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:
WCRO-2022-01769

June 14, 2023

Todd Tillinger
Chief, Regulatory Branch
U.S. Army Corps of Engineers, Seattle District
4735 East Marginal Way South, Bldg. 1202
Seattle, Washington 98134-2388

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the City of Sultan's Wastewater Treatment Plant Outfall Replacement Project, Snohomish County, Washington (USACE No. NWS-2022-32; HUC: 171100090603 – McCoy Creek-Skykomish River)

Dear Mr. Tillinger:

Thank you for your letter of July 20, 2022, 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 Army Corps of Engineers' (USACE) authorization of the City of Sultan's Wastewater Treatment Facility (WWTP) Outfall Replacement Project, pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers & Harbors Act. Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson–Stevens Fishery Conservation and Management Act [16 U.S.C. 1855(b)] for this action.

The enclosed document contains the biological opinion (opinion) prepared by the NMFS pursuant to section 7 of the ESA on the effects of the proposed action. In this opinion, the NMFS concludes that the proposed action would adversely affect but is not likely to jeopardize the continued existence of Puget Sound (PS) Chinook salmon and PS steelhead. The NMFS also concludes that the proposed action is likely to adversely affect designated critical habitat for PS Chinook salmon and PS steelhead but is not likely to result in the destruction or adverse modification of those designated critical habitats. This opinion also documents our conclusion that the proposed action is not likely to adversely affect southern resident (SR) killer whales and their designated critical habitat.

This opinion includes an incidental take statement (ITS) that describes reasonable and prudent measures (RPMs) the NMFS considers necessary or appropriate to minimize the incidental take associated with this action, and sets forth nondiscretionary terms and conditions that the USACE 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.

Section 3 of this document includes our analysis of the action's likely effects on EFH pursuant to Section 305(b) of the MSA. Based on that analysis, the NMFS concluded that the action would adversely affect designated freshwater EFH for Pacific Coast Salmon. Therefore, we have provided 3 conservation recommendations that can be taken by the USACE to avoid, minimize, or otherwise offset potential adverse effects on EFH. We also concluded that the action would not adversely affect EFH for Pacific Coast groundfish and coastal pelagic species. Therefore, consultation under the MSA is not required for those EFHs.

Section 305(b) (4) (B) of the MSA requires Federal agencies to provide a detailed written response to the NMFS within 30 days after receiving this recommendation. If the response is inconsistent with the EFH conservation recommendations, the USACE must explain why the recommendations will not be followed, including the scientific justification for any disagreements over the effects of the action and recommendations. 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 request that in your statutory reply to the EFH portion of this consultation you clearly identify the number of conservation recommendations accepted.

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: Jacalen Printz, USACE

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

City of Sultan's Wastewater Treatment Plant
Outfall Replacement Project Snohomish County, Washington
(USACE No. NWS-2022-32; HUC: 171100090603)

NMFS Consultation Number: WCRO-2022-01769

Action Agencies: U.S. Army Corps of Engineers

Affected Species and NMFS' 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	No	No	N/A	N/A
killer whales (*Orcinus orca*) Southern resident (SR)	Endangered	No	No	Yes	No

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
Pacific Coast Groundfish	No	No
Coastal Pelagic Species	No	No

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: June 14, 2023

TABLE OF CONTENTS

LIST OF ABBREIVIATIONS

ATC – Anthropogenic Trace Compounds
BE – Biological Evaluation
BMP – Best Management Practices
BOD_5 –Biochemical Oxygen Demand (5-day)
CFR – Code of Federal Regulations
cfu – Colony Forming Units
dB – Decibel (common unit of measure for sound intensity)
DIP – Demographically Independent Population
DPS – Distinct Population Segment
DQA – Data Quality Act
EF – Essential Feature
EFH – Essential Fish Habitat
ESA – Endangered Species Act
ESU – Evolutionarily Significant Unit
FR – Federal Register
FMP – Fishery Management Plan
HAPC – Habitat Area of Particular Concern
HDPE – High Density Polyethylene
HHCB – Hexahydrohexa methylcyclopentabenzopyran (synthetic musk used in cosmetics)
HUC – Hydrologic Unit Code
HPA – Hydraulic Project Approval
ITS – Incidental Take Statement
MGD - Million Gallons per Day
mg/L – Milligrams per Liter
ml – Milliliter
MPG – Major Population Group
MSA – Magnuson-Stevens Fishery Conservation and Management Act
NMFS – National Marine Fisheries Service
ng/L – Nanograms per Liter
NOAA – National Oceanic and Atmospheric Administration
NPDES – National Pollutant Discharge Elimination System
NTU – Nephlometric Turbidity Units
OHWM – Ordinary High-Water Mark
PAH – Polycyclic Aromatic Hydrocarbon
PBF – Physical or Biological Feature
PCB- Polychlorinated Biphenyl
PFMC – Pacific Fishery Management Council
POP – Persistent Organic Pollutant
PPCP – Pharmaceuticals and Personal Care Products
PS – Puget Sound
PSTRT – Puget Sound Technical Recovery Team
PSSTRT – Puget Sound Steelhead Technical Recovery Team
RL – Received Level
RPA – Reasonable and Prudent Alternative

RPM – Reasonable and Prudent Measure
SAV – Submerged Aquatic Vegetation
SEL – Sound Exposure Level
SL – Source Level
SR – Southern Resident (Killer Whales)
TRC – Total Residual Chlorine
TSS – Total Suspended Solids
USACE – U.S. Army Corps of Engineers
USEPA – U.S. Environment al Protection Agency
USGS – U.S. Geological Survey
VSP – Viable Salmonid Population
WCR – West Coast Region (NMFS)
WDFW – Washington State Department of Fish and Wildlife
WDOE – Washington State Department of Ecology
WWTP – Wastewater Treatment Plant

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 (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), as amended, and implementing regulations at 50 CFR part 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 part 600.

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 CFR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. On November 14, 2022, the Northern District of California issued an order granting the government's request for voluntary remand without vacating the 2019 regulations. The District Court issued a slightly amended order two days later on November 16, 2022. As a result, the 2019 regulations remain in effect, and we are applying the 2019 regulations here. For purposes of this consultation and in an abundance of caution, we considered whether the substantive analysis and conclusions articulated in the biological opinion and incidental take statement would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different.

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 (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the Oregon Washington Coastal Office.

1.2 Consultation History

On July 20, 2022, NMFS received a letter from the U.S. Army Corps of Engineers that requested consultation for their authorization of the City of Sultan's Wastewater Treatment Facility (WWTP) Outfall Replacement Project (USACE 2022). The request included the City's project drawings and biological evaluation (BE) (Gray & Osborne 2021; 2022a), and the Washington Department of Fish & Wildlife (WDFW) Hydraulic Project Approval (HPA) for the project (WDFW 2022).

On August 23, 2022, the NMFS requested more information regarding the WWTP design and outfall replacement. Information was provided by the applicant's Agent via phone call and subsequent email on August 25, 2022 (Gray & Osborne 2022b). The NMFS initiated formal ESA consultation and EFH consultation on August 25, 2022.

This opinion is based on the information in the documents identified above, and other additional information provided by the applicant's agent; 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 Federal Action

Under the ESA, "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). Under the MSA, federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded or undertaken by a federal agency (50 CFR 600.910).

The U.S. Army Corps of Engineers (USACE) proposes to authorize the City of Sultan (the City), under Section 404 of the Clean Water Act and Section 10 of the Rivers & Harbors Act, to replace the outfall from their municipal wastewater treatment plant (WWTP) in the City of Sultan, Snohomish County, Washington (Figures 1 and 2).

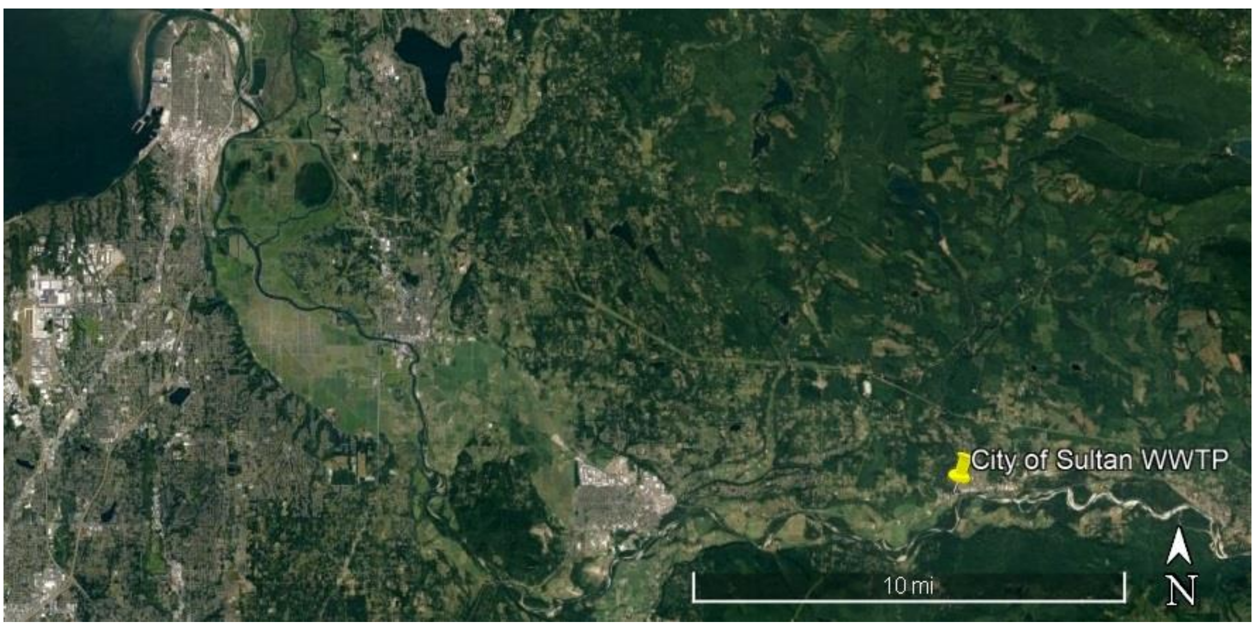

Figure 1. Google Earth photograph showing the City of Sultan's project site relative to Puget Sound, which is visible in the upper left corner.

The City is currently upgrading its WWTP to improve the treatment of waste water, and to increase its maximum month design flow from 0.72 million gallons per day (MGD) to 1.1 MGD to accommodate anticipated growth. To accommodate projected flows and to improve mixing, the City proposes to replace and relocate the existing 40-foot long, 6-inch diameter, high-density polyethylene (HDPE) outfall pipe with a single port (open-end) diffuser. The new outfall would be an 80-foot long, 12-inch diameter, HDPE pipe with an open-end diffuser that would be installed in a more downstream alignment than the current outfall (Figure 2).

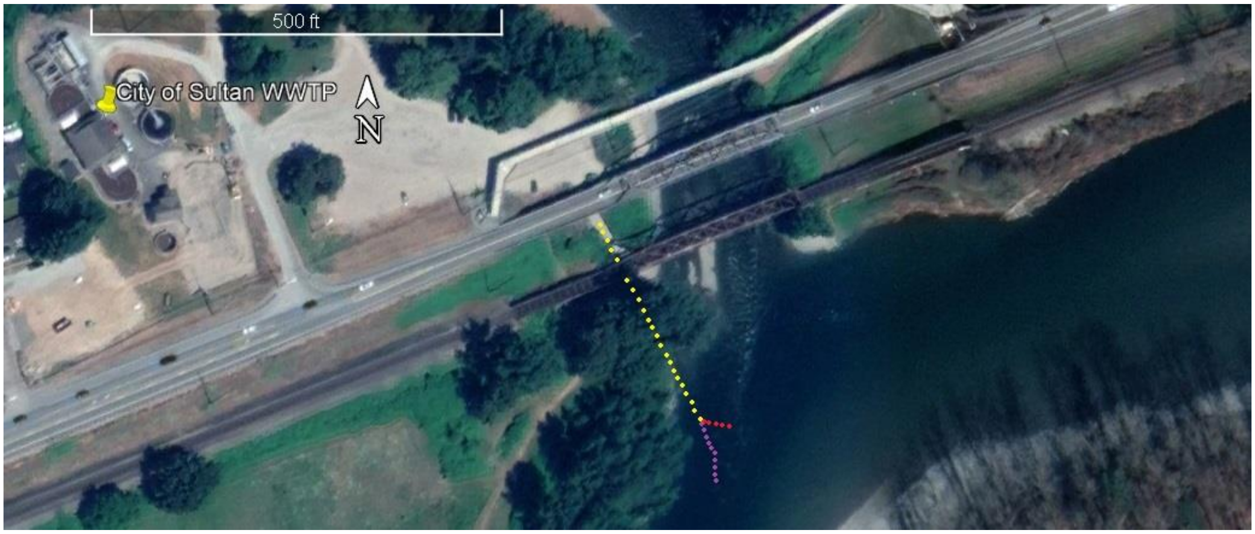

Figure 2. Google Earth photograph showing the City of Sultan's WWTP, and the approximate positions of the existing and proposed outfall pipes. The yellow dotted line indicates the alignment of the buried pipeline as it crosses the under the bank to its point of connection with the existing (red) and proposed (purple) outfall pipes in the Skykomish River. The Sultan River extends north under the bridges.

The project would require about 1 week of work that would be completed during the WDFW-authorized August 1 through August 15 in-water work window for the project (WDFW 2022), during which time, the point where the buried pipeline is connected to the existing outfall is expected to be well above the river's water level. To further reduce impacts on natural resources, the construction crews would be required to comply with all best management practices (BMPs) and protective measures identified in the BE, and with the provisions of the HPA for this project.

The project would begin with the construction crew fabricating the new 80-foot long outfall pipe at an unvegetated location under the bridges that cross the Sultan River, slightly upstream of the existing outfall. The work crew would fuse sections of 12-inch diameter HDPE pipe, attach pre-cast concrete anchors at intervals along the pipe's length, and temporarily seal the ends of the pipe so it would float. The pipe would be extended onto the water as it is fabricated, and temporarily stored floating on the water until the existing outfall is removed.

Working in the dry, the construction crew would use hand tools to clear away about 1 to 2 cubic yards of river sediments from around the buried 12-inch diameter pipeline where it connects to the exposed, existing 6-inch outfall pipeline. Prior to removing the existing outfall, the WWTP would temporarily close off the effluent pipeline, and hold back effluent in the WWTP.

Construction crews would operate a small work boat with an A-frame hoist (or a davit) and a winch to remove the existing outfall pipe. Divers would also be employed to assist with the removal. The workboat would anchor in the river, upstream of the pipeline, and divers would attach a hoist cable to the existing outfall. The divers would unbolt the in-water portion of existing pipeline from the existing riprap substrate. The upland construction crew would similarly disconnect the portion of the pipe that is above the water line. After it's disconnected, the pipe would be hauled aboard the workboat for transportation to an appropriate upland disposal facility.

After the existing pipe has been removed, the construction crew would float the new pipe into position. The shoreward end of the new pipe would be hoisted ashore by a land-based crane and bolted onto the exposed end of the buried pipeline. The new outfall pipe would be positioned over its intended alignment, and held against the current by the workboat's hoist, where it would sunken in a controlled manner, and bolted to the existing riprap by divers. The divers would also remove the end plug from the pipe. To protect the new pipe, the construction crew would install, by hand, about 3 cubic yards of 8-inch rock along both sides of the shoreward-most 15 feet of pipe. The protective rock would extend about 2.5 feet from the sides of the pipe.

