.

<u>Toxic Materials:</u> Construction related spills and discharges may introduce toxic materials to the water. PS Chinook salmon and PS steelhead can uptake contaminants directly through their gills, and through dietary exposure (Karrow *et al*. 1999; Lee and Dobbs 1972; McCain *et al*. 1990; Meador *et al*. 2006; Neff 1982; Varanasi *et al*. 1993). Some of the petroleum-based fuels, lubricants, and other fluids used by construction-related equipment contain Polycyclic Aromatic Hydrocarbons (PAHs). Sediment contaminants can include metals, pesticides, PAHs, Polychlorinated Biphenyls (PCBs), phlalates, and other organic compounds. Depending on the pollutant, its concentration, and/or the duration of exposure, exposed fish may experience effects that can range from avoidance of an affected area, to reduced growth, altered immune function, and mortality (Brette *et al*. 2014; Feist *et al*. 2011; Gobel *et al*. 2007; Incardona *et al*. 2004, 2005, and 2006; Mcintyre *et al*. 2012; Meadore *et al*. 2006; Sandahl *et al*. 2007; Spromberg *et al*. 2015).

The project includes a comprehensive suite of BMPs to reduce the risk and intensity of construction-related discharges. In the unlikely event of a construction-related spill or discharge, the amount of material released would likely be very small, and it would be quickly contained and cleaned up. Also, many of the fuels and lubricants that are used for this type of work would evaporate relatively quickly, so their residence time in the water would be brief. Further, non-toxic and/or biodegradable lubricants and fluids are strongly encouraged by the State, and are commonly used by many of the local contractors. Therefore, the in-water presence of construction-related contaminants would be very infrequent, very short-lived, and at concentrations too low to cause detectable effects on fitness or normal behaviors in exposed fish.

<u>Construction-related Reduced Riparian Vegetation:</u>

Construction related removal of riparian vegetation would cause minor effects in PS Chinook salmon and PS steelhead. Construction would require the removal some riparian vegetation at both sites. Although both affected areas would be replanted with native vegetation virtually identical to the vegetation that would be removed, it will take several years to decades before the replacement vegetation provide ecological functions equitable to pre-construction levels.

Reduced riparian vegetation can alter in-stream chemical and biological functions. Chemical processes involve inputs of thermal energy and organic matter, as well as linkages to terrestrial food webs, the retention and export of nutrients and nutrient cycling in the aquatic food web, and gas exchange (Beechie *et al*. 2010). Biological processes include aquatic and riparian plant and animal growth, and community development and succession, which establish the biodiversity and influence the life histories of aquatic and riparian organisms (Harman *et al*. 2012).

Reduced riparian vegetation can increase input of solar radiation to the water (insolation), which can raise temperatures and reduce dissolved oxygen. Specific vegetation removal is not described as part of the planned work at either site. However, access to some areas of the FSR 2000-35.4 site is likely to require the removal of a low number of trees and shrubs in scattered patches along about 200 feet of Chocwich Creek. Clearing and revetment construction at the FSR 4036.01 site would cause the removal of a low number of trees and shrubs along about 130 feet of riverbank on the SF Stillaguamish River.

The patchy removal of vegetation along Chocwich Creek may slightly increase summer-time insolation in small areas, and may occasionally cause very slight increases in-water temperatures. The temperature increases that may result at the site are not predictable with any degree of certainty. However, due to the very small size of the affected area, and the relatively large volume of water cold water that flows past the site, increases would likely be too small to cause detectable effects on the fitness or normal behaviors for any life stage of Chinook salmon and steelhead in the action area. Riparian impacts at the FSR 4036.01 site are unlikely to cause any detectable shade-related effects because the sun is always to the south of the site, and the affected area is on the north side of the river. Therefore, the existing vegetation provides very little over-water shade at any time of the year.

Removal of streambank vegetation also reduces the input of terrestrial-origin leaf litter, insects, and woody debris to streams. Many terrestrial insects are forage for salmonids, while vegetative matter often provides cover. Terrestrial organic matter is also important to nutrient cycling in aquatic food webs that support aquatic algae and invertebrates that are important resources for juvenile salmonids. At both sites, riparian impacts would slightly reduce the input of terrestrial-origin organic matter until the riparian vegetation returns to pre-construction levels of growth. However, due to the very small size of the affected areas, the input of terrestrial material in the adjacent stream reaches at both project sites, and the diluting effects of flowing water, the impacts on aquatic food webs attributable to the planned construction would likely be too small to cause detectable effects on the fitness or normal behaviors for any life stage of Chinook salmon and steelhead in the action area.

Structure-related Impacts:

The new revetment at the FSR 4036.01 site would cause habitat conditions that are likely to cause indirect adverse effects on PS Chinook salmon and PS steelhead through alteration of hydrological and biological processes. Riverine habitats are the product of physical, chemical, and biological processes that interact together to form and maintain the streams (Fischenich 2003). Physical processes involve the interaction of hydrological forces with the substrate and objects in the streambed that drive geomorphic adjustments in the channel, floodplain, and riparian habitats. Chemical processes involve inputs of organic matter, retention and export of nutrients and thermal energy, nutrient cycling in the aquatic food web, linkages to terrestrial food webs, and gas exchange (Beechie *et al*. 2010). Biological processes include aquatic and riparian plant and animal growth, and community development and succession, which establish the biodiversity and influence the life histories of aquatic and riparian organisms (Harman *et al*. 2012).

Hydrological Impacts: Under natural conditions, the physical shape and structure of a channel is ever-evolving in response to the interaction between the native substrate, the volume and velocity of water flow, sediment loads, and the availability of large wood. Changes in any of these can alter erosion and deposition rates that drive geomorphic adjustments that can change the channel alignment and depth, as well as drive side channel formation or abandonment. It can also alter the exposed substrate (rock, gravel, sand, or mud bottoms), and cause changes in the presence of large wood.

By design, bank stabilization structures replace dynamic natural processes with a set of semi-permanent conditions that prevent natural channel migration past the structure and alter fundamental channel and aquatic habitat formation processes (Cramer 2012). Revetments redirect water flows, which often increase erosion upstream and/or downstream of the revetment.

At stabilized bank sites, water flows also continue to cut into the revetments themselves, so most revetments require periodic maintenance and repair to prevent bank failure. The process often leads to an ever-steepening bank, and a simplified aquatic habitat with reductions in velocity diversity, depth diversity, substrate diversity, large wood recruitment and retention, stream bank roughness, and edge habitat features such as undercut banks and alcove habitats (Fischenich 2003; Pracheil 2010). Altered flows may also cause unexpected changes in the physical processes upstream and downstream from the structure that alter sediment recruitment and transport in the streambed, and may discourage the formation of complex off-channel habitats within the affected stream reaches. Also, because the revetments are intended to prevent bank failure, it is doubtful that the affected banks would ever again contribute to large wood to their rivers, which would impact natural streambed and bank formation processes.

Due to the complex relationships between the processes that are involved, it is virtually impossible to predict and quantify the exact effects that this action's new revetment at the FSR 4036.01 site would have on stream hydrology, geomorphology, and habitat forming processes in the SF Stillaguamish River. The new 128-foot long rip rap revetment would include 25 ballasted logs with root wads that would extend beyond the base and over the revetment toe. The lower half of the rip rap face, including most of the logs' exposed lengths, would be covered by a thick layer of natural streambed material. Above that, the rip rap would be covered by a minimum of 8 inches of topsoil (Figures 4 & 5). About 115 native willow cuttings would be planted into the streambed material along the length of the revetment.

The logs and root wads are expected to reduce flow velocities and may allow for some natural processes to occur, such as the accumulation of large wood and sediments along the length of the revetment. However, northward channel migration would be prevented at the site, and the new structure may cause some changes in upstream and downstream erosion and deposition patterns that may not have occurred in the absence of a revetment. This may include reduction in the sizes and depths of the pools that presently exist up- and downstream of the project site.

Based on the available information, the planned revetment would prevent channel migration past it into the foreseeable future. It would also likely alter erosion, sediment transport and deposition, and movement of LWD within the nearest bends in the SF Stillaguamish River, which may alter or discourage the formation of spawning habitats and complex off-channel habitats within the affected stream reach. These impacts may reduce the affected reach's ability to support salmonid spawning and rearing. Given the small size of the revetment, its influence on channel dynamics and channel forming processes are expected to be relatively small. Therefore, the resulting negative effects on habitat forming processes is also expected to be relatively small, and the revetment's influence on those processes will likely decrease with distance from the site and with increasing size of flood events. However, over the life of the structure low numbers of individual PS Chinook salmon and PS steelhead are likely to be adversely affected by the altered conditions, as described in more detail below.

Biological Impacts: The exact impacts the revetment would have on in-stream chemical and biological processes are uncertain, but likely includes temporarily reduced input of terrestrial-origin organic material, and may include simplified aquatic habitat and increased exposure to predators.

Separate from the construction-related removal of riparian vegetation discussed earlier, the revetment structures themselves would greatly limit or prevent the growth of riparian vegetation along the lengths of the revetments. The new revetment at the FSR 4036.01 site would likely limit the growth of riparian vegetation between the road and the SF Stillaguamish River. Also, it is extremely doubtful that the site would ever again contribute large wood to the river. Given the small size of the affected area, the site's location and orientation relative to the surrounding landscape and riparian vegetation, and the high rate of water exchange past the affected area, the impacts on water temperatures and input of terrestrial-origin organic material would likely be too small to cause detectable effects on individual PS Chinook salmon and PS steelhead.