When installed, the discharge end of the new outfall would be about 100 feet offshore from the OHWM on the near (right) bank, and about 20 feet below the water's surface during OHW. During ordinary low water, the outfall would be about 20 feet from the water's edge, and 10 feet below its surface (Gray & Osborne 2023a). After the new pipe is installed, the WWTP would reopen the pipeline and resume the discharge of WWTP effluent to the Skykomish River, just downstream of its confluence with the Sultan River (Figure 2).

To help offset the new pipeline's physical impacts on the river's substrate, the City would remove a minimum of 250 square feet of invasive Himalayan blackberry from a large patch that is located at the site, between the US Highway 2 and railroad bridges. They would then plant native riparian vegetation that would consist of a minimum of 4 each of the following shrubs: willows, snowberry, salmon berry, salal, and Oregon grape on approximately 3-foot centers. For a period of 5 years, plant survival will be monitored, new vegetation will be watered as needed, non-native blackberries would be removed, and weak and dead plantings associated with this mitigation measure will be replaced in kind. Although not planted as part of the project, alders and other native trees volunteering among the plantings would not be discouraged (Gray & Osborne 2023a).

<u>Other activities that could be caused by the proposed action</u>

The NMFS also considered, under the ESA, whether or not the proposed action would cause any other activities that could affect our trust resources. We determined that although the proposed action would cause no change in the chemical nature of the discharged WWTP effluent, it would result in the continued discharge of effluent into the Skykomish River, slightly relocate the discharge point, and also increase its flow capacity from 0.7 MGD to 1.1 MGD. Therefore, we included an analysis of the effects of the continued and relocated effluent discharge in the effects section of this Opinion.

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 to adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with the NMFS, and section 7(b)(3) requires that, at the conclusion of consultation, the NMFS provide 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 the NMFS to provide an ITS that specifies the impact of any incidental taking and includes reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

The USACE determined that the proposed action is likely to adversely affect PS Chinook salmon, PS steelhead, and designated critical habitat for both species, but would have no effect on SR killer whales and their designated critical habitat. The NMFS has proceeded with formal consultation for the proposed action because we have concluded that the proposed action is likely to adversely affect PS Chinook salmon, PS steelhead, and designated critical habitat for both species (Table 1). Additionally, because of the trophic relationship between PS Chinook salmon and SR killer whales, the NMFS analyzed the action's potential effects on SR killer whales and their designated critical habitat in the "Not Likely to Adversely Affect" Determinations section (2.12) of this opinion.

Table 1. ESA-listed species and critical habitat that may be affected by the proposed action.

ESA-listed species and or 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)
ESA-listed species and critical habitat not likely to be adversely affected (NLAA)				
Species	**Status**	**Species**	**Critical Habitat**	**Listed / CH Designated**
killer whales (*Orcinus orca*) southern resident	Endangered	NLAA	LAA	11/18/05 (70 FR 57565) / 11/29/06 (71 FR 69054)

LAA = likely to adversely affect NLAA = not likely to adversely affect
N/A = not applicable. The action area is outside designated critical habitat, or critical habitat has not been designated.

2.1 Analytical Approach

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion also relies on the regulatory definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02).

The designations of critical habitat for PS Chinook salmon and PS steelhead use the terms primary constituent element or essential features. The 2016 final rule (81 FR 7414; February 11, 2016) that revised the critical habitat regulations (50 CFR 424.12) replaced those terms 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 primary constituent elements, essential features, or PBFs. In this biological opinion, we use the term PBF to mean primary constituent element or essential feature, as appropriate for the specific critical habitat.

The ESA Section 7 implementing regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the final rule revising the definition and adding this term (84 FR 44976, 44977; August 27, 2019), that revision does not change the scope of our analysis, and in this opinion, we use the terms "effects" and "consequences" interchangeably.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the range-wide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their critical habitat using an exposure–response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly 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; or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.2 Range-wide Status of the Species and Critical Habitat

This opinion examines the status of each species that is likely to 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' "reproduction, numbers, or distribution" for the jeopardy analysis. 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 function of the PBFs that are essential for the conservation of the species.

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 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 listing regulations and critical habitat designations published in the Federal Register and in the recovery plans and other sources at: https://www.fisheries.noaa.gov/species-directory/threatened-endangered, and are incorporated here by reference.

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 the final supplement to the Shared Strategy's Puget Sound salmon recovery plan (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 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.

General Life History: Chinook salmon are anadromous fish that require well-oxygenated water that is typically less than 63º F (17º C), but some tolerance to higher temperatures is documented with acclimation. 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 Chinook salmon tend to 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. Both stream- and ocean-type Chinook salmon are present, but ocean-type Chinook salmon predominate in Puget Sound populations. 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. In Puget Sound, spring-run Chinook salmon tend to enter their natal rivers as early as March, but do not spawn until mid-August through September. Returning summer- and fall-run fish tend to enter the rivers early-June through early-September, with spawning occurring between early August and late-October.

Yearling stream-type fish tend to leave their natal rivers late winter through spring, and move relatively directly to nearshore marine areas and pocket estuaries. Out-migrating ocean-type fry tend to migrate out of their natal streams beginning in early-March. Those fish rear in the tidal delta estuaries of their natal stream for about two weeks to two months before migrating to marine nearshore areas and pocket estuaries in late May to June. Out-migrating young of the year parr tend to move relatively directly into marine nearshore areas and pocket estuaries after leaving their natal streams between late spring and the end of summer.

Spatial Structure and Diversity: 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; Ford 2022). 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 2019, the fraction of natural-origin spawners has declined in many of the populations outside of the Skagit watershed, and the ESU overall remains at a “moderate” risk of extinction (Ford 2022).

Abundance and Productivity: 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. Further, across the ESU, 10 of 22 MPGs show natural productivity below replacement in nearly all years since the mid-1980s, and the available data indicate that there has been a general decline in natural-origin spawner abundance across all MPGs over the most-recent fifteen years. Further, escapement levels for all populations remain well below the PSTRT planning ranges for recovery (Ford 2022). Based on the current information on abundance, productivity, spatial structure and diversity, the most recent 5-year status review concluded that the PS Chinook salmon ESU remains at “moderate” risk of extinction, that viability is largely unchanged from the prior review, and that the ESU should remain listed as threatened (Ford 2022).

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

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 Snohomish Basin supports both summer-run (Skykomish River) and fall-run (Snoqualmie River) Chinook salmon (Ford 2022; WDFW 2023). Both runs utilize the Snohomish and Skykomish Rivers from the project site to Puget Sound for spawning and migration (WDFW 2023). Both of populations are reportedly at less than 10% of their historic levels (Snohomish Basin Salmon Recovery Forum 2005 & 2019). The available abundance and trend data are difficult to interpret succinctly, but between 1980 and 2020, the number of returning adult fish from the Skykomish River summer-run has fluctuated between about 2,000 and 4,500 fish annually, with natural-origin spawners accounting for about half of the return. Over the same period, returning adult fish from the Snoqualmie River fall-run has fluctuated between about 1,000 and 2,500 fish annually, with natural-origin spawners accounting for about three-quarters of the return (Ford 2022).

Adult Chinook salmon utilize the project area for migration, and WDFW identifies the area as spawning habitat (WDFW 2023). Juvenile Chinook salmon also use the area for migration and foraging, and may also use the area for rearing. Adult summer-run Chinook salmon generally return to the river June through July, and adult fall-run Chinook salmon return between August and September (City of Everett 2001). Spawning can begin as early as late August, but the majority of spawning typically occurs between September and October (Haring 2002; City of Everett 2001). Young of the year juveniles are reported in the Snohomish River estuary February through September, with peak density occurring between May and June (Rice et al. 2014; Rowes and Fresh 2003), but stream-type fish may be present in the system year-round.

<u>Puget Sound (PS) steelhead</u>

The PS steelhead distinct population segment (DPS) was listed as threatened on May 11, 2007 (72 FR 26722). 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 MPGs; Northern Cascades, Central and South Puget Sound; and Hood Canal and Strait de Fuca (Myers et al. 2015) (Table 3). Critical habitat for Puget Sound steelhead DPS was designated by NMFS in 2016 (81 FR 9251, February 24, 2016). NMFS adopted the steelhead recovery plan for the Puget Sound DPS in December, 2019.

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 DIPs 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.

<u>General Life History:</u> 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).

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

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 (Ford 2022).

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 DIPs 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 DIPs. The long-term abundance of adult steelhead returning to many rivers in Puget Sound has fallen substantially since estimates began for many populations in the late 1970s and early 1980s. Despite relative improvements in abundance and productivity for some DIPs between 2015 and 2019, particularly in the Central and South Puget Sound MPG, low productivity persists throughout the 32 DIPs, with most showing long term downward trends (Ford 2022). Since the mid-1980s, trends in natural spawning abundance have also been temporally variable for most DIPs but remain predominantly negative, well below replacement for most DIPs, and most DIPs remain small (Ford 2022). 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 (Ford 2022). The PSSTRT concluded that the PS steelhead DPS is currently not viable (Hard et al. 2015). The most recent 5-year status review reported an increasing viability trend for the Puget Sound steelhead DPS, but also reported that the extinction risk remains moderate for the DPS, and that the DPS should remain listed as threatened (Ford 2022).

Limiting Factors: 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

PS Steelhead within the Action Area: The PS steelhead that occur in the action area are likely to be a mix of summer-run fish from the North Fork Skykomish and Tolt River DIPs, and winter-run fish from the Pilchuck, Snohomish/Skykomish, and Snoqualmie River DIPs (Ford 2022). PS steelhead from those DIPs utilize the Snohomish and Skykomish Rivers from the project site to Puget Sound for spawning, rearing, and migration (WDFW 2023).

The available abundance and trend data are difficult to interpret succinctly, but between 1980 and 2020, the abundance trends have been negative across the basin since the mid-1980s to the late-1990s. The annual numbers of returning adult fish from the Tolt River summer-run fluctuated between about 50 and 250 fish. Annual returns for the Snohomish/Skykomish winter-run fluctuated between about 500 and 4,000 fish. Annual returns for the Snoqualmie River winter-run fluctuated between about 450 and 2,250 fish. Annual returns for the Pilchuck River winter-run fluctuated between about 50 and 1,500 fish, and for the Tolt River summer-run, annual returns fluctuated between about 50 and 250 fish. However, natural-origin spawners account for nearly all of the returns in all four DIPs (Ford 2022).

Adult steelhead utilize the project area for migration, and WDFW identifies the area as spawning habitat for winter-run fish (WDFW 2023). Juvenile steelhead also use the area for migration and foraging, and may also use the area for rearing. Summer-run adults typically enter the river from May to October. Winter-run adults typically return to the river from November to early May. Hatchery fish predominate from November to February, while wild winter-run steelhead typically enter from February to April (R2 2008). In the Snohomish basin, steelhead spawning can occur anytime between December and June, depending upon the stock and race in question. The majority of spawning activity for hatchery stocks occurs late December through February, while wild fish spawning occurs primarily between March and mid-June (R2 2008). Juveniles may be present year-round, but typically migrate to marine waters between April and mid-May when they smoltify (Myers et al. 2015; R2 2008).

<u>Critical Habitat</u>

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 project site and surrounding area has been designated as critical habitat for PS Chinook salmon and PS steelhead.

The 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.

The NMFS designated critical habitat for PS steelhead on February 24, 2016 (81 FR 9252). That critical habitat is located in 18 freshwater subbasins between the Strait of Georgia Subbasin and the Dungeness-Elwha Subbasin, inclusively, but includes no marine waters.

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 CH are listed in Table 4.

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 wood 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 large wood recruitment (SSPS 2007).

Table 4. Physical or biological features (PBFs) of designated critical habitat for PS Chinook salmon and PS steelhead, with the corresponding life history events. Although offshore marine areas were identified in the final rule, none was designated as critical habitat.

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

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 large wood. The loss of side-channels, oxbow lakes, and backwater habitats has resulted in a significant loss of juvenile salmonid rearing and refuge habitat. When the water level of Lake Washington was lowered 9 feet in the 1910s, thousands of acres of wetlands along the shoreline of Lake Washington, Lake Sammamish and the Sammamish River corridor were drained and converted to agricultural and urban uses. 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, 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 large wood 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).

The freshwater critical habitat at and adjacent to the project site supports spawning, rearing, and migration for both species (NOAA 2023; WDFW 2023).

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).

The project site is located in the Skykomish River at its confluence with the Sultan River, at Sultan, Washington (Figures 1 and 2). As described in sections 2.5, the proposed action will result in short-term construction-related effects and long-term effects caused by the discharge of wastewater effluent. Construction-related effects are expected to extend up to 300 feet downstream from the in-water the construction area, whereas the downstream transport of wastewater contaminants is expected to extend to Puget Sound ay the mouth of the Snohomish River. Additionally, trophic connectivity between PS Chinook salmon and the SR killer whales that feed on them extends the action area to the marine waters of Puget Sound. The described area overlaps with the geographic ranges of the ESA-listed species and the boundaries of designated critical habitats identified in Table 1. The action area also overlaps with areas that have been designated, under the MSA, as EFH for Pacific Coast salmon, Pacific Coast groundfish, and coastal pelagic species.

2.4 Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. 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 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

Climate Change: Climate change is a factor affecting the environmental baseline, aquatic habitats in general, and the status of the ESA-listed species considered in this opinion. Although its effects are unlikely to be spatially homogeneous across the region, climate change is likely to play an increasingly important role in determining the abundance and distribution of ESA-listed species and the conservation value of designated critical habitats in the Pacific Northwest. Major ecological realignments are already occurring in response to climate change (IPCC WGII 2022). Long-term trends in warming have continued at global, national, and regional scales. Global surface temperatures in the last decade (2010s) were estimated to be 1.09 °C higher than the 1850-1900 baseline period, with larger increases over land ~1.6 °C compared to oceans ~0.88 °C (IPCC WGI 2021). The vast majority of this warming has been attributed to anthropogenic releases of greenhouse gases (IPCC WGI 2021). Globally, 2014 through 2018 were the 5 warmest years on record both on land and in the ocean (NOAA NCEI 2022). Events such as the 2013 through 2016 marine heatwave (Jacox et al. 2018) have been attributed directly to anthropogenic warming. Global warming and anthropogenic loss of biodiversity represent profound threats to ecosystem functionality (IPCC WGII 2022). These two factors likely have interacting effects on ecosystem function.

Updated projections of climate change are similar to or greater than previous projections (IPCC WGI 2021). NMFS is increasingly confident in our projections of changes to freshwater and marine systems because every year brings stronger validation of previous predictions in both physical and biological realms. Retaining and restoring habitat complexity, access to climate refuges (both flow and temperature), and improving growth opportunity in both freshwater and marine environments are strongly advocated for in the recent literature (Siegel and Crozier 2020).

Climate change is systemic, influencing freshwater, estuarine, and marine conditions. Other systems are also being influenced by changing climatic conditions. Literature reviews on the impacts of climate change on Pacific salmon (Crozier 2015; 2016; 2017; Crozier and Siegel 2018; Siegel and Crozier 2019; 2020) have collected hundreds of papers documenting the major themes relevant for salmon. Below, we describe habitat changes relevant to Pacific salmon and steelhead, prior to describing how these changes result in the varied specific mechanisms impacting these species in subsequent sections.

Forests

Climate change will continue to impact forests of the western U.S., which dominate the landscape of many watersheds in the region. Forests are already showing evidence of increased drought severity, forest fire, and insect outbreaks (Halofsky et al. 2020). Additionally, climate change will affect tree reproduction, growth, and phenology, which will lead to spatial shifts in vegetation. Halofsky et al. (2018) projected that the largest changes will occur at low- and high-elevation forests, with expansion of low-elevation dry forests and diminishing high-elevation cold forests and subalpine habitats.