As stated above, the revetment would alter habitat conditions at its location, and possibly in other areas within the nearest bends in the SF Stillaguamish River. Juvenile salmonids tend to aggregate more densely in edge habitats than in the center of rivers where adult salmonids occur in greater numbers (Washington Trout 2006). They also rely on off-channel habitats for rearing and refugia during high flow events. Studies also show that juvenile salmonids tend to select natural banks over hardened ones, and that the habitat provided by armored banks is typically degraded as compared to natural banks. Juvenile Chinook salmon are consistently more abundant along natural banks with wood, cobble, boulder, aquatic plants, and/or undercut bank cover compared than they are along rip rap banks (Beamer and Henderson 1998; Peters *et al.* 1998). In a study of 667 bank stabilization structures of various designs in Washington State, fish densities were generally positively correlated with increased amounts of large woody debris and overhead vegetation within 30 cm of the water surface. Fish densities under those conditions were also consistently higher than those at the control sites. Conversely, fish densities at sites that were stabilized by rip rap alone were consistently lower than at control sites (Peters *et al.* 1998). The planned revetment is designed to reduce the effects of exposed rip rap. However, the available information suggests that some rearing and migrating juvenile salmonids will selectively avoid the revetment in favor of undisturbed habitat.

Displaced individuals may experience decreased fitness from increased competition, which may reduce their likelihood of their survival. Juveniles that remain in the habitat adjacent to the revetment may experience decreased fitness and reduced likelihood of survival due to the suboptimal forage resources that may exist there, particularly during the first years following construction, and from the increased energetic costs that are caused by foraging in suboptimal habitat (Heerhartz and Toft 2015). The intensity of effect that any individual may experience due to exposure to altered habitat conditions at the project site is uncertain. Over time, the design of the FSR 4036.01 revetment may act to lessen these impacts. However, over its life, low numbers of juvenile PS Chinook salmon and PS steelhead are likely to experience some level of reduced fitness and/or altered normal behaviors due to the conditions that would be caused the revetment.

Over the life of the revetment, erosion is reasonably likely to expose some of the revetment's underlying rip rap. Should that occur, juvenile salmonids may experience increased exposure and vulnerability to predation. The habitat that is created by a rip rap revetment is often preferred by predatory species such as sculpins and trout. Sculpins are highly sedentary benthic fish that prey on salmonid eggs and juveniles. They prefer fast flowing, well oxygenated water, and unembedded rock and cobble substrate provide nesting cavities (Edwards and Cunjak 2007). Trout larger than 200mm were found at greater densities along rip rap than along natural banks (Peters *et al.* 1998), suggesting possible increased levels of trout predation on juvenile salmonids near rip rap. Further, armoring typically steepens banks, which places juvenile salmon in deeper waters where predators are more able to swim. Willette (2001) found that piscivorous predation of juvenile salmon increased fivefold when the juvenile salmon were forced to leave shallow nearshore habitats. Although this study was done in marine waters, it is reasonable to expect that a similar increase in predation would occur in freshwater systems under similar conditions. Over the life of the revetment, low numbers of juvenile PS Chinook salmon and PS steelhead may experience reduced fitness and mortality due to increased exposure to predators related to the revetment's rip rap.

The number of individuals of either species that may be adversely affected by structure-related impacts is unquantifiable with any degree of certainty. However, based on the small size and location of the planned revetment, the numbers of affected fish would comprise such small subsets of their respective cohorts, that their loss would cause no detectable population-level effects.

2.5.2 Effects on Critical Habitat

This assessment considers the intensity of expected effects in terms of the change they would cause in affected Primary Biological Features (PBFs) from their baseline conditions, and the severity of each effect, considered in terms of the time required to recover from the effect. Ephemeral effects are those that are likely to last for hours or days, short-term effects would likely last for weeks, and long-term effects are likely to last for months, years or decades.

Critical Habitat for Puget Sound Chinook Salmon and Puget Sound Steelhead:

The proposed action is likely to adversely affect critical habitat that has been designated for PS Chinook salmon and PS steelhead at both project sites. The FSR 2000-35.4 site provides freshwater spawning, rearing, and migratory habitat for PS Chinook salmon and PS steelhead. The FSR 4036.01 site provides freshwater spawning habitat for PS Chinook salmon, as well as freshwater rearing and migratory habitat for both species. The essential PBFs of critical habitat for both species are listed below. The expected effects on those PBFs from completion of the planned project, including full application of the conservation measures and BMPs, would be limited to the impacts on freshwater PBFs as described below. Note that impacts on freshwater spawning sites would only apply to PS steelhead. Impacts on freshwater rearing and migration would apply similarly to both species, with the exception that impacts on PS steelhead critical habitat is limited to the Beckler River.

1. Freshwater spawning sites:
   a. Water quantity – No changes expected.
   b. Water quality – The proposed action would cause long term minor adverse effects on water quality. Construction would briefly increase suspended solids, and may slightly reduce DO and introduce contaminants. Impacts on riparian vegetation are likely to slightly increase water temperatures for decades. Detectable effects are expected to be limited to the area within about 300 feet of either project site.
   c. Substrate – The proposed action would cause long-term minor adverse effects on substrate. The FSR 4036.01 revetment would permanently prevent erosion of the bank and is likely to slightly alter erosion, sediment transport and deposition, and movement of LWD within the nearest bends in the SF Stillaguamish River, which may reduce the reach's ability to support Chinook spawning.

2. Freshwater rearing sites:
   a. Floodplain connectivity – The proposed action would cause long term minor adverse effects on floodplain connectivity. The FSR 4036.01 revetment would permanently prevent natural channel migration past it, which is likely to lock the physical conditions at the site in a simplified state with reduced edge habitat features such as undercut banks and alcoves. The altered hydrology at the site may also impact bank habitat forming processes within the nearest bends in the SF Stillaguamish River.
   b. Forage – The proposed action would cause long term minor adverse effects on forage. The simplified aquatic habitats created by revetments are typically less supportive of salmonid foraging than natural banks. Also, impacts on riparian vegetation at the sites would decrease input of terrestrial insects and leaf litter that support aquatic food webs. Detectable effects would likely be minor and limited to the area immediately adjacent to the project sites, but the effects would persist for decades.
   c. Natural cover – The proposed action would cause long term minor adverse effects on natural cover. The FSR 4036.01 revetment would permanently prevent the formation of edge habitat features such as undercut banks along its length. Impacts on riparian vegetation would remove overhanging vegetation and slightly reduce the availability of woody debris and leaf litter that can provide in-water cover. These effects would persist for decades.
   d. Water quantity – No changes expected.
   e. Water quality – Same as above.

3. Freshwater migration corridors:
   d. Free of obstruction and excessive predation – The proposed action would cause long term minor adverse effects on obstruction and predation. The FSR 4036.01 revetment would alter edge habitat that may cause some juvenile salmonids to avoid it. Additionally, erosion of the revetment is likely to create conditions that are preferred by predatory species such as sculpins and trout, which would increase the risk of predation for juvenile salmonids that do not avoid the revetment. These effects would persist for decades.
   e. Water quantity – No changes expected.
   f. Water quality – Same as above.
   g. Natural Cover – Same as above.
4. Estuarine areas – None in the action area.
5. Nearshore marine areas – None in the action area.
6. Offshore marine areas – None in the action area.

2.6 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 the 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 ESA.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the Environmental Baseline section (Section 2.4).

The current condition of ESA-listed species and designated critical habitats within the action area are described in the Status of the Species and Critical Habitats and Environmental Baseline sections above. The contribution of non-federal activities to those conditions include past and on-going forest management, agriculture, urbanization, road construction, water development, and restoration activities. Those actions were driven by a combination of economic conditions that characterized traditional natural resource-based industries, general resource demands associated with settlement of local and regional population centers, and the efforts of conservation groups dedicated to river restoration and use of natural amenities, such as cultural inspiration and recreational experiences.

NMFS is unaware of any specific future non-federal activities that are reasonably certain to affect the action area. However, NMFS is reasonably certain that future non-federal actions such as the previously mentioned activities are all likely to continue and increase in the future as the human population continues to grow across the region. Continued habitat loss and degradation of water quality from development and chronic low-level inputs of non-point source pollutants will likely continue into the future. Recreational and commercial use of river waters within the action area is also likely to increase as the human population grows.

The intensity of these influences depends on many social and economic factors, and therefore is difficult to predict. Further, the adoption of more environmentally acceptable practices and standards may gradually reduce some negative environmental impacts over time. Interest in restoration activities has increased as environmental awareness rises among the public. State, tribal, and local governments have developed plans and initiatives to benefit ESA-listed PS Chinook salmon and PS steelhead within the watersheds of the action area. However, the implementation of plans, initiatives, and specific restoration projects are often subject to political, legislative, and fiscal challenges that increase the uncertainty of their success.

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat for the conservation of the species.

As described in more detail above at section 2.4, climate change is likely to increasingly affect the abundance and distribution of the ESA-listed species considered in the Opinion. The exact effects of climate change are both uncertain, and unlikely to be spatially homogeneous. However, climate change is reasonably likely to cause reduced instream flows in some systems, and may impact water quality through elevated in-stream water temperatures and reduced DO, as well as by causing more frequent and more intense flooding events. It may also impact coastal waters through elevated surface water temperature, increased and variable acidity, increasing storm frequency and magnitude, and rising sea levels. The adaptive ability of listed-species is uncertain, but likely reduced due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. The proposed action will cause direct and indirect effects on the ESA-listed species considered in the Opinion well into the foreseeable future. However, the action's effects on water quality, substrate, and the biological environment are expected to be of such a small scale that no detectable effects on ESA-listed species through synergistic interactions with the impacts of climate change are expected.

Both of the species considered in this Opinion are listed as threatened, based on declines from historic levels of abundance and productivity, loss of spatial structure and diversity, and an array of limiting factors as a baseline habitat condition. Both species will be affected over time by cumulative effects, some positive – as recovery plan implementation and regulatory revisions increase habitat protections and restoration, and some negative – as climate change and unregulated or difficult to regulate sources of environmental degradation persist or increase. Overall, to the degree that habitat trends are negative, as described below, effects on viability parameters of each species are also likely to be negative. In this context we consider the effects of the proposed action's effect on individuals of the listed species at the population scale.