Forest fires affect salmon streams by altering sediment load, channel structure, and stream temperature through the removal of canopy. Holden et al. (2018) examined environmental factors contributing to observed increases in the extent of forest fires throughout the western U.S. They found strong correlations between the number of dry-season rainy days and the annual extent of forest fires, as well as a significant decline in the number of dry-season rainy days over the study period (1984-2015). Consequently, predicted decreases in dry-season precipitation, combined with increases in air temperature, will likely contribute to the existing trend toward more extensive and severe forest fires and the continued expansion of fires into higher elevation and wetter forests (Alizedeh 2021).

Agne et al. (2018) reviewed literature on insect outbreaks and other pathogens affecting coastal Douglas-fir forests in the Pacific Northwest and examined how future climate change may influence disturbance ecology. They suggest that Douglas-fir beetle and black stain root disease could become more prevalent with climate change, while other pathogens will be more affected by management practices. Agne et al. (2018) also suggested that due to complex interacting effects of disturbance and disease, climate impacts will differ by region and forest type.

Freshwater Environments

The following is excerpted from Siegel and Crozier (2019), who present a review of recent scientific literature evaluating effects of climate change, describing the projected impacts of climate change on instream flows:

The magnitude of low river flows in the western U.S., which generally occur in September or October, and are driven largely by summer conditions and the prior winter's precipitation. Although, low flows are more sensitive to summer evaporative demand than to winter precipitation, interannual variability is greater for winter precipitation. Malek et al. (2018), predicted that summer evapotranspiration is likely to increase in conjunction with declines in snowpack and increased variability in winter precipitation, which suggests that summer flows are likely to become lower, more variable, and less predictable over time.

The effect of climate change on ground water availability is likely to be uneven. Sridhar et al. (2018) coupled a surface-flow model with a ground-flow model to improve predictions of surface water availability with climate change in the Snake River Basin. Projections using RCP 4.5 and 8.5 emission scenarios suggested an increase in water table heights in downstream areas of the basin and a decrease in upstream areas.

As cited in Siegel and Crozier (2019), Isaak et al. (2018), examined recent trends in stream temperature across the Western U.S. using a large regional dataset. Stream warming trends paralleled changes in air temperature and were pervasive during the low-water warm seasons of 1996-2015 (0.18-0.35°C/decade) and 1976-2015 (0.14-0.27°C/decade). Their results show how continued warming will likely affect the cumulative temperature exposure of migrating sockeye salmon O. nerka and the availability of suitable habitat for brown trout Salmo trutta and rainbow trout O. mykiss. Isaak et al. (2018) concluded that most stream habitats will likely remain suitable for salmonids in the near future, with some becoming too warm. However, in cases where habitat access is currently restricted by dams and other barriers salmon and steelhead will be confined to downstream reaches typically most at risk of rising temperatures unless passage is restored (FitzGerald et al. 2020; Myers et al. 2018).

Streams with intact riparian corridors and that lie in mountainous terrain are likely to be more resilient to changes in air temperature. These areas may provide refuge from climate change for a number of species, including Pacific salmon. Krosby et al. (2018), identified potential stream refugia throughout the Pacific Northwest based on a suite of features thought to reflect the ability of streams to serve as such refuges. Analyzed features include large temperature gradients, high canopy cover, large relative stream width, low exposure to solar radiation, and low levels of human modification. They created an index of refuge potential for all streams in the region, with mountain area streams scoring highest. Flat lowland areas, which commonly contain migration corridors, were generally scored lowest, and thus were prioritized for conservation and restoration. However, forest fires can increase stream temperatures dramatically in short time-spans by removing riparian cover (Koontz et al. 2018), and streams that lose their snowpack with climate change may see the largest increases in stream temperature due to the removal of temperature buffering (Yan et al. 2021). These processes may threaten some habitats that are currently considered refugia.

Marine and Estuarine Environments

Along with warming stream temperatures and concerns about sufficient groundwater to recharge streams, a recent study projects nearly complete loss of existing tidal wetlands along the U.S. West Coast, due to sea level rise (Thorne et al. 2018). California and Oregon showed the greatest threat to tidal wetlands (100%), while 68% of Washington tidal wetlands are expected to be submerged. Coastal development and steep topography prevent horizontal migration of most wetlands, causing the net contraction of this crucial habitat.

Rising ocean temperatures, stratification, ocean acidity, hypoxia, algal toxins, and other oceanographic processes will alter the composition and abundance of a vast array of oceanic species. In particular, there will be dramatic changes in both predators and prey of Pacific salmon, salmon life history traits and relative abundance. Siegel and Crozier (2019) observe that changes in marine temperature are likely to have a number of physiological consequences on fishes themselves. For example, in a study of small planktivorous fish, Gliwicz et al. (2018) found that higher ambient temperatures increased the distance at which fish reacted to prey. Numerous fish species (including many tuna and sharks) demonstrate regional endothermy, which in many cases augments eyesight by warming the retinas. However, Gliwicz et al. (2018) suggest that ambient temperatures can have a similar effect on fish that do not demonstrate this trait. Climate change is likely to reduce the availability of biologically essential omega-3 fatty acids produced by phytoplankton in marine ecosystems. Loss of these lipids may induce cascading trophic effects, with distinct impacts on different species depending on compensatory mechanisms (Gourtay et al. 2018). Reproduction rates of many marine fish species are also likely to be altered with temperature (Veilleux et al. 2018). The ecological consequences of these effects and their interactions add complexity to predictions of climate change impacts in marine ecosystems.

Perhaps the most dramatic change in physical ocean conditions will occur through ocean acidification and deoxygenation. It is unclear how sensitive salmon and steelhead might be to the direct effects of ocean acidification because of their tolerance of a wide pH range in freshwater (Ou et al. 2015 and Williams et al. 2019), however, impacts of ocean acidification and hypoxia on sensitive species (e.g., plankton, crabs, rockfish, groundfish) will likely affect salmon indirectly through their interactions as predators and prey. Similarly, increasing frequency and duration of harmful algal blooms may affect salmon directly, depending on the toxin (e.g., saxitoxin vs domoic acid), but will also affect their predators (seabirds and mammals). The full effects of these ecosystem dynamics are not known but will be complex. Within the historical range of climate variability, less suitable conditions for salmonids (e.g., warmer temperatures, lower stream flows) have been associated with detectable declines in many of these listed units, highlighting how sensitive they are to climate drivers (Ford 2022, Lindley et al. 2009, Ward et al. 2015; Williams et al. 2016). In some cases, the combined and potentially additive effects of poorer climate conditions for fish and intense anthropogenic impacts caused the population declines that led to these population groups being listed under the ESA (Crozier et al. 2019).

Climate change effects on salmon and steelhead

In freshwater, year-round increases in stream temperature and changes in flow will affect physiological, behavioral, and demographic processes in salmon, and change the species with which they interact. For example, as stream temperatures increase, many native salmonids face increased competition with more warm-water tolerant invasive species. Changing freshwater temperatures are likely to affect incubation and emergence timing for eggs, and in locations where the greatest warming occurs may affect egg survival, although several factors impact inter-gravel temperature and oxygen (e.g., groundwater influence) as well as sensitivity of eggs to thermal stress. Changes in temperature and flow regimes may alter the amount of habitat and food available for juvenile rearing, and this in turn could lead to a restriction in the distribution of juveniles, further decreasing productivity through density dependence. For migrating adults, predicted changes in freshwater flows and temperatures will likely increase exposure to stressful temperatures for many salmon and steelhead populations, and alter migration travel times and increase thermal stress accumulation for ESUs or DPSs with early-returning (i.e. spring- and summer-run) phenotypes associated with longer freshwater holding times (FitzGerald et al. 2020). Rising river temperatures increase the energetic cost of migration and the risk of in-route or pre-spawning mortality of adults with long freshwater migrations, although populations of some ESA-listed salmon and steelhead may be able to make use of cool-water refuges and run-timing plasticity to reduce thermal exposure (Barnett et al. 2020; Keefer et al. 2018).

Marine survival of salmonids is affected by a complex array of factors including prey abundance, predator interactions, the physical condition of salmon within the marine environment, and carryover effects from the freshwater experience (Burke et al. 2013; Holsman et al. 2012). It is generally accepted that salmon marine survival is size-dependent, and thus larger and faster growing fish are more likely to survive (Gosselin et al. 2021). Furthermore, early arrival timing in the marine environment is generally considered advantageous for populations migrating through the Columbia River. However, the optimal day of arrival varies across years, depending on the seasonal development of productivity in the California Current, which affects prey available to salmon and the risk of predation (Chasco et al. 2021). Siegel and Crozier (2019) point out the concern that for some salmon populations, climate change may drive mismatches between juvenile arrival timing and prey availability in the marine environment. However, phenological diversity can contribute to metapopulation-level resilience by reducing the risk of a complete mismatch. Carr-Harris et al. (2018), explored phenological diversity of marine migration timing in relation to zooplankton prey for sockeye salmon O. nerka from the Skeena River of Canada. They found that sockeye migrated over a period of more than 50 days, and populations from higher elevation and further inland streams arrived in the estuary later, with different populations encountering distinct prey fields. Carr-Harris et al. (2018) recommended that managers maintain and augment such life-history diversity.

Synchrony between terrestrial and marine environmental conditions (e.g., coastal upwelling, precipitation and river discharge) has increased in spatial scale causing the highest levels of synchrony in the last 250 years (Black et al. 2018). A more synchronized climate combined with simplified habitats and reduced genetic diversity may be leading to more synchrony in the productivity of populations across the range of salmon (Braun et al. 2016). For example, salmon productivity (recruits/spawner) has also become more synchronized across Chinook populations from Oregon to the Yukon (Dorner et al. 2018, Kilduff et al. 2014). In addition, Chinook salmon have become smaller and younger at maturation across their range (Ohlberger 2018). Other Pacific salmon species (Stachura el al. 2014) and Atlantic salmon (Olmos et al. 2020) also have demonstrated synchrony in productivity across a broad latitudinal range.

At the individual scale, climate impacts on salmon in one life stage generally affect body size or timing in the next life stage and negative impacts can accumulate across multiple life stages (Gosselin et al. 2021; Healey 2011; Wainwright and Weitkamp 2013). Changes in winter precipitation will likely affect incubation and/or rearing stages of most populations. Changes in the intensity of cool season precipitation, snow accumulation, and runoff could influence migration cues for fall, winter and spring adult migrants, such as coho and steelhead. Egg survival rates may suffer from more intense flooding that scours or buries redds. Changes in hydrological regime, such as a shift from mostly snow to more rain, could drive changes in life history, potentially threatening diversity within an ESU (Beechie et al. 2006). Changes in summer temperature and flow will affect both juvenile and adult stages in some populations, especially those with yearling life histories and summer migration patterns (Crozier and Zabel 2006; Crozier et al. 2010; Crozier et al. 2019).

At the population level, the ability of organisms to genetically adapt to climate change depends on how much genetic variation currently exists within salmon populations, as well as how selection on multiple traits interact, and whether those traits are linked genetically. While genetic diversity may help populations respond to climate change, the remaining genetic diversity of many populations is highly reduced compared to historic levels. For example, Johnson et al. (2018), compared genetic variation in Chinook salmon from the Columbia River Basin between contemporary and ancient samples. A total of 84 samples determined to be Chinook salmon were collected from vertebrae found in ancient middens and compared to 379 contemporary samples. Results suggest a decline in genetic diversity, as demonstrated by a loss of mitochondrial haplotypes as well as reductions in haplotype and nucleotide diversity. Genetic losses in this comparison appeared larger for Chinook from the mid-Columbia than those from the Snake River Basin. In addition to other stressors, modified habitats and flow regimes may create unnatural selection pressures that reduce the diversity of functional behaviors (Sturrock et al. 2020). Managing to conserve and augment existing genetic diversity may be increasingly important with more extreme environmental change (Anderson et al. 2015), though the low levels of remaining diversity present challenges to this effort (Freshwater 2019). Salmon historically maintained relatively consistent returns across variation in annual weather through the portfolio effect (Schindler et al. 2015), in which different populations are sensitive to different climate drivers. Applying this concept to climate change, Anderson et al (2015) emphasized the additional need for populations with different physiological tolerances. Loss of the portfolio increases volatility in fisheries, as well as ecological systems, as demonstrated for Fraser River and Sacramento River stock complexes (Freshwater et al. 2019; Munsch et al. 2022).

Environmental conditions at the project site and the surrounding area: The project site is located in the Skykomish River at its confluence with the Sultan River, at Sultan, Washington (Figures 1 and 2). The project site is more than 30 miles inland from Puget Sound, well outside of the zone of tidal influence. The Skykomish River is part of the Snohomish River Basin that originates in the Cascade Mountains. The Skykomish River runs about 29 miles before converging with the

Snoqualmie River and then on to the Snohomish River. The upper Skykomish River mainstem has a steep gradient which transports sediment quickly through confined channels. As the river gradient decreases downstream of Gold Bar, gravel and cobble settle out, forming multiple channels and excellent spawning riffles and rearing habitat (Snohomish Basin Salmon Recovery Forum 2005). In the lower reaches, the river banks are armored in many places, which limits the development of side-channel rearing habitat.

Forestry is most dominant in the highest elevation areas, including the Upper North Fork Skykomish and South Fork Skykomish watershed upstream of Sunset Falls (Snohomish Basin Salmon Recovery Forum 2005). Forest lands or wilderness comprise about 75 percent of the Snohomish River basin, which contributes to greater hydrologic and riparian function and better sediment conditions than are found in other basins across Puget Sound (SSPS 2007). About 50 percent of forest lands within the basin are in federal ownership. Much of this federal land is contained within designated wilderness, and the remainder is managed under the Northwest Forest Plan that limits most activities to restoration. Although forestry practices on private and state-managed forest lands within the action area are limited by federally approved habitat conservation plans, those practices have resulted in degradation and fragmentation of freshwater habitat, with consequent reduced connectivity, which are primary limiting factors and threats that affect salmon and steelhead in the Snohomish River basin. Logging road failures in the upper basins, including the upper Skykomish River reaches, has resulted in channel destabilization and sedimentation, which has degraded the quality of salmon and steelhead spawning habitat.

The land use on either side of the Skykomish River’s upper reaches and mainstem is mostly rural with interspersed municipalities. The greater Snohomish Basin faces heavy development pressure, especially in its lower reaches and estuaries. Streamside vegetation removal has occurred throughout the watershed to create lawns, stream access, and livestock grazing areas, resulting in bank erosion and loss of fish and aquatic habitat. Wetlands throughout the watershed have been extensively filled or modified.

The project site is outside of any areas identified on the Washington State Department of Ecology (WDOE) Water Quality Assessment 303(d) list for impaired water or sediment quality. However, the Skykomish River is listed at two locations within ten miles upstream of the outfall. About 8.5 miles upstream of the outfall site, near the city of Gold Bar, about 2.5 miles of the Skykomish River has a Category 2 (waters of concern) rating for fecal coliform. Less than half a mile downstream of that, an about 0.7 mile stretch of the Skykomish River has a Category 2 rating for hexachlorobenzene; toxaphene, 2, 3, 7, 8; -TCDD TEQ; Polychlorinated Biphenyls (PCBs); and methyl mercury. The Sultan River, immediately upstream of the outfall site has a Category 2 rating for dissolved oxygen, as do McCoy Creek and an unnamed creek, both located less than 2 miles downstream of the outfall site (WDOE 2023a). Additionally, the Sultan WWTP continuously discharges upwards of almost 1 MGD of Level-II-treated wastewater effluent to the Skykomish River though its outfall at the project site.