PS Chinook Salmon:

The PS Chinook salmon in the FSR 2000-35.4 action area are spring- and fall-run fish from the Upper Sauk River MPG. Those in the FSR 4036-0.1 action area are fall-run fish from the SF Stillaguamish MPG. The Upper Sauk River MPG has a relatively flat abundance trend, and natural-origin spawners account for over 90 percent of the population. Conversely, the trend in the SF Stillaguamish MPG is negative, and hatchery-origin spawners account for an ever-increasing proportion of the population such that they accounted for over half of the spawners in 2017.

Reduced or eliminated accessibility to historically important habitat, combined with degraded conditions in available habitat due to land use activities appear to be the greatest threats to the recovery of PS Chinook salmon. Commercial and recreational fisheries also continue to impact this species. The environmental baselines within the action areas have been degraded by the effects of past and on-going forest management, road building and maintenance, and recreational activities.

Both project sites provide spawning, rearing, and migratory habitat of PS Chinook salmon. Therefore, all PS Chinook salmon life stages are likely to utilize the actions areas. Project-related work would largely avoid the timing of out-migrating juveniles, but work at the FSR 2000-35.4 site overlaps with spring-run spawning, and work at both sites overlaps with the presence of stream-type juveniles and returning adults.

Work area isolation at both sites may injure or kill a combined total of 2 juvenile Chinook salmon during construction. Additionally, other short-term construction-related impacts, and long-term structure-related impacts at the FSR 4036-0.1 site, are likely to cause a range of effects that both individually and collectively would cause altered behaviors, reduced fitness, and mortality in low numbers of juveniles. Structure-related impacts at the FSR 4036-0.1 site are likely to persist for decades to come. The annual number of juveniles that are likely to be injured or killed by the exposure to other action-related stressors is unknown. However, the numbers are expected to be very low, and to represent such a small fraction of any annual cohort that it would have no detectable effect on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for either PS Chinook salmon population.

As compared to undisturbed habitats, the proposed action would slightly reduce the functional levels of habitat features within the nearest river bends either side of the FSR 4036-0.1 project site. However, these impacts would not prevent the recovery of this species within the action area. Based on the best available information, the scale of the direct and indirect effects of the proposed action, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to cause any population level impacts on PS Chinook salmon. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

PS Steelhead:

The PS steelhead in the FSR 2000-35.4 action area would be from the Sauk River Summer Run and Winter Run DIP. Those in the FSR 4036-0.1 action area would be from the SF Stillaguamish River Winter Run DIP. The Upper Sauk River DIP is a native stock with relatively low abundance, a positive abundance trend in recent years, and moderate viability. Conversely, the viability of the SF Stillaguamish DIP is considered low. The abundance trend is negative, hatchery-origin fish are present, and the likelihood of extinction within 100 years is high.

Reduced or eliminated accessibility to historically important habitat, combined with degraded conditions in available habitat due to land use activities appear to be the greatest threats to the recovery of PS steelhead. Fisheries activities also continue to impact this species. The environmental baselines within the action areas have been degraded by the effects of past and on-going forest management, road building and maintenance, and recreational activities.

Both project sites provide rearing and migratory habitat for PS steelhead, and the FSR 2000-35.4 site provides spawning habitat. Project-related work would largely avoid the timing of returning adults, spawning, and out-migrating juveniles, but overlaps with the presence of year-round rearing of juveniles.

Work area isolation at both sites may injure or kill a combined total of 3 juvenile steelhead during construction. Additionally, other short-term construction-related impacts, and long-term structure-related impacts at the FSR 4036-0.1 site, are likely to cause a range of effects that both individually and collectively would cause altered behaviors, reduced fitness, and mortality in low numbers of juveniles. Structure-related impacts at the FSR 4036-0.1 site are likely to persist for decades to come. The annual number of juveniles that are likely to be injured or killed by the exposure to other action-related stressors is unknown. However, the numbers are expected to be very low, and to represent such a small fraction of any annual cohort that it would have no detectable effect on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for either PS steelhead population.

As compared to undisturbed habitats, the proposed action would slightly reduce the functional levels of habitat features within the nearest river bends either side of the FSR 4036-0.1 project site. However, these impacts would not prevent the recovery of this species within the action areas. Based on the best available information, the scale of the direct and indirect effects of the proposed action, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to cause any population level impacts on PS steelhead. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

Critical Habitat for PS Chinook Salmon and PS Steelhead:

As described above at Section 2.5, the proposed action is likely to adversely affect designated critical habitat for PS Chinook salmon and PS steelhead. Past and ongoing land and water use practices have degraded salmonid critical habitat throughout the Puget Sound basin. Hydropower and water management activities have reduced or eliminated access to significant portions of historic spawning habitat. Timber harvests, agriculture, industry, urbanization, and shoreline development have adversely altered floodplain and stream morphology in many watersheds, diminished the availability and quality of estuarine and nearshore marine habitats, and reduced water quality across the region.

Global climate change is expected to increase in-stream water temperatures and alter stream flows, possibly exacerbating impacts on baseline conditions in freshwater habitats across the region. Rising sea levels are expected to increase coastal erosion and alter the composition of nearshore habitats, which could further reduce the availability and quality of estuarine habitats. Increased ocean acidification may also reduce the quality of estuarine habitats. In the future, non-federal land and water use practices and climate change are likely to increase. The intensity of those influences on salmonid habitats is uncertain, as is the degree to which those impacts may be tempered by adoption of more environmentally acceptable land use practices, by the implementation of non-federal plans that are intended to benefit salmonids, and by efforts to address the effects of climate change.

The PBFs of salmonid critical habitat that would be affected by the proposed action are freshwater spawning sites, rearing sites, and migration corridors free of obstruction and excessive predation. As described above, the proposed action would cause short- and long-term minor adverse effects on water quality, substrate, floodplain connectivity, forage, natural cover, and freedom from obstruction and excessive predation within about 300 feet of the project sites.

Based on the best available information, the scale of the proposed action's effects, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to measurably reduce the quality or functionality of the freshwater PBFs from their current levels. Therefore, the critical habitat would maintain its current level of functionality, and retain its current ability for PBF to become functionally established, to serve the intended conservation role for PS Chinook salmon and PS steelhead.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent actions, and cumulative effects, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of PS Chinook salmon or PS steelhead, nor is it likely to destroy or adversely modify designated critical habitat for either of these species.

2.9 Incidental Take Statement

Section 9 of the ESA and Federal regulations 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 actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency 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 (ITS).

2.9.1 Amount or Extent of Take

NMFS has determined that incidental take is reasonably certain to occur as follows:

Harm of juvenile Puget Sound Chinook salmon from
- exposure to fish salvage,
- exposure to construction-related noise and activity, and
- exposure to structure-related effects.

Harm of juvenile Puget Sound steelhead from
- exposure to fish salvage,
- exposure to construction-related noise and activity, and
- exposure to structure-related effects.

The USFS estimates that a maximum of 32 juvenile Chinook salmon and 55 juvenile steelhead may be captured during fish salvage for both project sites combined. Based on the expectation that 5% of those fish could be seriously injured or killed (NMFS 2013), NMFS expects that a maximum of 2 juvenile Chinook salmon and 3 juvenile steelhead may be seriously injured or killed during fish salvage.

NMFS cannot predict with meaningful accuracy the number of juvenile PS Chinook salmon and juvenile PS steelhead that are reasonably certain to be injured or killed by exposure to construction-related noise and activity and structure-related effects. The distribution and abundance of fish that occur within an action area are affected by habitat quality, competition, predation, and the interaction of processes that influence genetic, population, and environmental characteristics. These biotic and environmental processes interact in ways that may be random or directional, and may operate across far broader temporal and spatial scales than are affected by the proposed action. Thus, the distribution and abundance of fish within the action area cannot be attributed entirely to habitat conditions, nor can NMFS precisely predict the number of fish that are reasonably certain to be injured or killed if their habitat is modified or degraded by the proposed action.

Additionally, NMFS knows of no device or practicable technique that would yield reliable counts of individuals that experience these impacts. In such circumstances, NMFS uses the causal link established between the activity and the likely extent and duration of changes in habitat conditions to describe the extent of take as a numerical level of habitat disturbance. The most appropriate surrogates for take are action-related parameters that are directly related to the magnitude of the expected take.

For this action, the timing of work and the in-stream size of the construction areas are the best available surrogates for the extent of take of juvenile PS Chinook salmon and PS steelhead from exposure to construction-related noise and activity. Timing of work is applicable because the planned work windows were selected to minimize the potential for listed fish presence at the project sites. The in-stream size of the construction areas is applicable because the number of fish that are likely to be affected would increase as the size of impacted stream habitat increases. Therefore, working outside of the planned work window and/or impacting more in-stream habitat than anticipated would increase the number of fish likely to be exposed to construction-related noise and activity.

The length and design of the new revetment are the best available surrogates for the extent of take of juvenile PS Chinook salmon and PS steelhead due to structure-related effects. The length of the new revetment is applicable because the number of fish that are likely to be affected would increase as the size of impacted habitat increases, which is directly related to the length of the revetment. The design of revetment is applicable because the intensity of structure-related effects would increase as the embankment's design diverges from that of a natural streambank. Therefore, impacting more streambank than anticipated would increase the number of fish likely to be exposed to structure-related effects, and diverging from the planned design such that the steepness of the revetment or the amount of exposed rip rap increases would increase the intensity of effects in the exposed fish.

In summary, the extent of take for this action is defined as:

Puget Sound Chinook salmon:

- 32 juvenile PS Chinook salmon captured, with a maximum of 2 seriously injured or killed during fish salvage (12 and 1 at FSR 2000-35.4; 20 and 1 at FSR 4036.01).
- In- and near-stream work July 20 through August 30 for FSR 2000-35.4, and August 1 through August 15 for FSR 4036.01.
- The size of the FSR 2000-35.4 debris removal as described in the proposed action section of this biological opinion.
- The size and configuration of the FSR 4036.01 revetment as described in the proposed action section of this biological opinion.