Adult and juvenile PS Chinook salmon and PS steelhead migrate through the project area, and Chinook salmon spawning is documented in the reach, as well as downstream from it. Juveniles of both species likely shelter and forage in the project area and in areas downstream from it. The project area has also been designated as critical habitat for both species. The past and ongoing anthropogenic impacts described above have impacted these species and attributes of critical habitat at the project site and in areas downstream from it.

2.5 Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action (see 50 CFR 402.02). A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered the factors set forth in 50 CFR 402.17(a) and (b).

As described in Section 1.3, between August 1 and August 14, the City of Sultan would conduct about 1 week of work on the bank and in the water to remove and replace a WWTP outfall in the Skykomish River (Figure 2). The new HDPE outfall pipe would be 12-inches in diameter and about 80 feet long, with attached concrete weights that would be bolted to existing riprap. The work would require the use of a workboat, divers, and an upland construction crew, hand tools, and some sort of winch to haul the shoreward end of the new pipe to its connection point. To protect the new pipe, the construction crew would install about 3 cubic yards of 8-inch rock in 2.5-foot wide strips along both sides of the shoreward most 15 feet of pipe. When installed, the discharge end of the new outfall would be about 100 feet offshore from the OHWM on the near (right) bank, and about 20 feet below the water's surface during OHW.

The best available information about the proposed work supports the understanding that the construction would cause direct effects on fish and habitat resources at the project site through exposure to work-related noise, water contamination, and propeller wash. The proposed work would also cause indirect effects on fish and habitat resources through altered substrate. Additionally, although the proposed action would cause no change in the chemical nature of the effluent discharged by the outfall pipeline, it would slightly relocate the point of discharge, cause several decades of continued municipal effluent discharge into the Skykomish River, and increase the maximum flow volume capacity from 0.7 MGD to 1.1 MGD (~ 36 % increase). Therefore, the project would also cause indirect effects on fish and habitat resources through effluent-related impacts.

As described in Section 2.2, adult and juvenile PS Chinook salmon and PS steelhead migrate annually through the project area. Additionally, eggs, larva, and rearing juveniles of both species could also be episodically present in the affected area. Further, and the project area has been designated as critical habitat for PS Chinook salmon and PS steelhead.

As described in Section 2.2, PS Chinook salmon and PS steelhead utilize the project area, and the project area has been designated as critical habitat for both species. For Chinook salmon, the proposed in-water work window overlaps with the in-stream holding period for summer-run adults and the immigration season for fall-run adults. Also, very low numbers of stream-type juveniles may be present in the project area. The proposed work window avoids the emigration season for juveniles as well as spawning season for both runs. For steelhead, the proposed in-water work window overlaps with the immigration season for summer-run adults, and low numbers of rearing juveniles could be present. The proposed work window avoids the emigration season for juveniles as well as the spawning seasons for both runs.

Therefore, pre-spawning adults and rearing juveniles of both species, as well as the PBFs of critical habitat for both species may be exposed to the direct effects of the project. Additionally, eggs, larva, juveniles, adults, and the PBFs of critical habitat for both species would be exposed to discharged WWTP effluent at the project site and in downstream areas for decades to come.

2.5.1 Effects on Listed Species

Work-related Noise

The proposed in-water work, and workboat operations would cause fish-detectable levels of in-water noise. Exposure to that noise would adversely affect juvenile PS Chinook salmon and PS steelhead, and cause minor effects on adults of both species.

The effects caused by a fish's exposure to noise vary with the hearing characteristics of the fish, the frequency, intensity, and duration of the exposure, 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 (Mueller 1980; Picciulin et al. 2010; 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 damage (a.k.a. temporary threshold shift (TTS), 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 (PTS)) and mortality. The best available information about the auditory capabilities of the fish considered in this opinion suggest that their hearing capabilities are limited to frequencies below 1,500 Hz, with peak sensitivity between about 200 and 300 Hz (Hastings and Popper 2005; Picciulin et al. 2010; Scholik and Yan 2002; Xie et al. 2008).

The NMFS uses two metrics to estimate the onset of injury for fish exposed to high intensity impulsive sounds (Stadler and Woodbury 2009). The metrics are based on exposure to peak sound level and sound exposure level (SEL). Both are expressed in decibels (dB). The metrics are: 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. Further, any received level (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 potentially experience TTS or PTS from the noise, regardless of accumulation of the sound energy (Stadler and Woodbury 2009). When the range to the 150 dB_{SEL} isopleth exceeds the range to the applicable SEL_{CUM} isopleth, the distance to the 150 dB_{SEL} isopleth is typically considered the range at which detectable behavioral effects would begin, with the applicable SEL_{CUM} isopleth identifying the distance within which sound energy accumulation would intensify effects. However, when the range to the 150 dB_{SEL} isopleth is less than the range to the applicable SEL_{CUM} isopleth, only the 150 dB_{SEL} isopleth would apply because no accumulation of effects are expected for noise levels below 150 dB_{SEL}. This assessment considers the range to the 150 dB_{SEL} isopleths as the maximum ranges for detectable acoustic effects from exposure to work-related noise.

The discussion in Stadler and Woodbury (2009) indicate that these thresholds likely overestimate the potential effects of exposure to impulsive sounds. Further, Stadler and Woodbury's assessment did not consider non-impulsive sound, which is believed to be less injurious to fish than impulsive sound. Therefore, application of the criteria to non-impulsive sounds is also likely to overestimate the potential effects in fish. However, these criteria represent the best available information. Therefore, to avoid underestimating potential effects, this assessment applies these criteria to the impulsive and non-impulsive sounds that are expected from the proposed work to gain a conservative idea of the potential effects that fish may experience due to exposure to that noise.

Elevated in-water noise at levels capable of causing detectable effects in exposed fish would be caused by up to 1 week in-water work that would include the use of a workboat and in-water use of power tools such as saws, drills, and wrenches.

The estimated source levels (SL, sound level at 1 meter from the source) and acoustic signature information used in this assessment for in-water work are based on the best available information, as described in multiple acoustic assessments for similar projects (NMFS 2016; 2018a), and in other sources (CalTrans 2015; Dickerson et al. 2001; FHWA 2017; Picciulin et al. 2010; Reine et al. 2012 & 2014; Richardson et al. 1995).

The best available information supports the understanding that all of SLs for in-water work would be below the 206 dB_{peak} threshold for the onset of instantaneous injury in fish. In the absence of location-specific transmission loss data, variations of the equation RL = SL – #Log(R) is often used to estimate the received sound level at a given range from a source (RL = received level (dB); SL = source level (dB, 1 m from the source); # = spreading loss coefficient; and R = range in meters (m). Numerous acoustic measurements in shallow water environments support the use of a value close to 15 for projects like this one (CalTrans 2015). This value is considered the practical spreading loss coefficient, and was used for all sound attenuation calculations in this assessment. Application of the practical spreading loss equation to the expected SLs for in-water work suggests that noise levels above the 150 dB_{SEL} threshold could extend to about 72 feet (22 m) around the workboat, and 33 feet (10 m) during power tool use (Table 5).

Project-related workboat operations and in-water power tool use would likely occur daily during the 1 week of in-water work, and consist of relatively continuous periods during any day they are used. Any or all of these sound sources could overlap temporally during the completion of this project. However, the sound sources are very unlikely to have any additive effects on sound intensity due the differences in the frequencies and other characteristics of their sounds. At most, the combination of the various types of equipment noise during any given day would cause fish-detectable in-water noise levels across the entire workday.

Table 5. Estimated in-water source levels for the loudest expected project-related sources with the estimated ranges to the source-specific effects thresholds for fish.

Source	Acoustic Signature	Source Level	Threshold Range
Workboat based on a standard tugboat	< 2 kHz Combination	185 dB_{peak}	206 dB_{peak} @ N/A
Episodic periods measured in minutes to hours over a 1-week period.		170 dB_{SEL}	187 SEL_{CUM} @ 6 m
		170 dB_{SEL}	150 dB_{SEL} @ 22 m
Pneumatic Tools (i.e. impact wrench)	Est. < 2 kHz Impulsive	185 dB_{peak}	206 dB_{peak} @ N/A
Episodic periods measured in minutes to hours over a 1-week period.		165 dB_{SEL}	187 SEL_{CUM} @ 4 m
		165 dB_{SEL}	150 dB_{SEL} @ 10 m
Pumps	Est. < 2 kHz Impulsive	181 dB_{peak}	206 dB_{peak} @ N/A
Episodic periods measured in minutes to hours over a 1-week period.		161 dB_{SEL}	187 SEL_{CUM} @ 2 m
		161 dB_{SEL}	150 dB_{SEL} @ 5 m
Air Compressor	Est. < 2 kHz Impulsive	178 dB_{peak}	206 dB_{peak} @ N/A
Episodic periods measured in minutes to hours over a 1-week period.		158 dB_{SEL}	187 SEL_{CUM} @ 2 m
		158 dB_{SEL}	150 dB_{SEL} @ 3 m

To be protective of fish, this assessment estimates work-related in-water noise levels above the 150 dB_{SEL} threshold would be continuously present at the project site for 1 week, and that the area of effect for fish would be described as a circular area with a 72-foot radius around the workboat, and a overlapping oval areas that would extend about 33 feet either side of the existing outfall's 40-foot length, and the proposed outfall's 80-foot length.

The instantaneous noise levels would be non-injurious. However, Chinook salmon and steelhead that are within the 150 dB_{SEL} isopleth, are likely to experience behavioral disturbances, such as avoidance of the area and or delayed migration past the project area, acoustic masking, startle responses, altered swimming patterns, and increased risk of predation for juveniles. The intensity of these effects would increase with increased proximity to the source and or duration of exposure. Response to this exposure would be non-lethal in most cases, and would be unlikely to cause any detectable fitness impacts or meaningful changes in the normal behaviors of adults. However, some juveniles are likely to experience stress and fitness effects that could reduce their long-term survival, and individuals that are eaten by predators would be killed.

The number of juvenile PS Chinook salmon that would be impacted by this stressor, and the intensity of any effects that an exposed individual may experience are unquantifiable with any degree of certainty. However, based on the project's timing and very short duration of work, the number of individuals likely to be exposed to work-related noise would comprise extremely small subsets of their population's cohort. Further, the number of individuals that are likely to be measurably affected by the exposure would most likely comprise a small subset of the total number of exposed individuals. Therefore, the numbers of juvenile PS Chinook salmon and PS steelhead that would be meaningfully affected by work-related noise would be too low to cause detectable population-level effects.

<u>Work-related Water Contamination</u>

The proposed project would cause water quality impacts through increased turbidity and introduction of toxic materials. Exposure to these stressors would adversely affect juvenile PS Chinook salmon and juvenile PS steelhead, and cause minor effects on adults of both species.

Turbidity: Workboat operations, including anchor deployment and recovery, as well as divers conducting in-water work to remove and replace the outfall pipe would mobilize bottom sediments and cause turbidity plumes with various concentrations of total suspended sediments (TSS). The intensity of turbidity is typically measured in Nephlometric Turbidity Units (NTU) that describe the opacity caused by the suspended sediments, or by the concentration of TSS as measured in milligrams per liter (mg/L). A strong positive correlation exists between NTU values and TSS concentrations. Depending on the particle sizes, NTU values roughly equal the same number of mg/L for TSS (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 are relatively comparable.

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 of turbidity on fish 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. Bjornn and Reiser (1991) report that adult and larger juvenile salmonids appear to be little affected by the high concentrations of suspended sediments that may be mobilized during storm and snowmelt runoff episodes. However, empirical data from numerous studies report the onset of minor physiological stress in juvenile and adult salmon after one hour of continuous exposure to suspended sediment concentration levels between about 1,100 and 3,000 mg/L, or to three hours of exposure to 400 mg/L, and seven hours of exposure to concentration levels as low as 55 mg/L (Newcombe and Jensen 1996). The authors reported that serious non-lethal effects such as major physiological stress and reduced growth were reported after seven hours of continuous exposure to 400 mg/L and 24 hours of continuous exposures to concentration levels as low as about 150 mg/L.

Workboat propeller wash would be the project activity most likely to mobilize the most bottom sediments. The intensity and duration of the resulting turbidity plumes are uncertain, and would depend on a combination of the boat's thrust, the water depth under it, and the type of substrate. The higher the thrust and the finer the sediment, the more sediment that is likely to be mobilized. Fine material (silt) remains mobilized longer than coarse material (sand). The shallower the water, the more thrust energy that would reach the substrate. A recent study described the turbidly caused by large tugboats operating in Navy harbors (ESTCP 2016). At about 13 minutes, the plume extended about 550 yards (500 m), where the TSS concentration was about 80 mg/L. The plume persisted for hours and extended far from the event, but the TSS concentration fell to 30 mg/L within 1 hour and to 15 mg/L within 3 hours. At its highest concentration, the plume was below the concentrations required to elicit physiological responses reported by Newcombe and Jensen (1996). Based on the small size of the workboat and the expected work to be done, it is extremely unlikely that the intensity and duration of the resulting turbidity would be anything close to the conditions described above. Based on that information, and on the consultations for similar projects in the region, sediment mobilization from workboat propeller wash would likely consist of relatively low-concentration plumes that could extend no more than 300 feet from the workboat, and due to river currents, last no more than minutes in any area after the disturbance ends.

To be protective of fish, this assessment assumes that work-related turbidity may extend as far as 300 feet from in-water work, but at levels below the limits stated immediately above. The most likely effects of salmonid exposure to the expected action-related turbidity concentrations would be temporary behavioral effects such as avoidance of the plume, mild gill flaring, and slightly reduced feeding rates during the exposure.

<u>Toxic Materials:</u> The proposed workboat operations is likely to introduce toxic materials to the water from equipment-related spills and discharges, as may the use of upland construction equipment.

The operation of vessels and construction equipment routinely results in leaks and spills of fuels, lubricants, and other fluids that can enter the water. Many of the fuels, lubricants, and other fluids commonly used in vessels and construction equipment are petroleum-based hydrocarbons that contain Polycyclic Aromatic Hydrocarbons (PAHs), PCBs, phlalates, other organic compounds, and metals. The project includes BMPs specifically intended to reduce the risk and intensity of discharges and spills. In the event of a spill or discharge, the event would likely be relatively small, quickly contained and cleaned. Based on the best available information, the in-water presence of contaminants related to vessel and equipment operation would be infrequent, short-lived, and at relatively low concentrations.

Fish 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). 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 (Beitinger and Freeman 1983; 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).

PAHs can cause reduced growth, increased susceptibility to infection, and increased mortality in juvenile salmonids (Eisler 1987; Meador et al. 2006; Varanasi et al. 1993). Gill tissues are highly susceptible to damage because they actively pass large volumes of water and are thereby exposed to PAHs present in water (USACE 2016). Other effects include damage to the skin, fins, and eyes, as well as damage to internal organs as liver tumors.

To summarize, within 300 feet, the project’s in-water work would cause water quality impacts through increased turbidity and the introduction of toxic materials. Within that distance, turbidity and pollutant concentrations are unlikely to exceed thresholds for acute injuries or mortality. However, exposure would likely cause temporary behavioral disturbances such as avoidance of the affected area, altered migration, gill flaring, reduced feeding rates, reduced swimming performance, and increased vulnerability to predators. The exposure may also act synergistically with work-related noise to increase the likelihood and or intensity of avoidance and vulnerability to predators in exposed individuals. It may also act additively with other exposures to toxicants to induce long-term fitness impacts such as reduced growth and altered immune function that could reduce the long-term survival in exposed individuals.