Puget Sound steelhead:

- 55 juvenile PS steelhead captured, with a maximum of 3 seriously injured or killed during fish salvage (20 and 1 at FSR 2000-35.4; 35 and 2 at FSR 4036.01).
- In- and near-stream work July 20 through August 30 for FSR 2000-35.4, and August 1 through August 15 for FSR 4036.01.
- The size of the FSR 2000-35.4 debris removal as described in the proposed action section of this biological opinion.
- The size and configuration of the FSR 4036.01 revetment as described in the proposed action section of this biological opinion.

Exceedance of any of the exposure limits described above would constitute an exceedance of authorized take that would trigger the need to reinitiate consultation.

Some of these take surrogates could be construed as partially coextensive with the proposed action but they nevertheless function as effective reinitiation triggers. These take surrogates will likely be monitored on a near-daily basis; thus any exceedance of the surrogates will be apparent in real-time and well before the project is completed. Further, if the size and configuration of the revetment exceeds the proposal, it could still meaningfully trigger reinitiation because the USFS has authority to conduct compliance inspections and to take actions to address non-compliance, including post-construction (33 CFR 326.4).

2.9.2 Effect of the Take

In the Opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to jeopardize the continued existence of PS Chinook salmon and PS steelhead, nor is it likely to destroy or adversely modify designated critical habitat for either of these species (Section 2.8).

2.9.3 Reasonable and Prudent Measures (RPM)

"Reasonable and prudent measures" are nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02).

The USFS shall:

1. Minimize incidental take of PS Chinook salmon and PS steelhead from fish salvage.

2. Minimize incidental take of PS Chinook salmon and PS steelhead from exposure to construction-related noise and activity.

3. Minimize incidental take of PS Chinook salmon and PS steelhead from exposure to structure-related effects.

4. Implement monitoring and reporting to confirm that the take exemption for the proposed action is not exceeded.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary. The USFS or any applicant must comply with them in order to implement the RPM (50 CFR 402.14). The USFS or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. To implement RPM Number 1, Minimize incidental take of PS Chinook salmon and PS steelhead from fish salvage, the USFS shall require its contractors to:
    a. Conduct fish salvage only during July 20 through August 30 for FSR 2000-35.4, and August 1 through August 15 for FSR 4036.01.

b. Comply with the following protective measures and BMP applicable to Fish Capture and Release (from NMFS 2013).
    i. If practicable, before dewatering, allow listed fish to migrate out of the work area, herd them out of the area with barrier nets, or carefully remove them from the exclusion area with hand or dip-nets, seining, or minnow traps; otherwise carefully remove fish as the area is slowly dewatered.
    ii. Fish capture will be supervised by a qualified fisheries biologist, with experience in work area isolation and competent to ensure the safe handling of fish.
    iii. Conduct fish capture activities during periods of the day with the coolest air and water temperatures possible, normally early in the morning to minimize stress and injury of species present.
    iv. Monitor the nets frequently enough to ensure they stay secured to the banks and free of organic accumulation.
    v. Electrofishing will be used during the coolest time of day, and only after other means of fish capture are determined to be infeasible or ineffective.
        1. Do not electrofish when the water appears turbid, *e.g.*, when objects are not visible at depth of 12 inches.
        2. Do not intentionally contact fish with the anode.
        3. Use direct current (DC) or pulsed direct current within the following ranges:
            a. If conductivity is less than 100 µs, use 900 to 1100 volts.
            b. If conductivity is between 100 and 300 µs, use 500 to 800 volts.
            c. If conductivity greater than 300 µs, use less than 400 volts.
        4. Begin electrofishing with a minimum pulse width and recommended voltage, then gradually increase to the point where fish are immobilized.
        5. Immediately discontinue electrofishing if fish are killed or injured, *i.e.*, dark bands visible on the body, spinal deformations, significant de-scaling, torpid or inability to maintain upright attitude after sufficient recovery time. Recheck machine settings, water temperature and conductivity, and adjust or postpone procedures as necessary to reduce injuries.
    vi. If buckets are used to transport fish:
        1. Minimize the time fish are in a transport bucket.
        2. Keep buckets in shaded areas or, if no shade is available, covered by a canopy.
        3. Limit the number of fish within a bucket; fish will be of relatively comparable size to minimize predation.
        4. Use aerators or replace the water in the buckets at least every 15 minutes with cold clear water.
        5. Release fish in an area with adequate cover and flow refuge; downstream release is acceptable provided the release site is below the influence of construction.
        6. Be careful to avoid mortality counting errors.
    vii. Monitor and record fish presence, handling, and injury during all phases of fish capture and submit a fish salvage report (see 3.a. below).