The number of juvenile PS Chinook salmon and or juvenile PS steelhead that would be impacted by this stressor, and the intensity of any effects that an exposed individual may experience are unquantifiable with any degree of certainty. However, for the same reasons stated above for work-related noise, the number of individuals likely to pass the project area during the proposed work would comprise very small subsets of their populations' cohorts. Further, the numbers of individuals that are likely to be measurably affected by an exposure would most likely comprise small subsets of the total numbers of exposed individuals. Therefore, the numbers of PS Chinook salmon and PS steelhead that would be meaningfully affected by work-related water contamination would be too low to cause detectable population-level effects.

Work-related Propeller Wash

Work-related propeller wash is not likely to adversely affect PS Chinook salmon or PS steelhead, but cause only minor effects in adults. For the reasons stated at the beginning of this section, it is extremely unlikely that any PS/GB bocaccio would be exposed to this stressor.

Spinning boat propellers kill fish and small aquatic organisms (Killgore et al. 2011; VIMS 2011). Spinning propellers also generate fast-moving turbulent water (propeller wash) that can displace and disorient small fish, as well as dislodge benthic aquatic organisms and submerged aquatic vegetation (SAV), particularly in shallow water and or at high power settings (propeller scour).

However, based on the timing, duration, and location of the proposed workboat operations, it is extremely unlikely that juveniles of either species would be in close enough proximity to workboat operations to be meaningfully affected by propeller wash. Based on their much larger size, adults of both species would be able to avoid the boat, and to swim against its propeller wash without experiencing any measurable effect on their fitness or normal behaviors.

Altered Substrate

Altered substrate would adversely affect juvenile PS Chinook salmon and juvenile PS steelhead. The project would install an 80-foot long, 12-inch diameter, outfall pipe with concrete anchors, and 75 square feet of protective rock that would be installed in a 2.5-foot wide band of 8-inch rocks on each side of the shoreward 15 feet of the new pipe.

The new pipe and its protective rock would cover sloping unconsolidated river sediments that that would normally support submerged aquatic vegetation (SAV) and benthic organisms along the upper bank of the river. The pipe and its protective rocks would create a hardened, steepened, and porous structure that would rise about 1 foot above the substrate across preferred migratory habitat of juvenile salmonids, creating habitat conditions that are likely to affect the migratory behaviors of juvenile salmonids. Additionally, the pipe and its protective rock would provide habitat conditions that are preferred by piscivorous fish that prey on juvenile salmonids (Edwards and Cunjak 2007; Peters et al. 1998).

With the exception of out-migrating steelhead smolts, most juvenile salmonids within rivers and streams exhibit shoreline obligation. This means that they are biologically compelled to follow the bank and to aggregate in shallow-water edge habitats. Conversely, steelhead smolts and adult salmonids tend toward the center of rivers and streams. Additionally, studies show that juvenile salmonids tend to select natural banks over hardened ones (Beamer and Henderson 1998; Peters et al. 1998), which are also typically degraded as compared to natural banks (Heerhartz and Toft 2015). Therefore, most rearing and migrating juvenile salmonids that encounter the pipeline are likely to selectively avoid the area in favor of undisturbed habitat, which may include swimming into deeper water.

Avoidance of the pipeline may increase inter- and intraspecific competition in adjacent areas. Swimming into deeper water to go around the pipeline would increase juvenile salmonids' exposure and vulnerability to predators, while also reducing their own foraging success. Predatory attacks tend to be more successful in deeper water than in the very shallow water. Willette (2001) found that piscivorous predation of juvenile salmon increased fivefold when juvenile salmon were forced to leave shallow nearshore habitats. Also, foraging in deeper water typically has higher energetic costs for juvenile salmonids than foraging in shallow shoreline waters (Heerhartz and Toft 2015). Alternatively, juveniles that remain in close proximity to the pipeline may experience decreased fitness and reduced likelihood of survival due to increased risk of predation, as well as to reduced forage availability and increased energetic costs caused by foraging in the suboptimal habitat along the new pipeline (Heerhartz and Toft 2015).

In summary, the upper portion of the new pipeline and it protective rock is likely to slightly alter the migratory behaviors of juvenile salmonids, to improve habitat conditions for fish that prey on juvenile salmonids, and to reduce the availability of shelter and forage resources for juvenile salmonids. The number of juvenile PS Chinook salmon and or juvenile PS steelhead that would be impacted by this stressor, and the intensity of any effects that an exposed individual may experience are unquantifiable with any degree of certainty. However, based on the location and the very small size of the affected area, the numbers of individuals likely to pass the project area annually would comprise very small subsets of their populations' cohorts. Further, the numbers of individuals that are likely to be measurably affected by an exposure would most likely comprise small subsets of the total numbers of exposed individuals. Therefore, the numbers of PS Chinook salmon and PS steelhead that would be meaningfully affected by altered substrate would be too low to cause detectable population-level effects.

Effluent-related Impacts

Effluent-related impacts would adversely affect juvenile PS Chinook salmon and juvenile PS steelhead. The proposed action would result in the decades-long continuation of WWTP effluent discharge to the Skykomish River, would slightly relocate the point of discharge in the river (Figure 2), and would also facilitate an increase in the WWTP's maximum month design flow.

Background: The Sultan WWTP treats wastewater from residential and associated commercial developments, including restaurants, schools, and one industrial user for a population of about 6,000 residents. There no intentional inclusion of stormwater into the sewer system (i.e. it is a separated system). The WWTP provides secondary treatment, using extended aeration activated sludge technology to remove a minimum of 85 percent of the influent's suspended and dissolved solids. The existing diffuser is located in the Skykomish River, at its confluence with the Sultan River, near the southwest corner of the city. The outfall is located close to the river's thalweg, about 100 feet waterward of the OHWM along the right bank of the river, and at a water depth of about 8 feet during low summer flows (WDOE 2018a; 2023b).

The Sultan WWTP is a relatively small facility, currently permitted for a maximum month design flow of 0.72 MGD. By comparison, the King County South WWTP is permitted for a maximum month design flow of 144 MGD (WDOE 2015).

The Sultan WWTP currently discharges its effluent under National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit No. WA0023302, which was issued by the WDOE on March 12, 2018 (WDOE 2018b), and administratively extended past its March 31, 2023 expiration date while the City's permit renewal application is being processed (WDOE 2023c). The permit requires that discharges comply with the provisions of the State of Washington Water Pollution Control Law Chapter 90.48 Revised Code of Washington and the Federal Water Pollution Control Act (Clean Water Act) Title 33 United States Code, Section 1342 et seq. With the exception of limited circumstances, the permit prohibits the intentional diversion of waste streams from any portion of a treatment facility (bypass).

The current NPDES permit limits the discharge of Biochemical Oxygen Demand (5-day; BOD_5) and total suspended solids (TSS) to weekly averages of 270 pounds per day, each; pH to 6.0 to 9.0 standard units; fecal coliform bacteria to a weekly geometric mean of 400 cfu/100ml, and total residual chlorine (TRC) to a daily maximum of 0.75 mg/L. The permitted chronic mixing zone extends from the riverbed to the surface, between 100 feet upstream to 308 feet downstream of the outfall, with a maximum width of 50 feet. The acute mixing zone also extends from the riverbed to the surface, but is limited to within 10 feet upstream to 31 feet downstream of the outfall, with a maximum width of 5 feet. Note that the NPDES permit states an acute mixing zone width of 50 feet, but that is a typographical error (Gray & Osborne. 2023b).

The City's ongoing WWTP upgrades would increase the plant's maximum month design flow from 0.72 MGD to 1.1 MGD, which would be facilitated by the proposed project, which would install a 12-inch diameter, single-port diffuser at about 100 feet from the OHWM, and 20 below OHW (about the same distance from shore and depth as the existing outfall), but about 100 feet farther downstream, and oriented in a more downstream alignment than the existing outfall to improve mixing.

The renewed NPDES permit is expected to be issued after the ongoing WWTP upgrades are completed. The exact limits of the renewed NPDES permit are undetermined at the time of writing this opinion. However, based on the best available information (Gray & Osborne. 2023a-c; WDOE 2023b), the renewed permit would include some changes over the existing permit, the most notable of which would be a new maximum month design flow of 1.1 MGD (about a 53% increase over the current permit), and BOD_5 and TSS weekly averages would increase to 271 and 298 pounds per day, respectively. The pH, fecal coliform bacteria, and TRC limits would remain unchanged, as would the permitted mixing zones (Gray & Osborne. 2023a-c).

Based on the best available information, we have identified acute toxicity, chronic accumulation of contaminants (chronic toxicity), and exposure to altered environmental conditions as potential effects associated with the discharge of wastewater through the new outfall.

Acute Toxicity and Chronic Accumulation of Contaminants

Contaminants and Potential Effects: As described under Work-related Water Contamination, fish can uptake contaminants directly through their gills, and through dietary exposure. Direct exposure to effluent-borne pollutants can cause effects in exposed fish that range from avoidance behaviors, to reduced growth, altered immune function, and immediate mortality. The intensity of effects depends largely on the pollutant, its concentration, the duration of exposure, and the life stage of the exposed individual.

In addition to the pollutants identified above, WWTP effluent typically includes Anthropogenic Trace Compounds (ATCs), which are unregulated and of growing concern in aquatic habitats. ATCs include micropollutants, such as pharmaceuticals and personal care products (PPCPs), as well as surfactants, industrial chemicals, and pesticides that are discharged in municipal wastewater (Gerbersdorf et al. 2015; USEPA 2013). Microplastics and automotive-related pollutants are other pollutants of growing concern that are discharged in municipal wastewater (Chan et al. 2019; Du et al. 2017; Garcia et al. 2020; Gola et al. 2021; Mason et al. 2016; Masoner et al. 2019; NWFSC 2022a & b; Peter et al. 2018; Tian et al. 2020).

WWTP effluents are a major source of ATCs in aquatic habitats, including marine and coastal environments (Fabbri and Franzellitti 2016; Harding et al. 2016; Lubliner et al. 2010; Mottaleb et al. 2015; Srain et al. 2020; Valder et al. 2014). ATCs and microplastics are continuously discharged into all of the sanitary sewer systems of the world due to routine household and industrial use of source products. Automotive-related pollutants are sometimes improperly disposed of directly into sanitary sewer systems. They also enter sanitary sewer systems that are combined with local stormwater discharge systems.

Standard waste water treatment systems, including secondary treatment systems are not designed to remove ATCs, microplastics, and automotive-related pollutants, and consequently remove only a portion of those pollutants from the wastewater stream (Gerbersdorf et al. 2015; Lubliner et al. 2010; Mason et al. 2016; Ramirez et al. 2009; USEPA 2013). Tertiary treatment systems typically remove only select pollutants effectively (USEPA 2013).

Therefore, nearly all municipal WWTP effluents contain a complex mixture of ATCs that include antibiotics, analgesics, endocrine disruptors, microbial disinfecting substances, carcinogens, toxic chemicals, as well as microplastics that are discharged to receiving waters on a continuous basis (Gerbersdorf et al. 2015; Jobling et al. 1998; Kidd et al. 2007; Lubliner et al. 2010; Mason et al. 2016; Ramirez et al. 2009; USEPA 2013). A recent survey of surface and groundwater sources that was done by the U.S. Geological Survey (USGS) found Hexahydrohexa methylcyclopentabenzopyran (HHCB; a synthetic musk used as a fragrance in cosmetics) was the most commonly detected PPCP, followed by chloroform and tri(2-utoxyethyl)phosphate (Valder et al. 2014). HHCB is considered very toxic to aquatic life with long lasting effects (NIH 2022). The U.S. Environmental Protection Agency's (USEPA) National Rivers and Streams Assessment found 7 pharmaceuticals and 2 personal care product chemicals in the fish tissue samples, with antihistamines, antidepressants, and musks being the most prevalent (USEPA 2013). Nearly all municipal WWTP effluents also continuously contain millions of microplastic particles (Mason et al. 2016). During rainstorms, the effluents from

WWTPs with combined sewer and stormwater inflows would also include automotive-related pollutants such as PAHs, 6-PPD and 6-PPD Quinone (6PPD-q), trace metals, and other pollutants that enter the wastewater stream from roadway stormwater drainage systems (NWFSC 2022a).

ATCs, microplastics, and automotive-related pollutants usually occur in aquatic habitats at low but consistent concentrations. However, many aquatic species, including salmonids, experience sub-lethal adverse effects from exposure to ATCs at environmentally relevant concentrations (low nanogram per liter ng/L range), particularly for pharmaceuticals and pesticides that are designed to cause physiological effects at very low concentrations (Fabbri and Franzellitti 2016; Gerbersdorf et al. 2015; Lubliner et al. 2010; Parrott and Blunt 2005; Srain et al. 2020; USEPA 2013). In freshwater environments, adult coho salmon are known to experience lethal effects from exposure to environmentally relevant concentrations of automotive-related pollutants (NWFSC 2022a).

ATCs are increasingly reported in a variety of biological matrices, including fish tissue (Ramirez et al. 2009). Additionally, most PPCPs are persistent and tend to bioaccumulate in cell tissue (Mottaleb et al. 2015; Muir et al. 2017; Srain et al. 2020). Therefore, for fish that remain within an affected waterbody, or for those that migrate past numerous WWTP discharges, there is a high probability of cumulative effects from chronic exposure to the persistent and complex cocktail of ATCs in their environments (Gerbersdorf et al. 2015; Jobling et al. 1998; USEPA 2013)

Exposure to PPCPs at environmentally relevant concentrations has been shown to cause a wide range of sub-lethal metabolic effects and or tissue damage across a diverse list of aquatic species that included fish, arthropods, mollusks, echinoderms, planktonic invertebrates, plants, and bacteria, and some organisms experienced lethal effects at higher concentrations (Srain et al. 2020). PPCPs interfere with endocrine systems, disrupt homeostasis, and cause a host of abnormalities in aquatic organisms that are exposed to them (Fabbri and Franzellitti 2016; Gerbersdorf et al. 2015; Srain et al. 2020). Further, mixtures of PPCPs led to toxic effects, even when individual PPCP concentrations were below their threshold for effect (Srain et al. 2020).

Reproductive impacts are the most commonly reported effects in fish that are exposed to PPCPs at environmentally relevant concentrations. Environmental exposure to PPCPs during the sexual differentiation phase of embryonic development has been shown to induce sex reversal and or intersexuality, while exposure during sexual maturation has been shown to inhibit gonadal development in both males and females. It also causes feminization in juvenile males (intersexuality), and reduced fecundity (Fabbri and Franzellitti 2016; Gerbersdorf et al. 2015; Harding et al. 2016; Jobling et al. 1998; Kidd et al. 2007; Lubliner et al. 2010; Parrott and Blunt 2005; Srain et al. 2020). Lubliner et al. (2010) also report that the female to male ratio in white sucker fish that were downstream of a WWTP discharge was 90% female to 10% male, and that there was also an increased incidence of intersex fish. Kidd et al. (2007) report that exposure to environmentally relevant concentrations of a synthetic estrogen quickly led to the near extirpation of fathead minnows in a test lake.

Microplastics are widely detected in U.S. municipal WWTP effluent, and it is estimated that over 4 million microplastic particles are discharged per facility per day. Plastic fragments, pellets, and fibers are the most common type of microplastic particles within the effluent. Many of the plastic fragments and pellets found in the effluent are thought to come from the ‘microbeads’ that are found in many cosmetics and personal care products, but some likely originate from other plastic objects that enter the wastewater stream. Although most microfibers are plastic, some probably originate from non-plastic sources (Mason et al. 2016).

Aquatic animals close to urban areas have high accumulations of microplastics in their tissues, with no significant difference in accumulation between fish species (Chan et al. 2019; Garcia et al. 2020; Gola et al. 2021). Ingestion of microplastics can cause physiological responses such as alterations in metabolic processes and intestinal activity, as well as altered predation behaviors and swimming performance (Chan et al. 2019; Garcia et al. 2020). Microplastics accumulate in the gills, guts, and liver of fish, and cause multiple toxic effects including inflammation, increased enzyme activity, and altered metabolic pathways (Lu et al. 2016). The accumulation of microplastics can create a false sense of satiety and or cause blockage of the gastrointestinal tract that may prevent the ability to consume adequate forage, both of which can lead to starvation (Chan et al. 2019; Garcia et al. 2020). Microplastics can also act as a carrier of other pollutants, and accelerate bioaccumulation through food chains. Organic pollutants, heavy metals, and other chemicals easily attach to microplastics, which enter the food web when the particles are mistakenly ingested by organisms that are subsequently consumed by other aquatic animals (Garcia et al. 2020; Gola et al. 2021).

Automotive-related pollutants are likely to be present in WWTP effluents during rainstorms for systems that are combined with stormwater drainage systems. They may also be episodically present when automotive-related products are improperly disposed of directly into sanitary sewer systems. The full suite of roadway-related chemicals under possible review now numbers in the thousands. However, three distinct but co-occurring classes of harmful automotive-related contaminants have been identified, and are ubiquitous in roadway stormwater runoff: PAHs (particularly phenanthrene), metals (particularly copper) and 6PPD and its abiotic transformation product 6PPD-q (NWFSC 2022a).

PAH toxicity in fish, including salmonids, is often sub-lethal and delayed in time, but all fish species studied to date are vulnerable to PAH toxicity, with thresholds for severe developmental abnormalities that are often in the low parts-per-billion (µg/L) range. PAHs bioconcentrate to high levels in fertilized fish eggs, and have been shown to cause complete heart failure and extra-cardiac defects that often lead to mortality at or soon after hatching. In larval fish, PAH exposure has been shown to cause abnormal development of the heart, eye and jaw structure, and energy reserves (Harding et al. 2020; NWFSC 2022a). In juvenile fish, PAHs can cause reduced growth, increased susceptibility to infection, and increased mortality (Eisler 1987; Meador et al. 2006; Varanasi et al. 1993). Gill tissues are highly susceptible to damage from PAHs present in the water (USACE 2016). Other effects include damage to the skin, fins, and eyes, as well as damage to internal organs such as liver tumors.

Exposure to dissolved copper concentrations between 0.3 to 3.2 µg/L above background levels has been shown to cause avoidance of an area, to reduce salmonid olfaction, and to induce behaviors that increase juvenile salmon's vulnerability to predators in freshwater (Giattina et al. 1982; Hecht et al. 2007; McIntyre et al. 2012; Sommers et al. 2016; Tierney et al. 2010). However, copper is much less toxic to fish in saltwater than in freshwater. Baldwin (2015) reports that dissolved copper's olfactory toxicity in salmon is greatly diminished with increased salinity. In estuarine waters with a salinity of 10 parts per thousand (ppt), no toxicity was reported for copper concentrations below 50 µg/L. Sommers et al. (2016) report no copper-related impairment of olfactory function in salmon in saltwater.

6PPD and its abiotic transformation product 6PPD-q is deposited onto roads from motor vehicle tire ware, and is the primary cause of urban runoff coho mortality syndrome in adult Puget Sound coho (Tian et al. 2020). The mechanisms underlying mortality in salmonids is under investigation, but likely involve cardiorespiratory disruption (NWFSC 2022a). Coho juveniles appear to be similarly susceptible to the acutely lethal toxicity of 6PPD/6PPD-q (McIntyre 2015). Laboratory studies have also demonstrated that juvenile steelhead and juvenile Chinook salmon are also susceptible to varying degrees of mortality when exposed to urban stormwater. The onset of mortality is very rapid in coho (i.e., within the duration of a typical runoff event), but more delayed in steelhead and Chinook salmon (NWFSC 2022a).

<u>Exposure:</u> Mixing zones are specific portions of a waterbody within which wastewater discharges are allowed to mix with and become diluted by the surrounding waters. It is beyond the boundary of the zone where specified standards must be met. Acute mixing zones are intended to prevent lethality of organisms that pass outside of the zone's boundary. However, organisms that are within the acute mixing zone may be exposed to lethal effluent concentrations. Similarly, the chronic mixing zone is intended to prevent chronic effects in organisms that pass outside of the zone's boundary, but organisms that are within the chronic mixing zone can be exposed to effluent concentrations capable of causing chronic effects (USEPA 2014). Therefore, under the existing NPDES permit, organisms that are within the 10- by 31- by 5-foot acute mixing zone around the new outfall diffuser may be exposed to lethal effluent concentrations, and organisms that are within the 100- by 308- by 50-foot chronic mixing zone may be exposed to contaminants at concentrations that would cause chronic effects. Under the renewed NPDES permit, the acute and chronic mixing zones would remain 10 by 31 by 5 feet and 100 by 308 by 50 feet, respectively.

As described earlier, the proposed action would install a replacement a WWTP outfall near the right bank of the Skykomish River. That immediate area is documented to provide spawning habitat for PS Chinook salmon and PS steelhead, as well as migratory and forage habitat for juveniles of both species. The immediate area also likely supports some degree of rearing for both species. Further, river currents would carry decreasing concentrations of WWTP effluent downstream to Puget Sound, at Everett. Additionally, the area has been designated as critical habitat for PS Chinook salmon, and PS steelhead. Therefore, all life stages of both species are extremely likely to be exposed to wastewater effluent from the new outfall.

Within the effluent plume, some individuals of all freshwater life stages (eggs, rearing juveniles, and immigrating adults), for both species, are likely to directly absorb and or ingest some combination of the contaminants discussed above. The increasing contaminant concentrations within the chronic mixing zone would likely cause fish to avoid the acute mixing zone.

Therefore, few, if any Chinook salmon and or steelhead are likely to experience acute mortality from effluent exposure. However, it is extremely likely that some individuals of all freshwater life stages for both species would be directly and indirectly exposed to effluent concentrations capable of causing chronic effects. Based on the best available information, as described above, chronic exposure to the effluent's contaminants is likely to cause varying levels of fitness impacts such as, negative reproductive effects and reduced long-term survival in some of the exposed eggs, juveniles, and adults of both species considered here. The annual numbers of individuals that would be directly exposed to the effluent is uncertain and likely to be highly variable over time, as are the intensity of effects that exposed individuals are likely to experience

Altered Environmental Conditions

In addition to directly exposing fish to the numerous contaminants discussed above, the effluent discharge would alter habitat conditions within the mixing zones and in the downstream reaches of the river.

The effluent plume would create temperature, contaminant, and dissolved oxygen gradients that would increase in intensity with movement toward the diffuser. Also, effluent-borne nitrogen, other nutrients, and suspended solids may increase productivity and forage availability downstream of the outfall, but also diminish forage quality. The exact extent of detectable effluent and sediments that would be discharged from the new outfall is unknown. However, to avoid underestimating potential impacts, this assessment assumes that fish-detectable contaminant concentrations would extend well beyond the chronic mixing zone, and that some contaminants and sediments could be detectable the full distance downstream from the outfall to the mouth of the Snohomish River at Everett.

How Chinook salmon and steelhead would respond to effluent-altered environmental conditions is likely to be highly variable and context driven. Depending on the conditions of the exposure, some fish are likely to experience avoidance behaviors soon after detecting chemical changes in the water (Beitinger and Freeman 1983), whereas others may exhibit no overt response, and others may be attracted to the plume. Some individuals are likely to exhibit a mix of behaviors, such as an initial avoidance response that is followed by habituation and possible attraction, and vice versa. Eggs within gravels downstream of the outfall would be unable to overtly respond to the exposure.

Avoidance: The potential for effluent avoidance would depend largely on how and where the effluent plume overlays occupied habitat resources. Where the overlay occurs close to the outfall and effluent concentrations are high, the likelihood and intensity of avoidance would be high, whereas an overlay well downstream and or along the outer edges of the plume, where concentrations are low, exposed individuals may exhibit no overt response. Normal avoidance behaviors may also be overridden by higher drives, such as juveniles that are driven to remain within a preferred location that has highly desirable habitat conditions, such as ample shelter and forage resources. Also, the drive to spawn in adults could override the avoidance behavior.

Plume avoidance would reduce direct exposure to water-born contaminants. However, it could displace juveniles from preferred habitat, which could cause increased competition and increased vulnerability to predators, which could cause negative impacts on their fitness and long-term survival. This is especially so in the case of alevins (newly hatched juveniles that normally remain within gravels until their yolk sack is absorbed). Due to their state of underdevelopment, alevins that prematurely abandon the gravels of their redd are extremely unlikely to survive. Plume avoidance could also drive adults away from preferred spawning habitats.

Because eggs would be unable to avoid the plume, they would remain within it as long as the currents drive the plume over their redd. As such, they would be continuously exposed to the contaminants within the effluent plume.

Altered forage availability and quality: The effluent's dissolved nutrient and suspended solids load may increase productivity for planktonic and benthic organisms and SAV within the detectable plume and the affected substrate, possibly causing a slight increase in forage availability within the affected area. Dissolved nutrients would likely become undetectable relatively quickly with time and distance from the outfall, whereas solids that settle-out in areas of slow-moving water could be present longer and slightly farther downstream. However, as discussed earlier, organisms that are exposed to the plume and its settled-out solids are likely to uptake contaminants, and the exposed organisms that are consumed by other organisms will connect the effluent-borne contaminants to the food web.

For example, West et al. (2008) found that the three known Pacific herring populations in the Puget Sound region have different persistent organic pollutant (POP) loading patterns that are likely due to differential exposure to POPs based on where those herring populations feed. Further, because Pacific herring rely heavily on planktonic krill, calapnoid copepods, and larval invertebrates and fishes that have no direct connection to sediments, it is believed that those planktonic species are accumulating the POPs directly from the water column and from the planktonic food web (West et al. 2008).

Therefore, juvenile Chinook salmon and steelhead that forage in the affected area are likely to consume contaminated prey. Additionally, the increased forage availability may create the situation where foraging species, including juvenile Chinook salmon and steelhead may preferentially remain within the affected area. Those fish that remain within the affected area due to the area's increased forage availability would increase both their direct exposure to effluent-borne contaminants as well as their consumption of contaminated prey.

Settlement of Suspended Solids: The WWTP is currently authorized to discharge a weekly average of 270 pounds of TSS per day, which would increase to ### pounds per day with the issuance of the renewed NPDES permit. The discharged suspended solids would settle onto the riverbed in an unknown pattern of deposition as they are carried downstream by river flow. Deposition rates likely follow some bell-shaped curve, based on particle mass and water velocity, with deposition first increasing with distance, peaking at some distance, then decreasing again.

The settlement of solids may alter the availability and quality of SAV and forage within the affected area, and in spawning areas, may affect gravel sedimentation levels. However, given the relatively small amount of TSS discharge, the biodegradability of those sediments, and the high levels of fine sediment loading that occurs naturally in the river, WWTP-related TSS settlement is extremely unlikely to cause and detectable increase in sedimentation. However, many heavy metals and POPs, such as pesticides, PAHs, and PCBs, tend to adhere to solid particles discharged from outfalls. Therefore, the settlement of suspended solids is likely to act as a low but steady source of heavy metals and POPs that would be taken up by the benthic organisms within the affected area, and those contaminants would likely bioaccumulate in the local food web at higher rates than in unaffected areas.

Dissolved Oxygen: The WWTP is currently authorized to discharge a weekly average of 270 pounds per day, each for BOD_5 and TSS, which would increase to 2711 and 298 pounds per day, respectively, with the issuance of the renewed NPDES permit. BOD and TSS both reduce dissolved oxygen levels in receiving waters. Respiration related to the biological breakdown of the BOD reduces the dissolved oxygen concentration within the plume. TSS typically reduces dissolved oxygen through decreased photosynthesis due to turbidity-related reduced light.

Reduced dissolved oxygen can cause avoidance of the affected area (Hicks 1999). It can also reduce swimming performance (Bjornn and Reiser 1991), and mortality can occur when oxygen levels become severely depleted. It is unknown if the authorized amounts of discharged BOD and TSS are high enough to meaningfully reduce dissolved oxygen levels in the river, and if so, how intensely it may do so, or how far downstream it would be detectable. Based on the best available information, it is extremely unlikely that any exposed fish would experience direct mortality due to exposure to action-related reduced dissolved oxygen. However, we assume that exposed fish may experience some level of avoidance and or altered swimming due to the exposure, and that the intensity of the effects would likely increase as in-water temperatures increase during the summer because elevated water temperatures reduce water’s ability to hold oxygen.

In summary: Over the decades of effluent discharge through the new outfall, some Chinook salmon and steelhead of all freshwater life stages are likely to be exposed to the effluent-borne pollutants. In addition to possible avoidance behaviors, some individuals that enter the new outfall’s plume area are likely to uptake contaminants directly from the water column and through the consumption of contaminated forage. The intensity of their exposures and responses are likely to be highly variable.

Due to the expectation that their exposures would be outside of the acute mixing zone, no direct mortality is expected for any individuals of either species. However, the small size and state of immaturity of exposed eggs and juveniles increases the likelihood that some exposed individuals would experience fitness impacts that would reduce their likelihood of survival to adulthood and or reduce their future reproductive success, both of which could be exacerbated by repeated exposures to other effluent discharges within the river and while within Puget Sound. Some exposed adult Chinook salmon are also likely to experience behavioral and or fitness impacts that could reduce their reproductive success.

The exact numbers of PS Chinook salmon and PS steelhead that may be annually exposed to the effluent is unpredictable and likely to be highly variable over time. The project’s location makes it theoretically possible that every Chinook salmon and steelhead that passes through the

Snohomish River could be exposed to project-related effluent. However, the outfall's small discharge volume supports the expectation that the detectably affected area would encompass an extremely small portion of the watershed, and that only fish that pass close to the outfall are likely to be exposed to detectable levels of action-related contaminants. Further, only small subsets of those individuals are likely to remain within the affected area long enough to experience detectable effects, with eggs and juveniles being the most likely to experience meaningful fitness impacts. Exact juvenile to adult survival ratios are not known for either species. However, even under natural conditions, individual juvenile salmonids have a very low probability of survival to adulthood (Bradford 1995). Based on the best available information, the annual numbers of action-affected eggs and juveniles would be too low to influence any VSP parameters, or to cause any detectable population-level effects for either species.

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 PS Chinook salmon and PS steelhead: The proposed action, including full application of the planned conservation measures and BMPs, is likely to adversely affect designated critical habitat for PS Chinook salmon and PS steelhead as described below.