2. To implement RPM Number 2, Minimize incidental take of PS Chinook salmon and PS steelhead from construction-related noise and activity, the USFS shall require its contractors to:
   a. Limit in- and near-stream work to July 20 through August 30 for FSR 2000-35.4, and August 1 through August 15 for FSR 4036.01,
   b. Limit in- and near-stream work for the FSR 2000-35.4 project to the stream reaches in Chocwich Creek and SF Sauk River as described in the project description of this opinion, and
   c. Limit in- and near-stream work for the FSR 4036.01 revetment to the stream reach in the SF Stillaguamish River as described in the project description of this opinion.

3. To implement RPM Number 3, Minimize incidental take of PS Chinook salmon and PS steelhead from exposure to structure-related effects, the USFS shall require its contractors to install the FSR 4036.01 revetment as summarized in the project description of this opinion. In particular, the revetment shall:
   a. Be no longer than about 128 feet;
   b. Incorporate enough ballasted logs to cover the revetment face with root wads (About 25, depending on the size of the logs and root wads);
   c. Be no steeper than a 1.5H:1V slope;
   d. Be covered by streambed material along its lower length, a minimum of 8 inches of top soil along its upper length; and
   e. Include about 115 willow pole plantings along it lower face.

4. To implement RPM Number 4, implement a monitoring and reporting program to confirm that the take exemption for the proposed action is not exceeded, the USFS shall require their contractor(s) to collect and report details about the take of listed fish. That plan shall:
   a. Require the contractor to maintain and submit fish salvage logs to verify that all take indicators are monitored and reported. Minimally, the logs should include:
      i. The identity (name, title, organization), qualification, and contact information of the persons conducting fish salvage, and the person completing the report;
      ii. The location, date, time, and air and water temperatures;
      iii. The method(s) of capture and handling procedures that were used; and
      iv. The species and quantities of captured fish, and their disposition at release (i.e. alive with no apparent injuries, alive with apparent minor/serious injuries, dead with/without apparent injuries).
   b. Require the contractor to maintain and submit construction logs to verify that all take indicators are monitored and reported. Minimally, the logs should include:
      i. The dates, and start and stop times for all work;
      ii. Identification of the site;
      iii. Description of the work being done;
      iv. The linear extent and slopes of the restored streambank, berm/groin, and/or revetment; and
      v. Identification of the fill layers and materials that are installed in the new revetment.

c. Require that measurements and photographs be taken and provided to the USFS that ascertain the post-construction size and configuration of the revetments;
d. Establish procedures for the submission of photographs and other documentation to the USFS, which will draft and submit a post-construction report to NMFS.
e. Submit an electronic post-construction report to NMFS within six months of project completion. Send the report to: projectreports.wcr@noaa.gov. Be sure to include the NMFS Tracking number for this project in the subject line: Attn: WCR-2018-10345.

2.10 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).

1. The USFS should consider replacing the FSR 2000-35.4 culvert with a bridge, relocating the road away from Chocwich Creek alluvial fan, or some combination thereof that would improve fish passage and reduce the likelihood of culvert blockage/failure during high-flow events.

2.11 Reinitiation of Consultation

This concludes formal consultation for the U.S Forest Service' FSR 2000-35.4 and FSR 4036-0.1 Repair Projects in Snohomish County, Washington. As 50 CFR 402.16 states, 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 taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat that was not considered in this Opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect essential fish habitat (EFH). The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration 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 of it 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 can be taken by the action agency to conserve EFH. The analysis that follows is based, in part, on the description of EFH contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

The waters and substrates of the FSR 2000-35.4 and FSR 4036-0.1 action areas are designated as freshwater EFH for Pacific Coast Salmon, which include Chinook, coho, and pink salmon. This EFH is identified and described in Appendix A to the Pacific Coast salmon fishery management plan (PFMC 2014).

3.2 Adverse Effects on Essential Fish Habitat

The ESA portion of this document (Sections 1 and 2) describes the adverse effects of the proposed action on ESA-listed species and critical habitats, and is relevant to the effects on EFH for Pacific Coast Salmon. Based on the analysis of effects presented in Section 2.5, the proposed action will cause small scale long-term adverse effects on EFH for Pacific salmon through direct or indirect physical and chemical alteration of the water and substrate. It would also alter habitat conditions at the sites in a manner that slightly alters migratory behaviors and reduces natural cover and forage resources for juvenile salmonids. It may also increase the risk of predation.

3.3 Essential Fish Habitat Conservation Recommendations

Implementation of the following conservation recommendation would minimize adverse effects on EFH for Pacific Coast Salmon that are likely to result from the proposed action.

1. The USFS should consider replacing the FSR 2000-35.4 culvert with a bridge, relocating the road away from Chocwich Creek alluvial fan, or some combination thereof that would improve fish passage and reduce the likelihood of culvert blockage/failure during high-flow events.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the USFS must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. 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, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the 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)(1)).

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

The USFS 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

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these 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 the USFS and FHWA. Other users could include WDFW, the government and citizens of Snohomish County, and Native American tribes. Individual copies of this Opinion were provided to the USFS. 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 Opinion and 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 West Coast Region ESA quality control and assurance processes.

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