1. Freshwater spawning sites:
    a. Water quantity – The proposed action would cause long-term minor effects on this attribute. WWTP effluent discharges would very slightly increase water quantity (up to 1.1 MGD) in the Skykomish River downstream of the diffuser.
    b. Water Quality – The proposed action would cause long-term minor adverse effects on this attribute. The project would replace an existing WWTP outfall in the Skykomish River, just downstream of its confluence with the Sultan River. Over 1 week, project work may cause brief minor increases in suspended sediments and low levels of work-related contaminants within about 300 feet of ongoing work. Additionally, the proposed action would facilitate the decades-long continuation of effluent discharge at maximum month design flow of 2.3 MGD into the Skykomish River. The effluent would contain low levels of organic material that would affect dissolved oxygen levels and elevate in-water nutrient loads, as well as introduce low levels of numerous contaminants that are known to be harmful to fish and other aquatic organisms. The currently permitted chronic mixing zone extends from the riverbed to the surface, between 100 feet upstream to 308 feet downstream of the outfall, with a maximum width of 50 feet. Under the renewed NPDES permit, the dimensions of the chronic mixing zone would remain 50 by 100 by 308 feet. The exact extent of the detectable effluent plume is unknown, but it would exceed the chronic mixing zone boundary. Due to variability in discharge volumes, and the lack of real-time control over the size of the mixing zones, this assessment assumes that detectable effluent-borne contaminants could extend well beyond the chronic mixing zone, and because some of the pollutants are known to be persistent and to float, this assessment

assumes that water quality impacts would extend the length of the river between the diffuser and Puget Sound.

c. Substrate – The proposed action would cause long-term minor effects on this attribute. The WWTP would discharge a weekly average of 270 pounds of TSS per day, which would increase to 298 pounds per day with the issuance of the renewed NPDES permit. The discharged suspended solids would settle onto the riverbed downstream of the new outfall. However, given relatively small amount of discharged TSS, the biodegradability of those sediments, and the high levels of fine sediment loading that occurs naturally in the river, WWTP-related TSS settlement is extremely unlikely to cause and detectable increase in the sedimentation of river gravels.

2. <u>Freshwater rearing sites:</u>
   a. Water quantity – Same as above.
   b. Floodplain Connectivity – The proposed action caused no effect on this attribute.
   c. Water Quality and Forage – The proposed action would cause long-term minor adverse effects on these attributes. The effects on water quality would be the same as above. The proposed action would cause minor long-term adverse effects on this attribute. The proposed outfall pipe with its concrete anchors and protective rock would cover an area of about 250 square feet, where some of the naturally occurring SAV and benthic organisms that support juvenile salmonids would be unlikely to repopulate the substrate. Additionally, the continued effluent discharge would slightly diminish the availability and quality of forage through the loss of some organisms that would perish due to effluent exposure, and or through the contamination of forage organisms that uptake effluent-related contaminants. As described in Section 2.5, exposure to action-attributable contaminants is likely to slightly reduce the numbers of available prey organisms downstream of the outfall, through low levels of direct mortality and through reduced long-term fitness and or reduced fecundity in some of the prey organisms that experience non-lethal exposures.
   d. Natural Cover – The proposed action would cause long-term minor adverse effects on this attribute. The proposed outfall pipe with its concrete anchors and protective rock would cover an area of about 250 square feet, where some of the naturally occurring SAV is unlikely to repopulate the substrate.

3. <u>Freshwater migration corridors free of obstruction and excessive predation:</u>
   a. Obstruction and excessive predation – The proposed action would cause short- and long-term minor adverse effects on this attribute. The project’s 1 week of in-water work would cause conditions that are likely to cause avoidance behaviors that may slightly delay immigration for returning adults of both species, as well as avoidance behaviors in rearing juveniles that may increase their risk of predation. The proposed outfall pipe with its concrete anchors and protective rock would create about 250 square feet of habitat that would be supportive of piscivorous fish that feed on juvenile salmonids, which may slightly increase the risk of predation at the site. The proposed action would also cause the continued discharge of WWTP effluent to the Skykomish River. The effluent plume would cause water quality conditions that are likely to cause some rearing juvenile Chinook salmon and steelhead to abandon preferred shelter and foraging habitat to avoid the effluent plume. This, in turn may slightly increase the risk of predation for some of the

exposed juvenile Chinook salmon and steelhead. It may also cause slight migratory delays for immigrating adults.

b. Water quantity – Same as above.
c. Water quality – Same as above.
d. Natural Cover – Same as above.

4. <u>Estuarine areas free of obstruction and excessive predation:</u> Outside of the expected range of detectable effects.

5. <u>Nearshore marine areas free of obstruction and excessive predation:</u> Outside of the expected range of detectable effects.

6. <u>Offshore marine areas:</u> Outside of the expected range of detectable effects.

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 consultation [50 CFR 402.02 and 402.17(a)]. 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 discussion of the environmental baseline (Section 2.4).

The current conditions of ESA-listed species and designated critical habitat within the action area are described in the Range-wide Status of the Species and Critical Habitat and Environmental Baseline sections above. The non-federal activities in and upstream of the action area that have contributed to those conditions include past and on-going bankside development and upland urbanization, as well as upstream forest management, agriculture, road construction, water development, subsistence and recreational fishing, and restoration activities. Those actions were, and continue to be, 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 restoration and use of natural amenities, such as cultural inspiration and recreational experiences.

The NMFS is unaware of any specific future non-federal activities that are reasonably certain to affect the action area. However, the 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 input from point- and non-point pollutant sources will likely continue and increase into the future. Recreational and commercial use of the waters within the action area are 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. 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 assessing the risk that the proposed action poses to species and critical habitat. 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 and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably 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 as a whole for the conservation of the species.

As described in more detail above in Section 2.4, climate change is likely to increasingly affect the abundance and distribution of the ESA-listed species considered in the opinion. It is also likely to increasingly affect the PBFs of designated critical habitats. 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 dissolved oxygen, as well as by causing more frequent and more intense flooding events.

Climate change 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 is 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 and critical habitats considered in this 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 or critical habitat through synergistic interactions with the impacts of climate change are expected.

2.7.1 ESA Listed Species

PS Chinook salmon and PS steelhead are both 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, the effects on viability parameters of each species are also likely to be negative. In this context we consider how the proposed action's impacts on individuals would affect the listed species at the population and ESU/DPS scales.

PS Chinook salmon

The long-term abundance trend of the PS Chinook salmon ESU is slightly negative. 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 most recent 5-year status review reported a general decline in natural-origin spawner abundance across all PS Chinook salmon MPGs over the most-recent fifteen years. It also reported that escapement levels remain well below the PSTRT planning ranges for recovery for all MPGs, and concluded that the PS Chinook salmon ESU remains at "moderate" risk of extinction (Ford 2022).

The project site is located in the Skykomish River at its confluence with the Sultan River, at Sultan, Washington (Figures 1 and 2). The PS Chinook salmon that are most likely to be present in the action area would be a mix of summer-run and fall-run fish of 2 populations (Ford 2022; WDFW 2023).

The available abundance and trend data are difficult to interpret succinctly, but between 1980 and 2020, the numbers of returning adult fish from both populations have fluctuated, but with an overall flat to slightly negative long-term abundance trends, especially since 2020 (Ford 2022).

The project area and downstream reaches of the river is used by PS Chinook salmon for spawning, rearing, and migration. The environmental baseline at and adjacent to the project site has been degraded by more than 100 years of urbanization and agriculture with the related bankside hardening and input of point and non-point stormwater and sewer discharges, including effluent discharge from the Sultan WWTP.

The proposed 1 week of construction would cause a range of effects that both individually and collectively would cause altered behaviors and possible mortality in extremely low numbers of juveniles. Additionally, for several decades to come, exposure to WWTP effluent is likely to annually cause sub-lethal fitness impacts in very low numbers of eggs, juveniles, and adults that are annually present in the project area and in downstream areas affected by the effluent. The exposure would reduce the long-term survival and or cause negative reproductive effects in some of the exposed eggs and juveniles, and some of the exposed adults may experience fitness impacts that may slightly reduce their spawning success.

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 detectable effects on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for the affected PS Chinook salmon populations. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

PS steelhead

The long-term abundance trend of the PS steelhead DPS is negative, especially for natural spawners. Abundance information is unavailable for about 1/3 of the DIPs. In most cases where no information is available, abundances are assumed to be very low. Although most DIPs for which data are available experienced improved abundance over the last five years, 95% of those DIPs are at less than half of their lower abundance target for recovery. The extinction risk for the Puget Sound steelhead DPS is considered moderate. 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 Ford 2022.

The project site is located in the Skykomish River at its confluence with the Sultan River, at Sultan, Washington (Figures 1 and 2). The PS steelhead that are most likely to be present in the action area would be a mix of summer-run and winter-run fish from 5 DIPs (Ford 2022; WDFW 2023). The available abundance and trend data indicate that PS steelhead abundance trends have been negative across the basin since the mid-1980s to the late-1990s (Ford 2022).

The project area and downstream reaches of the river is used by PS steelhead for spawning, rearing, and migration. The environmental baseline at and adjacent to the project site has been degraded by more than 100 years of urbanization and agriculture with the related bankside hardening and input of point and non-point stormwater and sewer discharges, including effluent discharge from the Sultan WWTP.

The proposed 1 week of construction would cause a range of effects that both individually and collectively would cause altered behaviors and possible mortality in extremely low numbers of juveniles. Additionally, for several decades to come, exposure to WWTP effluent is likely to annually cause sub-lethal fitness impacts in very low numbers of eggs, juveniles, and adults that are annually present in the project area and in downstream areas affected by the effluent. The exposure would reduce the long-term survival and or cause negative reproductive effects in some of the exposed eggs and juveniles, and some of the exposed adults may experience fitness impacts that may slightly reduce their spawning success.

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 detectable effects on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for the affected PS steelhead DIPs. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

2.7.2 Critical Habitat

Critical habitat was designated PS Chinook salmon and PS steelhead to ensure that specific areas with PBFs that are essential to the conservation of those listed species are appropriately managed or protected. These critical habitats will be affected over time by cumulative effects, some positive – as restoration efforts 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 trends are negative, the effects on the PBFs of these critical habitats are also likely to be negative. In this context we consider how the proposed action's impacts on the attributes of the action area's PBFs would affect these designated critical habitats' abilities to support the conservation of their respective species as a whole.

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, shoreline development, and point and non-point stormwater and wastewater discharges 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 critical habitat 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, freshwater rearing sites, and freshwater migration corridors free of obstruction and excessive predation. The site attributes of those PBFs that would be adversely affected by the proposed action are water quality, substrate, forage, natural cover, and freedom from obstruction and excessive predation. As described above, the proposed action would cause long-term minor adverse effects on all of those attributes within a relatively short distance downstream from the project site.

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 cause any detectable long-term negative changes in the quality or functionality of the nearshore marine areas PBF in the action area. Therefore, this critical habitat will maintain its current level of functionality, and retain its current ability for PBFs 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 and critical habitats, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is the NMFS' biological opinion that 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 those two 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). "Harass" is further defined by interim guidance as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "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

In the biological opinion, the NMFS determined that incidental take is reasonably certain to occur as follows:

Harm of PS Chinook salmon and PS steelhead from exposure to:

- Work-related Noise,
- Work-related Water Contamination,
- Work-related Propeller Wash,
- Altered Substrate, and
- Effluent-related Impacts.

The NMFS cannot predict with meaningful accuracy the number of PS Chinook salmon and PS steelhead that are reasonably certain to be injured or killed annually by exposure to any of these stressors. The distribution and abundance of the 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 the 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, the NMFS knows of no device or practicable technique that would yield reliable counts of individuals that may experience these impacts. In such circumstances, the 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.

The timing and duration of in-water work is applicable for work-related noise, water contamination, and propeller wash because the proposed August 1 through August 15 in-water work window avoids the period of time when juvenile Chinook salmon and steelhead would be most numerous and vulnerable to the effects of the planned in-water work. It also avoids the spawning seasons for both species. Therefore, working outside of the proposed work window would likely increase the number of juvenile PS Chinook salmon and steelhead that would be exposed to work-related stressors. It could also negatively impact spawning by both species, which was not considered in this opinion. Similarly, working more than the proposed 1 week of in-water work would expose more individuals of both species than was considered in this opinion.

The size, location, and characterists of the proposed outfall pipe, including its anchors and protective rock, are the best available surrogates for the extent of take of juvenile PS Chinook salmon and juvenile PS steelhead from exposure to altered substrate, and from exposure to effluent-related impacts. The size and location of the outfall pipe is appropriate for altered substrate because, as the size the outfall pipe, its anchors, and or its protective rock increases, and or as the outfall pipline is moved higher on the riverbank, the larger the area where SAV-related cover and forage organisms would be diminished for juvenile salmonids. Also, as the size of the pipe, its anchors, and or its protective rock increases, or is moved higher on the riverbank, the size of the area where juvenile salmonids would be exposed to predator-supportive habitat would increase.

The diameter the new outfall pipe, and the location of its diffuser relative to the nearest OHWM are the best available surrogates for the extent of take of PS Chinook salmon and PS steelhead from exposure to effluent-related impacts. The diameter of the outfall pipe is appropriate because, as the diameter of the pipe increases, the maximum flow volume through it would increase. As flow volume increases, the amount of pollutants discharged to the Skykomish River would increase. As the amount of discharged pollutants increase, the number of exposed Chinook salmon and steelhead and or the intensity of fitness and behavioral effects that exposed fish would experience would also increase. The location of the diffuser relative to the nearest OHWM is appropriate because the shorter the distance from shore that the diffuser is located, the more the chronic and acute mixing zones would overlap with the juvenile salmonid-preferred shallow bankside habitat adjacent to the outfall, and the higher the effluent concentrations would be in that area. Increasing either of those conditons would increase the number of exposed individuals and or increase the intensity of the effects of the exposure.

In summary, the extent of PS Chinook salmon and PS steelhead take for this action is defined as:

- 1 week of in-water work to be completed between August 1 and August 15; and
- A new 80-foot long, 12-inch diameter, HDPE outfall pipe with concrete anchors and protective rock, installed with its diffuser about 100 feet waterward of the OHWM, 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.

Although these take surrogates could be construed as partially coextensive with the proposed action, they nevertheless function as effective re-initiation triggers. If any of these take surrogates exceed the proposal, it could still meaningfully trigger re-initiation because the USACE 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 biological opinion, the NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.9.3 Reasonable and Prudent Measures

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

The USACE shall require the applicant to:

1. Ensure the implementation of monitoring and reporting to confirm that the take exemption for the proposed action is not exceeded.

2.9.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. The USACE, and the applicant have 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. The following terms and conditions implement reasonable and prudent measure 1:

    a. The USACE shall require the applicant to develop and implement plans to collect and report details about the take of listed fish. That plan shall:
        i. Require the applicant and or their contractor to maintain and submit records to verify that all take indicators are monitored and reported. Minimally, the records should include:
            1. Documentation of the timing and duration of in-water work to ensure that all in-water work is completed within 1 week, between August 1 and August 15; and
            2. Documentation of the location and characteristics of the new outfall pipe to confirm that it is consistent with the conditions described in the proposed action section of this biological opinion.
        ii. Require the applicant to establish procedures for the submission of the construction records and other materials to the appropriate USACE office, and to submit an electronic post-construction report to the NMFS within six months of project completion. Send the report to: projectreports.wcr@noaa.gov. Be sure to include Attn: WCRO-2022-01769 in the subject line.

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).

To reduce adverse impacts on water quality that the project would cause in the Skykomish River through continued discharge of WWTP effluent:

1. The City of Sultan should partner with the Washington Department of Ecology to explore development of a Habitat Conservation Plan and apply for an Incidental Take Permit pursuant to section 10(a)(1)(B) of the ESA for their state-issued NPDES permit, in order to obtain incidental take authorization for unavoidable take of listed species that is anticipated to occur as a result of these permit issuances.

2. The City of Sultan should more completely identify the pollutant load in the effluent discharged from their WWTP, and as part of future NPDES permit applications, to commit to incrementally apply new technologies to reduce pollutant concentrations in the effluent.

3. The USACE, and the U. S. Environmental Protection Agency (USEPA) should approach the National Marine Fisheries Service and the U.S. Fish and Wildlife Service to develop a programmatic biological opinion for the authorization of infrastructure projects that would

result in the continued discharge of wastewater and or stormwater to the waters of the Puget Sound Basin, including those that would be discharged under state-issued NPDES permits. The project description for that programmatic consultation should include clear conservation measures intended to avoid and minimize the effects of NPDES permit actions on species and critical habitats listed under the ESA, as well as on essential fish habitat identified under the MSA, and should provide a mechanism for compensatory mitigation for unavoidable adverse effects, including take.

2.11 Re-initiation of Consultation

This concludes formal consultation for the Federal Emergency Management Agency's funding, and the U.S. Army Corps of Engineers' authorization, of the City of Sultan's Wastewater Treatment Facility (WWTP) Outfall Replacement Project in the Skykomish River, Snohomish County, Washington.

Under 50 CFR 402.16(a): "Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action."

2.12 "Not Likely to Adversely Affect" Determinations

This assessment was prepared pursuant to section 7(a)(2) of the ESA, implementing regulations at 50 CFR 402 and agency guidance for preparation of letters of concurrence.

As described in Section 2 and below, the NMFS has concluded that the proposed action is not likely to adversely affect SR killer whales and their designated critical habitat. Detailed information about the biology, habitat, and conservation status and trends of these whales can be found in the listing regulations and critical habitat designations published in the Federal Register, as well as in the recovery plans and other sources at: https://www.fisheries.noaa.gov/species-directory/threatened-endangered, which are incorporated here by reference.

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the listed species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action (50 CFR 402.02). The applicable standard to find that a proposed action is not likely to adversely affect listed species or critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those that are extremely unlikely to occur.

2.12.1 Effects on Listed Species

The effects analysis in this section relies heavily on the descriptions of the proposed action and project site conditions discussed in Sections 1.3 and 2.4, and on the analyses of effects presented in Section 2.5. As described in Section 2.5, action-related stressors expected to cause adverse effects include work-related noise, water contamination, propeller wash, and forage diminishment; altered benthic habitat; and effluent-related impacts. The extent of work-related effects and altered benthic habitat would be limited to the marine waters and substrates within about 300 feet either side of the proposed marine pipeline route, and detectable effluent would be limited to the area within about 700 feet around the new outfall diffuser.

SR killer whales

The proposed action will have no direct effects on SR killer whales or their critical habitat because all construction and its impacts would take place in freshwater, and SR killer whales and their designated critical habitat are limited to marine waters.

However, the project may indirectly affect SR killer whales through the trophic web by affecting the quantity and quality of prey available to them. We therefore analyze that potential here but conclude that the effects on SR killer whales will be insignificant.

As described in Section 2.5.1, action-related impacts would annually affect very low numbers of Chinook salmon eggs and juveniles. The construction’s detectable effects on fish would last 1 week and be limited to an area about 300 feet around the proposed work. During that time, an extremely small proportion the work year’s juvenile PS Chinook salmon cohort could be exposed to work-related impacts, and only a very small subset of the individuals that pass through the affected area are likely to be detectably affected by the exposure.

As also described in Section 2.5.1, the volume of action-attributable effluent and the size of the affected area in the Skykomish River are both very small, and only very small proportions of each year’s PS Chinook salmon egg and juvenile cohorts would be exposed to the effluent plume from the new outfall. Again, only very small subsets of the exposed individuals are likely to be meaningfully affected by the exposure. Therefore, only extremely small proportions of each year’s Chinook salmon egg and juvenile cohort are likely to experience fitness or behavioral impacts that may reduce their long-term survival.

The exact Chinook salmon egg or juvenile to adult ratios are not known. However, even under natural conditions, individual juvenile Chinook salmon have a very low probability of surviving to adulthood (Bradford 1995). We note that human-caused habitat degradation and other factors such as hatcheries and harvest exacerbate natural causes of low survival such as natural variability in stream and ocean conditions, predator-prey interactions, and natural climate variability (Adams 1980; Quinones et al. 2014). However, based on the best available information, the annual numbers of project-affected juveniles would be too low to influence any VSP parameters of any of the affected populations, or to cause any detectable reduction in adult Chinook salmon availability to SR killer whales in marine waters.

Further, the numbers of surviving adult Chinook salmon that may have been contaminated by exposure action-attributable pollutants as juveniles would be extremely low, and the attributable pollutant concentrations in those fish would also be extremely low. Therefore, very few adult Chinook salmon are likely to be contaminated with action-attributable pollutants, and the concentrations of action-attributable pollutants in specific adult Chinook salmon would be extremely low. Based on this, over the life of any specific SR killer whale, it is extremely unlikely that it would consume enough action-attributable contaminated Chinook salmon to cause any detectable effects of its long-term fitness and normal behaviors.

2.12.2 Effects on Critical Habitat

This assessment considers the intensity of expected effects in terms of the change they would cause in affected physical or 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 to last for weeks, and long-term effects are likely to last for months, years or decades.

SR killer whale Critical Habitat: Designated critical habitat for SR killer whales includes marine waters of the Puget Sound that are at least 20 feet deep. The expected effects on SR killer whale critical habitat from completion of the proposed action, including full application of the conservation measures and BMP, would be limited to the impacts on the PBFs as described below.

1. Water quality to support growth and development
   The proposed action would cause no detectable effects on marine water quality.

2. Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth
   The proposed action would cause long-term undetectable effects on this attribute. Action-related impacts would annually injure very low numbers of individual Chinook salmon eggs and juveniles (primary prey). However, the numbers of affected Chinook salmon eggs and juveniles would be too small to cause detectable effects on the numbers of available adult Chinook salmon in marine waters. Therefore, it would cause no detectable reduction in prey availability and quality.

3. Passage conditions to allow for migration, resting, and foraging
   The proposed action would cause no detectable effects on passage conditions.

For the reasons expressed immediately above, the NMFS has concluded that the proposed action is not likely to adversely affect ESA-listed SR killer whales and their designated critical habitat.

3. MAGNUSON–STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT RESPONSE

Section 305(b) of the MSA directs Federal agencies to consult with the NMFS on all actions or proposed actions that may adversely affect Essential Fish Habitat (EFH). Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). 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) of the MSA also requires the NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)].

This analysis is based, in part, on the EFH assessment provided by the USACE and the descriptions of EFH contained in the fishery management plan for Pacific Coast salmon developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce (PFMC 2014).

3.1 Essential Fish Habitat Affected By the Project

The project site is located in the Skykomish River at its confluence with the Sultan River, at Sultan, Snohomish County, Washington (Figures 1 and 2). The waters and substrates of the Skykomish River are designated as freshwater EFH for various life-history stages of Pacific Coast Salmon, which within the watershed include Chinook, coho, and pink salmon. Due to trophic links between PS Chinook salmon and SR killer whales, the project's action area also overlaps with marine waters that have been designated, under the MSA, as EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species. However, the action would cause no detectable effects on any components of marine EFH. Therefore, the action's effects on EFH would be limited to impacts on freshwater EFH for Pacific Coast Salmon, and it would not adversely affect marine EFH for Pacific Coast Salmon, or EFH for Pacific Coast groundfish and coastal pelagic species.

Freshwater EFH for Pacific salmon is identified and described in Appendix A to the Pacific Coast salmon fishery management plan, and consists of four major components: (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and holding habitat.

Those components of freshwater EFH for Pacific Coast Salmon depend on habitat conditions for spawning, rearing, and migration that include: (1) water quality (e.g., dissolved oxygen, nutrients, temperature, etc.); (2) water quantity, depth, and velocity; (3) riparian-stream-marine energy exchanges; (4) channel gradient and stability; (5) prey availability; (6) cover and habitat complexity (e.g., large woody debris, pools, aquatic and terrestrial vegetation, etc.); (7) space; (8) habitat connectivity from headwaters to the ocean (e.g., dispersal corridors); (9) groundwater-stream interactions; and (10) substrate composition.

As part of Pacific Coast Salmon EFH, five Habitat Areas of Particular Concern (HAPCs) have been defined: 1) complex channels and floodplain habitats; 2) thermal refugia; 3) spawning habitat; 4) estuaries; and 5) marine and estuarine submerged aquatic vegetation. The project area provides the spawning habitat HAPC habitat feature.

3.2 Adverse Effects on Essential Fish Habitat

The ESA portion of this document (Sections 1 and 2) describes the proposed action and its adverse effects 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 minor short- and long-term adverse effects on freshwater EFH for Pacific Coast Salmon as summarized below.

Freshwater EFH for Pacific Coast Salmon

1. Water quality: The proposed action would cause long-term minor adverse effects on this attribute. The project would replace an existing WWTP outfall in the Skykomish River, just downstream of its confluence with the Sultan River. Over 1 week, project work may cause brief minor increases in suspended sediments and low levels of work-related contaminants within about 300 feet of ongoing work. Additionally, the proposed action would facilitate the decades-long continuation of effluent discharge into the Skykomish River from a Level-2 WWTP with a maximum month design flow of 1.1 MGD. The effluent would contain low levels of organic material that would affect dissolved oxygen levels and elevate in-water nutrient loads, as well as introduce low levels of numerous contaminants that are known to be harmful to fish and other aquatic organisms. The currently permitted chronic mixing zone extends from 100 feet upstream to 308 feet downstream of the outfall, with a maximum width of 50 feet. The renewed NPDES permit is expected to maintain the same mixing zone dimensions (Gray & Osborne. 2023c). The exact extent of the detectable effluent plume is unknown, but it would exceed the chronic mixing zone boundary. Due to variability in discharge volumes, and the lack of real-time control over the size of the mixing zones, this assessment assumes that detectable effluent-borne contaminants could extend well beyond the chronic mixing zone, and because some of the pollutants are known to be persistent and to float, this assessment assumes that water quality impacts would extend the length of the river between the outfall and Puget Sound.

2. Water quantity, depth, and velocity: The proposed action would cause long-term minor adverse effects on this attribute. The outfall would discharge effluent from a WWTP with a maximum month design flow of 2.3 MGD. The effluent discharges would very slightly increase water quantity in the Skykomish River downstream of the diffuser. The new outfall

structure would be installed on the riverbed, and may slightly affect water velocity along about 0.25 mile of the river either side of its location.

3. Riparian-stream-marine energy exchanges: No changes expected.

4. Channel gradient and stability: No changes expected. The existing riprap at the site already prevents bank migration along the right bank of the river, and the new outfall is extremely unlikely to cause any detectable changes to channel gradient and stability beyond that caused by the riprap.

5. Prey availability: The proposed action would cause minor long-term adverse effects on this attribute. The proposed outfall pipe with its concrete anchors and protective rock would cover an area of about 250 square feet, where some of the naturally occurring SAV and benthic organisms that support juvenile salmonids would be unlikely to repopulate the substrate. Additionally, the continued effluent discharge would slightly diminish the availability and quality of forage through the loss of some organisms that would perish due to effluent exposure, and or through the contamination of forage organisms that uptake effluent-related contaminants. As described in section 2.5, exposure to action-attributable contaminants is likely to slightly reduce the numbers of available prey organisms downstream of the outfall, through low levels of direct mortality and through reduced long-term fitness and or reduced fecundity in some of the prey organisms that experience non-lethal exposures. Further, the City would remove 250 square feet of invasive Himalayan blackberry from a bankside area, and to replant the area with a minimum of 20 native shrubs. Until the replacement vegetation grows enough to fully replace the existing functionality (likely a few years after the end of the project), the project site and downstream areas may experience slightly reduced input of organic material of terrestrial origin (insects, leaf litter, etc.), which is important to the in-stream nutrient cycle. Over time, the quality and quantity of organic material input from the new native vegetation may exceed that of the existing conditions.

6. Cover and habitat complexity: The proposed action would cause long-term minor adverse effects on this attribute. The proposed outfall pipe with its concrete anchors and protective rock would cover an area of about 250 square feet, where some of the naturally occurring SAV is unlikely to repopulate the substrate.

7. Space: No changes expected.

8. Habitat connectivity from headwaters to the ocean: No changes expected.

9. Groundwater-stream interactions: No changes expected.

10. Connectivity with terrestrial ecosystems: The proposed action would cause long-term minor adverse and beneficial effects on this attribute. As mitigation for the outfall’s substrate impacts, the City would remove 250 square feet of invasive Himalayan blackberry from a bankside area, and to replant the area with a minimum of 20 native shrubs. Until the replacement vegetation grows enough to fully replace the existing functionality (likely a few

years after the end of the project), the project site and downstream areas may experience slightly reduced input of organic material of terrestrial origin (insects, leaf litter, etc.), which is important to the in-stream nutrient cycle. Over time, the quality and quantity of organic material input from the new native vegetation may exceed that of the existing conditions.

11. Substrate composition: The proposed action would cause long-term minor effects on this attribute. The WWTP would discharge a weekly average of 270 pounds of TSS per day, which would increase to ### pounds per day with the issuance of the renewed NPDES permit. The discharged suspended solids would settle onto the riverbed downstream of the new outfall. However, given relatively small amount of discharged TSS, the biodegradability of those sediments, and the high levels of fine sediment loading that occurs naturally in the river, WWTP-related TSS settlement is extremely unlikely to cause and detectable increase in the sedimentation of river gravels.

Habitat Areas of Particular Concern (HAPCs)

Spawning habitat is the only HAPC likely to be affected by the proposed action. All effects on that HAPC are identified above at 1 - 4, and 11 under Freshwater EFH for Pacific Coast Salmon.

3.3 Essential Fish Habitat Conservation Recommendations

The NMFS determined that the following conservation recommendations are necessary to avoid, minimize, mitigate, or otherwise offset the impact of the proposed action on EFH.

The NMFS knows of no reasonable measures, beyond the planned design features and construction BMPs, that the applicant could include to further reduce or offset the project's construction-related effects on the attributes of freshwater EFH for Pacific Coast Salmon.

To reduce adverse impacts on water quality that the project would cause in the Skykomish River through continued discharge of WWTP effluent:

4. The City of Sultan should partner with the Washington Department of Ecology to develop a Habitat Conservation Plan and apply for an Incidental Take Permit pursuant to section 10(a)(1)(B) of the ESA for their state-issued NPDES permit, in order to obtain incidental take authorization for unavoidable take of listed species that is anticipated to occur as a result of these permit issuances.

5. The City of Sultan should more completely identify the pollutant load in the effluent discharged from their WWTP, and as part of future NPDES permit applications, to commit to incrementally apply new technologies to reduce pollutant concentrations in the effluent.

6. The USACE, and the U. S. Environmental Protection Agency (USEPA) should approach the National Marine Fisheries Service and the U.S. Fish and Wildlife Service to develop a programmatic biological opinion for the authorization of infrastructure projects that would result in the continued discharge of wastewater and or stormwater to the waters of the Puget Sound Basin, including those that would be discharged under state-issued NPDES permits.

The project description for that programmatic consultation should include clear conservation measures intended to avoid and minimize the effects of NPDES permit actions on species and critical habitats listed under the ESA, as well as on essential fish habitat identified under the MSA, and should provide a mechanism for compensatory mitigation for unavoidable adverse effects, including take.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the USACE must provide a detailed written response to the 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 the NMFS' EFH Conservation Recommendations unless the NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of the 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 the 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, the 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 USACE must reinitiate EFH consultation with the 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 the 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 the USACE.

Other interested users could include the applicant, the WDFW, the governments and citizens of Snohomish County and the City of Sultan, and Native American tribes. Individual copies of this opinion were provided to the USACE. The document will be available at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adhere to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by the 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 part 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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